

Disadvantages of Control Chart in Printing Quality Control over Solder Paste and Strategies for Improvement

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Abstract

Control chart is one kind of the most common and effective tools for SPC quality control, however, it is not infallible for ever. The results of actual data processing have proved that the conventional control chart may educe the opposite conclusions to other evaluating methods in some special cases. For solving the above problems, we use Bayes theory to introduce proper 'correction coefficient' to amend the control parameters so that the control limit is more accurate and the judgment is more reasonable and reliable.

Keywords: Control chart, SPC, CPI, Correction coefficient, Bayes theory

1. Introduction

Statistical Process Control (SPC) is a process control tool making use of Mathematical Statistics. The control chart is a statistical tool controlling the products quality in the process of manufacture, which is also one kind of the most common and effective tools for SPC quality control.

During the application of control chart, its ordinate axis is set as the quality characteristic value, whose scales are divided by the processing variation; its horizontal axis is the sampling time or sample number of measured products, which is drawn on the figure according to the precedence, as shown in figure 1. There are three straight transverse lines in the control chart, the middle one of which is Center Line (CL) protracted by blue solid. The upper line is called Upper Control Limit (UCL) and the lower one is called Lower Control Limit (LCL), which are often represented by red dash lines denoting the acceptable arrange of variation. The quality characteristics of the actual products are shown by black lines.

Once the control chart is evaluated that, 'the quality management begins with control chart and also ends with control chart.' The control chart changes the quality control mode from post-checkout to prevention, which provides a wide prospect for guaranteeing the quality of products, reducing production costs, enhancing productivity, so it has been applied widely in many countries. However, control chart is not infallible for ever and the conventional control chart may educe the opposite conclusions to other evaluating methods in some special cases.

2. Process Capability Indices

Process Capability Indices (CPI) is used to indicate the capability of assuring the quality of production in the normal condition of process, which means that Man, Machine, Material, Technique, Measurement and Environment are fully standardized and in the stable state. CPI is also named Capability Index of Process (CPK) and the corresponding calculation formula is shown as follows:

CPI=Technical Specification Requirements/ Process Capability

When the distributing centre coincides with the tolerance center, CPI is marked as C_p , otherwise, CPI is marked as C_{pk} , which is shown as figure 2.

The calculation of CPI can be divided into 4 types (Zhao, Yandong. 2005), which is shown as table 1.

The process quality can be divided into 5 grades according to C_{pk} , which is shown as table 2.

3. Contradiction between control chart and CPI

If we get enough samples in the machining, the samples will follow the normal distribution $\bar{X} \sim N\left(\mu, \frac{\sigma^2}{n}\right)$,

where μ and σ^2 are the average and variance of population, respectively. The CL, UCL and LCL of \bar{X} control chart are shown below according to the 3σ theory:

$$\begin{cases} UCL_x = \mu + 3\sigma \\ CL_x = \mu \\ LCL_x = \mu - 3\sigma \end{cases} \quad (1)$$

When the measured data are monitored using the above formula, we can draw a control chart shown in figure 3. From the criterion of control chart (Liu Keneng, Peng Chen and Fu Geyan. 2009), there are two abnormal points A & C between UCL and LCL in figure 3, which denotes that some problems arise in machining and we have to

stop machines to check. If now we calculate C_{pk} , the value may be higher and even more than grade 2. We can come to the conclusion through testing the productions.

In fact, in the actual activity of sampling, the samples can not be infinite even very small in some cases, so the boundary of control chart made according to the normal distribution may appear some deviation, which will directly affect the judgment result. For figure 3, when we make necessary correction for the original chart according to some other known conditions, the factual control boundary is shown as UCL' & LCL' and the abnormal point only contains point B in this case.

Therefore, this paper will analyze the reasonable corrective method of controlling the boundary of chart and CPI as well as decision-made owned by human beings to obtain more reliable and truthful quality control statistic theory and measurement.

4. The correction of control chart boundary

The applied basis of control chart is based on the quality index of obtained data totally obeying to the normal distribution, where the deviation existing in the parameters of $N(\mu, \sigma^2)$ are not large can be known that the parameters μ and σ^2 separately obey some prior distributions $F(\mu)$ and $G(\sigma^2)$. Because the estimation is deduced statistically, it is possible for deviations existing which may cause loss. The two characteristics of the actual problem just accord with the requirement of Bayes analysis. The Bayes analysis suppose the distributing parameters of indexes contain the prior distribution, so the parameters can be deduced statistically according to the prior distribution and current samples. In the condition that a reasonable prior distribution with small variance is chosen, the Bayes estimation of small samples can improve the traditional estimation well. Therefore, we can obtain the Bayes estimation of the index parameters of current productions fully using the smaller samples of past productions and current ones.

The parameter μ to be estimated is a random variable during Bayesian analysis. People can manually determine the probability density $\varphi(\mu)$ of parameter μ according to the past experiences, which is named the prior distribution of μ . Supporting x_1, x_2, \dots, x_n are a sample from the total samples X, the sampling result is ζ . Then the prior distribution density $\varphi(\mu)$ of μ is corrected using Bayes method according to the information provided by ζ to obtain the posterior distribution density $\varphi'(\mu)$. The formula (2) is shown as follows:

$$\varphi'(\mu)\Delta\mu \approx \frac{P(\zeta|\mu_i < \mu \leq \mu_i + \Delta\mu) \cdot \varphi(\mu_i)\Delta\mu}{\sum_k P(\zeta|\mu_i < \mu \leq \mu_i + \Delta\mu) \cdot \varphi(\mu_i)\Delta\mu} \quad (2)$$

When $\Delta\mu \rightarrow 0$, the limit of the above formula is

$$\varphi'(\mu) = \frac{P(\zeta|\mu) \bullet \varphi(\mu)}{\int_{-\infty}^{+\infty} P(\zeta|\mu) \bullet \varphi(\mu) d\mu} \quad (3)$$

All the samples obey the law of $X \sim N(\mu, \sigma^2)$, so

$$P(\zeta|\mu) = \prod_{k=1}^n \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x_k - \mu)^2}{2\sigma^2}} \bullet dx \triangleq \prod_{k=1}^n N_{\mu}(x_k, \sigma^2) dx \quad (4)$$

In formula (4), $N_{\mu}(x_k, \sigma^2)$ denotes the distribution density of normal random variable of some observed value x_k , where μ and σ^2 are respectively the average and variance of total samples.

$$\begin{aligned} \varphi'(\mu) &= \frac{\left[\prod_{k=1}^n N_{\mu}(x_k, \sigma^2) \right] \bullet \varphi(\mu)}{\int_{-\infty}^{+\infty} \left[\prod_{k=1}^n N_{\mu}(x_k, \sigma^2) \right] \bullet \varphi(\mu) d\mu} = \frac{N_{\mu}(\bar{x}, \sigma^2/n) \bullet \varphi(\mu)}{\int_{-\infty}^{+\infty} N_{\mu}(\bar{x}, \sigma^2/n) \bullet \varphi(\mu) d\mu} \\ &= m \bullet N_{\mu}(\bar{x}, \sigma^2/n) \bullet \varphi(\mu) \end{aligned} \quad (5)$$

Where $m = \left(\int_{-\infty}^{+\infty} N_{\mu}(\bar{x}, \sigma^2/n) \bullet \varphi(\mu) d\mu \right)^{-1}$ is constant and $\bar{x} = \frac{1}{n}(x_1 + x_2 + \dots + x_n)$

After we get the posterior distribution density $\varphi'(\mu)$ of parameter μ made from x_1, x_2, \dots, x_n , then we can combine the error because of estimating μ using \bar{X} and the implicit random variable X , which can be reckoned in the random variable X using the total probability formula. Now, the distribution density formula of random variable X is as follows:

$$f_x(x) = \int_{-\infty}^{+\infty} f_x(x|\mu) \varphi'(\mu) d\mu \quad (6)$$

When no data or information about μ is provided, from the limit theory in probability we know that: μ is uniform distribution and $\varphi(\mu)$ almost equals to 1 everywhere (the probability of $\varphi(\mu) \neq 1$ is 0, which is the event with 0 probability). Further more, $\varphi'(\mu)$ is the distribution density of random variable and m should be 1 almost everywhere (the probability of $m \neq 1$ is 0, which is the event with 0 probability), so

$$\varphi'(\mu) = N_{\mu}(\bar{x}, \sigma^2/n) \bullet \varphi(\mu) \quad (7)$$

Substitute formula (7) into the formula (6), then

$$f_x(x) = \int_{-\infty}^{+\infty} N_x(\mu, \sigma^2) \bullet N_{\mu}(\bar{x}, \sigma^2/n) d\mu = N_x(\bar{x}, \sigma^2 + \sigma^2/n) \quad (8)$$

This means $X \sim N(\bar{x}, \sigma^2 + \sigma^2/n)$. So according to “3 σ Principle”, the control boundary of X is:

$$\begin{cases} UCL_x = \bar{X} + 3\sqrt{\sigma^2 + \sigma^2/n} \\ CL_x = \bar{X} \\ LCL_x = \bar{X} - 3\sqrt{\sigma^2 + \sigma^2/n} \end{cases} \quad (9)$$

Thus, comparing with formula (1), when there is no information about μ , the controlling center line CL_x does

not change, but the locations of UCL_x and LCL_x change.

On the other hand, if the data or information about μ has existed, which means that $X \sim N(\mu_1, \sigma_1^2)$ (where μ_1 and σ_1^2 are the known constants) has been known, the control boundary of X is:

$$\begin{cases} UCL_x = \mu_2 + 3\sqrt{\sigma^2 + \sigma_2^2} \\ CL_x = \mu_2 \\ LCL_x = \mu_2 - 3\sqrt{\sigma^2 + \sigma_2^2} \end{cases} \quad (10)$$

Where $\sigma_2^2 = (\sigma_1^2 \bullet \sigma^2 / n) / (\sigma_1^2 + \sigma^2 / n)$, $\mu_2 = (\bar{x} \bullet \sigma_1^2 + \mu_1 \bullet \sigma^2 / n) / (\sigma_1^2 + \sigma^2 / n)$

5. Illustration

Now, we take some solder paste volume test results as an example shown in table 3, and the test frequency is 2 panels/hour.

$\bar{x} - R$ control chart are shown in figure 4, 5 and 6 respectively.

Based on the data C_{pk} listed in table 3, we calculate the following:

$$T_u = 18.95, T_l = 10.20, T = T_u - T_l = 18.95 - 10.20 = 8.75, \sigma = 1.0538$$

$$\text{So, } C_p = \frac{T}{6\sigma} = \frac{8.75}{6 \times 1.0538} = 1.384 \quad (11)$$

As $\bar{\bar{x}} = 14.68$ is different with $T_m = (T_l + T_u) / 2 = 14.575$, therefore, there is some deviation in the process:

$$k = \frac{|\mu - T_m|}{T / 2} = 0.024 \quad (12)$$

$$C_{pk} = (1 - k)C_p = 1.35 \quad (13)$$

From figure 4, we know that the control chart R is not abnormal. However, the 23rd point is out of LCL in figure 5, which is considered abnormal in the process according to the conventional judgment method. It is found that the value of C_{pk} is higher to 1.35 through calculation. From figure 2, the corresponding conclusion is “the process ability is good enough” and what we should do is “lower requirements for raw material, simplifying the quality testing, adopting sampling tests or decreasing test frequency”. The contrary results prove the judgment for traditional control chart is not accuracy.

From figure 4 and 6, there are no abnormal conditions in control charts R and \bar{X} . The value of C_{pk} is 1.35, the corresponding conclusion is “the process ability is good enough” and what we should do is “lower requirements for raw material, simplifying the quality testing, adopting sampling tests or decreasing test frequency”. These two conclusions of judgment match each other well, which denotes that the corrected method is more reliable and truthful for the real production.

6. Conclusion

This paper takes the common control chart $\bar{x} - R$ as an example and discussed the advantages in the process of application. When the boundary of control chart is determined, which only depends on the sampling data to estimate and not consider the former conditions or other interfere or just concerns the information of total and samples but ignores the acquired or existed information, it is usually found that the conclusion may conflict with other judgment indexes. Thus, to solve the above problems, we can use Bayes theory to introduce the proper “correction coefficient” to correct the control parameters, which can high the accuracy of control limits and make the conclusion more reasonable, reliable and believable.

References

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Table 1. Calculations of CPI

| No. | Types | Formulas | Comments |
|-----|--|--|--|
| (1) | No skewing in process | $C_p = \frac{T}{6\sigma}$ | Upper and lower limits exist when $\mu = T_m$ |
| (2) | Skewing in process | $C_{pk} = (1 - k)C_p$ $k = \frac{ \mu - T_m }{T/2}$ | Upper and lower limits exist when $\mu \neq T_m$ and k is called offset coefficient. |
| (3) | Only upper limit T_u exists, $X < T_u$ | $C_p(u) = \frac{T_u - \mu}{3\sigma}$ | |
| (4) | Only lower limit T_l exists, $X > T_l$ | $C_p(l) = \frac{\mu - T_l}{3\sigma}$ | |

Note that: Supposing the sample quality characteristic value fits normal distribution $X \sim N(\mu, \sigma^2)$, and the specification for X is (T_l, T_u) . Here, central value $T_m = (T_l, T_u)/2$ while tolerance $T = (T_u - T_l)$.

Table 2. Different CPI for Different Process Ability

| Range | Class | $T_u - \mu$ or $(\mu - T_l)$ | Judgment | Comments |
|---------------------------|------------|------------------------------|-------------------------------|--|
| $C_{pk} \geq 1.67$ | Super-fine | $\geq 5\sigma$ | Too high process ability | Shrink key project's tolerance range for higher product quality; or lower equipment's accuracy or wider fluctuation range for higher efficiency or lower cost. |
| $1.33 < C_{pk} < 1.67$ | Grade 1 | $4\sigma \sim 5\sigma$ | Enough process ability | Wider fluctuation range for non-critical project; or lower requirements for raw material; or use sampling test or lower test frequency to simplify quality inspection. |
| $1 < C_{pk} \leq 1.33$ | Grade 2 | $3\sigma \sim 4\sigma$ | Acceptable process ability | Control chart or other methods must be used to monitor or control abnormal change, and inspect products in normal way. |
| $0.67 \leq C_{pk} \leq 1$ | Grade 3 | $2\sigma \sim 3\sigma$ | Insufficiency process ability | Analyze the reasons for large scatteration and take measures for improvement. On condition that it does not affect the quality of production, strengthen quality inspection and its frequency. |
| $C_{pk} < 0.67$ | Grade 4 | $< 2\sigma$ | Unacceptable process ability | Usually, stop working to find the reasons and improve process to improve C_p . Otherwise, seek out the unaccepted ones. |

Table 3. Data for Solder Paste Volume Sampling

| Process | Machine | Parameter | Gage | USL (10 ⁷ um ³) | LSL (10 ⁷ um ³) | Sampl eSize | Freque ncy | Model name | SPC chart number | | |
|----------|------------------|--------------------------|--------------|---|---|----------------|----------------|---------------|---------------------|-------|-------|
| Printing | DEK | Volume | KY3030 | 18.95 | 10.20 | 8 | 2panels /hr | Q2686 | Q2686_C49_1 | | |
| Time | Operat or No. | Average (\bar{X}) | Range (R) | Samples of Measurements | | | | | | | |
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 19:50 | 4073 | 14.98 | 2.45 | 16.01 | 15.32 | 15.38 | 15.97 | 13.65 | 13.56 | 15.62 | 14.32 |
| 20:50 | 4073 | 15.09 | 3.43 | 15.53 | 12.54 | 15.38 | 15.97 | 15.53 | 15.13 | 15.13 | 15.53 |
| 21:50 | 4073 | 15.17 | 2.15 | 15.34 | 15.13 | 15.53 | 15.53 | 15.53 | 13.38 | 15.38 | 15.53 |
| 22:50 | 4073 | 14.34 | 3.00 | 13.68 | 14.35 | 12.54 | 15.38 | 12.54 | 15.13 | 15.53 | 15.54 |
| 20:45 | 4073 | 14.11 | 3.09 | 12.45 | 13.26 | 14.23 | 13.35 | 15.38 | 15.12 | 15.54 | 13.55 |
| 21:45 | 4073 | 15.04 | 2.99 | 12.55 | 15.13 | 15.53 | 15.36 | 15.54 | 15.13 | 15.53 | 15.54 |
| 22:45 | 4073 | 14.28 | 2.99 | 12.54 | 15.13 | 13.52 | 15.53 | 15.15 | 12.88 | 15.11 | 14.35 |
| 0:50 | 8815 | 14.21 | 2.99 | 13.12 | 12.65 | 14.12 | 13.12 | 14.12 | 15.54 | 15.39 | 15.64 |
| 1:50 | 8815 | 15.01 | 2.50 | 15.53 | 15.16 | 15.34 | 15.26 | 13.95 | 15.69 | 15.84 | 13.34 |
| 2:50 | 8815 | 14.00 | 3.26 | 14.02 | 13.55 | 12.54 | 15.80 | 12.65 | 15.53 | 13.22 | 14.65 |
| 3:50 | 8815 | 14.86 | 2.79 | 16.01 | 13.22 | 15.54 | 14.65 | 15.17 | 15.16 | 15.12 | 14.00 |
| 18:15 | 4073 | 15.28 | 1.18 | 15.13 | 15.28 | 15.38 | 15.53 | 15.53 | 15.53 | 14.35 | 15.53 |
| 19:15 | 4073 | 14.17 | 3.48 | 12.54 | 13.25 | 14.02 | 13.25 | 16.02 | 13.36 | 15.53 | 15.39 |
| 20:15 | 4073 | 14.32 | 3.30 | 12.54 | 14.82 | 12.88 | 15.34 | 13.66 | 14.25 | 15.26 | 15.84 |
| 21:15 | 4073 | 14.33 | 2.99 | 13.55 | 14.55 | 13.66 | 14.55 | 12.54 | 15.13 | 15.13 | 15.53 |
| 22:15 | 4073 | 15.17 | 2.15 | 15.34 | 15.13 | 15.53 | 15.53 | 15.53 | 13.38 | 15.38 | 15.53 |
| 22:50 | 8815 | 14.94 | 1.86 | 13.68 | 14.35 | 15.54 | 15.38 | 14.39 | 15.13 | 15.53 | 15.54 |
| 0:50 | 8604 | 14.94 | 2.19 | 15.54 | 15.53 | 15.53 | 13.35 | 15.38 | 15.12 | 15.54 | 13.55 |
| 1:50 | 8604 | 14.25 | 3.00 | 13.00 | 12.54 | 12.66 | 14.05 | 15.54 | 15.13 | 15.53 | 15.54 |
| 2:50 | 8604 | 15.18 | 1.18 | 15.26 | 15.13 | 15.36 | 15.53 | 15.15 | 15.53 | 15.11 | 14.35 |
| 3:50 | 8815 | 15.15 | 2.60 | 15.54 | 14.67 | 13.34 | 15.16 | 15.94 | 15.54 | 15.39 | 15.64 |
| 4:50 | 8815 | 14.06 | 3.29 | 13.25 | 14.25 | 13.65 | 12.55 | 13.95 | 15.69 | 15.84 | 13.34 |
| 5:50 | 8815 | 13.64 | 2.99 | 12.55 | 13.66 | 13.65 | 12.58 | 12.88 | 13.65 | 15.54 | 14.65 |
| 7:50 | 8604 | 15.01 | 1.28 | 14.64 | 14.26 | 15.54 | 14.65 | 15.17 | 15.16 | 15.12 | 15.53 |
| 8:50 | 8604 | 15.23 | 1.18 | 15.13 | 15.28 | 15.38 | 15.53 | 15.12 | 15.53 | 14.35 | 15.53 |
| 9:50 | 8604 | 13.83 | 3.31 | 12.54 | 13.02 | 12.68 | 15.53 | 15.85 | 12.57 | 13.02 | 15.39 |
| 10:50 | 8604 | 15.34 | 1.02 | 15.00 | 14.82 | 15.53 | 15.34 | 15.36 | 15.53 | 15.26 | 15.84 |
| 21:10 | 9941 | 15.47 | 0.84 | 15.53 | 15.53 | 15.38 | 15.97 | 15.53 | 15.13 | 15.13 | 15.53 |
| 22:10 | 9941 | 14.07 | 2.95 | 13.25 | 14.25 | 12.66 | 15.53 | 12.58 | 13.38 | 15.38 | 15.53 |
| 23:10 | 9941 | 14.94 | 1.86 | 13.68 | 14.35 | 15.54 | 15.38 | 14.39 | 15.13 | 15.53 | 15.54 |

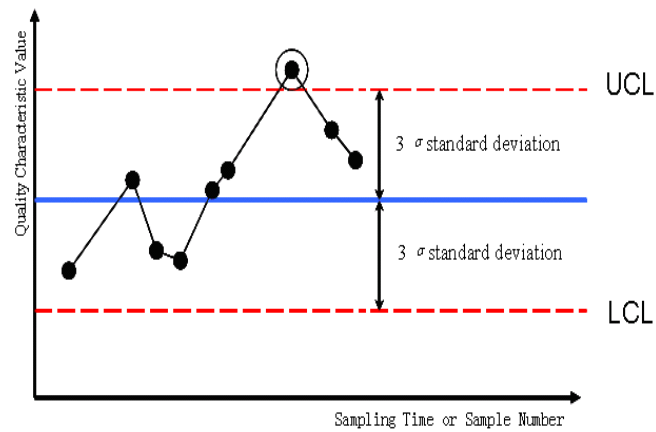
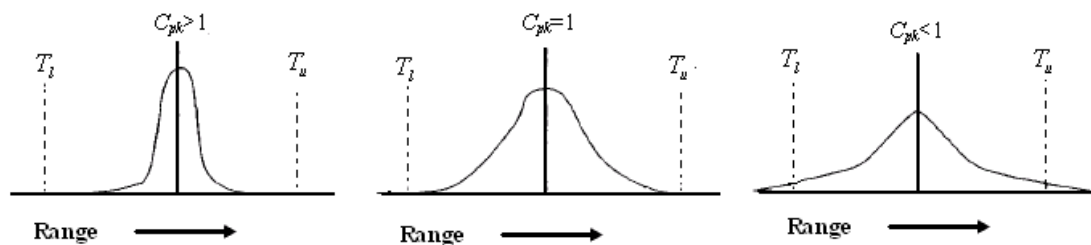


Figure 1. Simple Control Chart



Note that T_l denotes the upper limit of specification and T_u denotes the lower limit.

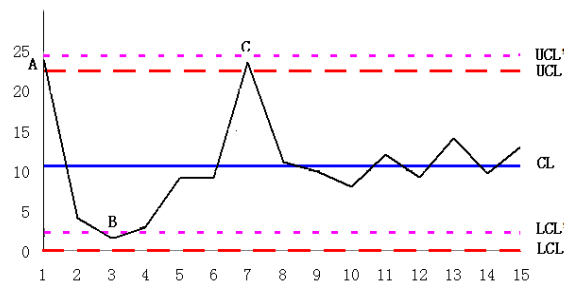
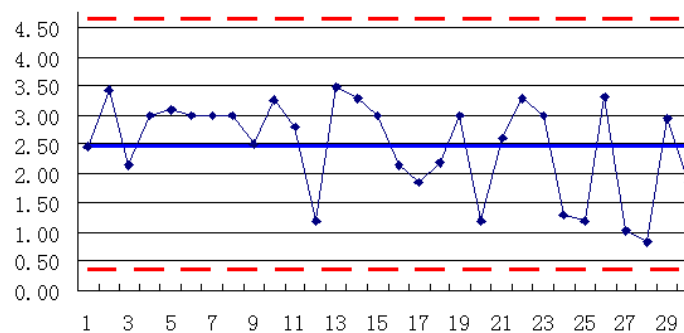
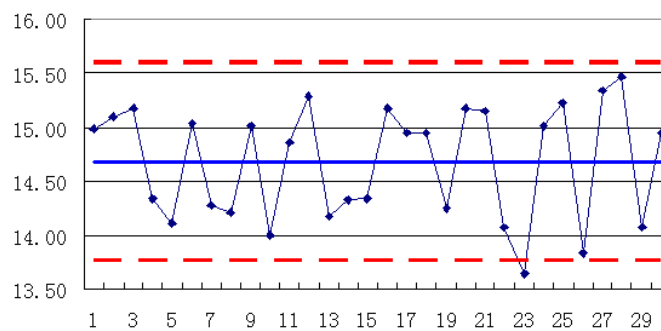
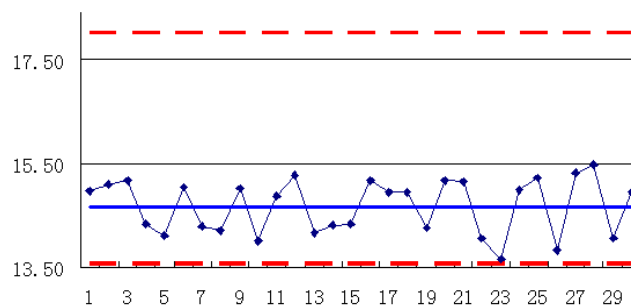
Figure 2. Characteristic Curve of C_{pk} 

Figure 3. Non-corrected & Corrected Control Chart

Figure 4. R Control Chart

Figure 5. Non-corrected \bar{X} Control ChartFigure 6. Corrected \bar{X} Control Chart

Comparison Study on Oil Palm Trunk and Oil Palm Fruit Bunch Fibre Reinforced Laterite Bricks

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Abstract

The main aim of this study was to compare the physical properties and mechanical properties of Oil Palm Trunk (OPT) fibre and Oil Palm Fruit Bunches (OPFB) fibre reinforced laterite bricks. For comparison purposes, the properties such as dimension, density, water absorption and the compressive strength of both types of bricks were determined. The effects of the incorporation of various amounts of fibres on the above properties were analysed. The tests were carried out according to BS 3921: 1985 for clay bricks. The samples were pressed at the factory Majpadu Bricks Sdn. Bhd., Malaysia and tested at the Material Testing Laboratory, Universiti Teknologi MARA, Shah Alam, Malaysia. The findings of this research were, firstly, the dimension of bricks content with OPFB fibres were less accurate than bricks with OPT fibres. Secondly, the density of bricks with OPFB fibres was higher than the density of bricks with OPT fibres. Thirdly, in compressive strength of the bricks with OPFB fibres was higher than bricks with OPT fibres, with the maximum fibre content identified as 3 percent fibres. Finally, the water absorption of bricks with OPFB fibres was lower than the water absorption of bricks with OPT fibres. It can be concluded that the bricks with OPFB fibres had better physical and mechanical properties than bricks with OPT fibres. OPFB fibres is better for reinforcement in the laterite bricks and properties of the bricks with OPT Fibres were to be improved.

Keywords: Natural fibres, Oil palm trunk fibre, Oil palm fruit bunch fibre, Laterite bricks

1. Introduction

Generally, oil palm is the most important agricultural and commercial plantation crop in Malaysia. Oil palm which better characteristics that people recognized as 'tree of life' because all part such as fruits, trunks, leaves and can be effectively utilized for living. In order which utilities of the palm oil residue is better to added to make the value product, two of the utilities were chosen for study, it was Oil Palm Trunk fibre and Oil Palm Fruit Bunch fibre. This research is In order to determine which fibre is better for reinforcement, the bricks have to be pressed from the same source of raw materials and testing in the same period. Natural fibres, as a substitute for glass fibres in composite components, have gained interest in the last decade, especially in the housing sector. Fibres like jute, sisal, coconut fibre (coir), ramie, banana, flax, hemp etc. are cheap and have better stiffness per unit weight and also have a lower impact on the environment. Structural applications are rare since existing production techniques are not applicable for such natural fibre concrete products and non-availability of semi-finished materials with adequate quality. An experiment carried out by Corson at the Building Research Station, United Kingdom, on sisal fibre reinforced concrete.

Noticed that an addition of sisal fibres in concrete increased the need of water in the matrix. The cement reactions were distributed by substances, which were dissolved from sisal fibre (Zonsveld, 1984). In Brazil discovered that vegetable fibres have been used for reinforcement in many types Of mortar and concretes. For instance, building component was developed with coir and sisal fibres, and also incipient research work was done with jute, sugar-cane baggage and bamboo fibres (Agopyan, 1988). The research carried out by Saleh A.M

had found that the density of OPFB fibre reinforced laterite bricks decreased with the increase in the volume of fibre incorporated. The highest compressive strength was 8.67 MN/m^2 (Saleh, 1999). Research by Abas (2001), on the use of coir fibres on compress Laterite brick. The main objective of her research was to study the physical and mechanical properties of the pressed laterite brick with an addition of coir fibres. It was found that the physical property of coir fibre reinforced laterite bricks which is density decreased with an increase volume of coir fibres in coir fibre reinforced laterite (CFRL) bricks compare to control brick (no fibre). Secondly, the compressive strength of coir fibre reinforced laterite bricks increased with increase of coir fibre content. A research on the effects of the incorporation of different types of fine aggregates which were mine sand, quarry dust and river sand into non-fired pressed laterite bricks. She found that the quarry-dust laterite bricks gave the highest compression strength. (3.34 MN/m^2 in mix 1 and 2.31 MN/m^2 mixes 2) (Zairani, 2001). A research on the effects of rubberwood fibre incorporated into the pressed laterite brick. Finding on this report that increased in fibre content had resulted in the density of rubberwood fibre reinforced laterite (RFRL) bricks. The water absorption of the RFPL bricks increased with an increase in fibre content and the compressive strength were increased with the increase the fibre contents. It was showed that, increase in moisture content of the sand and laterite soil can decrease of compressive strength of bricks (Sairi, 2002). Research to compare two fibres compare the Oil Palm Fruit Bunches (OPFB) fibre and Coconut Coir fibre reinforced laterite bricks. The result stated, firstly, the dimension of bricks content with OPFB fibres were more accurate than bricks with coir fibres. Secondly, the density of bricks with OPFB fibres was lower than the density of bricks with coir fibres. Thirdly, in compressive strength of the bricks with OPFB fibres was higher than bricks with coir fibres, with the maximum fibre content identified as 3% fibres. Finally, the water absorption of bricks with OPFB fibres was lower than the water absorption of bricks with coir fibres (Ismail S, 2002). Therefore the objectives of this research is to compare the physical properties and mechanical properties between oil palm trunk (OPT) reinforced laterite bricks and oil palm fruit bunches (OPFB) reinforced laterite bricks.

2. Experiment

The first stage of this experimental work was to determine physical properties of the above both bricks namely dimension and density. The second stage of this experimental work was to determine their compressive strengths and the water absorption properties. This testing was according to the experimental procedures as described in BS 3921:1985. The specimen design mix used in this research was 70% of soil, 24% of sand and 6% of cement. The OPT fibres and OPFB fibres used were from Wood Chemistry Division from Forest Research Institute Malaysia (FRIM) refer to photo1. The laterite soil was taken from the hill nearby the factory and the sand used was from puchong tin mines. The both fibre content incorporated in bricks were from 1% to 5% of cement weight. The bricks specimens were prepared at Majpadu Bricks Sdn Bhd factory located at Jalan Kebun, Klang, Malaysia. The fibres were firstly mixed with cement and packed in air tight plastic bags at Material Testing Laboratory, Faculty Architecture, Planning and Surveying, Universiti Teknologi MARA, Shah Alam, Malaysia. Before transported to the brick factory (Majpadu Sdn. Bhd.) at Shah Alam to be pressed into bricks. The two types of brick samples prepared in this research used the same proportion of constituent materials. The experimental works carried out involved 6 types sample of laterite bricks contained OPT fibres and 6 types sample of laterite bricks contained OPFB fibres. Each type of samples consisted of 20 bricks used to determine compressive strength and water absorption giving the total number bricks approximately were 240 units. The mix proportion used for the all samples was 70% of soil, 24% of sand and 6% of cements. The material wastage allowance was 45% which allow for wastage during mixing and pressing of bricks. Table 1 shows the total quantity of materials prepared for 20 units bricks for 6 sample of OPT fibre reinforced laterite bricks and OPFB fibre reinforced laterite bricks. The amounts of OPT and OPFB fibres were calculated based on the percentage of cement weight. Table 2 shows the percentage and quantity of OPT fibres used for laterite bricks. The percentage and quantity of OPFB fibres used for laterite bricks is shown in Table 3. The preparation of laterite bricks for this research was carried at Majpadu Bricks Sdn Bhd. There were four stages of process to produce OPFB fibre reinforced laterite bricks and coir fibre reinforced laterite bricks. Both fibres were cut at an interval length about 25 mm. The fibres were kept properly in dry area. Fibres and cement were mixed earlier at laboratory before mixing done with soil and sand at factory. The fibres and cement were weighing based on the ratio of the cement weight before mixing. Their mixed by hand to spread the fibres in cement were not clinging evenly.

Then, cement –fibres mixes were packed separately in plastic bags based on different types of percentage fibres. After that, the cement and fibres were transported to the factory and the cement and fibres were mixed with laterite soil and sand. The soil and sand were weight earlier according to the specified mix proportion before mixing with cement and fibres. Then all the material was mixed together about 8 to 10 minutes. The constituent materials and fibres were mixed by hand to ensure that fibres dispersed evenly in the cement. After the mixing

by hand shovel, the constituent materials were mixed again into the pressing machine which has a mini mixer about 4 to 5 minutes to thoroughly mix the materials before pressing into bricks. The pressure of the pressing machine to produce the bricks was 9 – 10 MN/m² depend on the weight of bricks. Secondly, the process is the pressing machine was pressed out the bricks.

Then the bricks were collected and identifications of the types samples by mark and stacked on the palette. In the curing process, the bricks were wrapped and used plastic film to avoid rapid. The bricks were kept under sheltered area for 24 hours and were sprayed with water. The bricks were stored in open air for 21 days before delivered to testing laboratory for testing at the age 28 days. Six types of laterite bricks contained OPT fibres and six types of laterite bricks contained OPFB fibres had been prepared for testing refer to photo2. The detail of the samples is given in Table 4 and Table 5.

3. Results and Discussion

The dimension of Oil Palm Trunk fibre reinforced laterite (OPT) bricks and oil palm fruit bunches (OPFB) fibres reinforced laterite bricks had been obtained by measuring the length, width and depth of the bricks which were used in the calculation of volume. Table 6 show the comparison dimension between oil palm trunk fibre reinforced bricks and Oil Palm Fruit Bunch fibre reinforced laterite brick. From the results standard deviations show that dimension of bricks with OPT fibre content are more accurate between bricks with OPFB fibre contents. The standard deviation for average length, width, depth, area and volume for both bricks with OPT and OPFB fibre content were almost zero and lower. But generally OPT have a zero standard deviation. So it can be summarized that bricks with OPT fibre have more accuracy from OPFB fibre. Bricks dimension, weight of material and percentage of fibre content may influence the density of bricks.

In Table 7 shown the comparison on average density of OPT bricks and OPFB fibre reinforced laterite bricks with variable percentage of fibre content. From the results, generally density bricks with OPT fibre content are lower than bricks content with the OPFB fibre. Illustration of the comparison results as shown in Figure 1. Figure 1 shows the average density bricks with two different type of fibre content. The results show that the both bricks content with OPT fibre and OPFB fibre are reduces statically decrease with increase the percentage of fibres content. With comparison of two types of bricks the results shows bricks with OPT fibres have lower density than bricks with OPFB fibre. The OPT fibre get lower density than OPFB fibre because OPT fibre had bigger width (35.30 microns) than the width of OPFB fibres (25 microns) refer to figure 1. Therefore the OPT fibres had displaced more heavy constituent materials, resulted in lower density of OPT fibre bricks.

Referring to Table 8, shows the average of compressive strength OPT fibre reinforced laterite bricks and OPFB fibre reinforced laterite bricks. Generally the compressive strength for OPFB fibre reinforced laterite bricks was higher than OPT fibre reinforced laterite bricks. The results showed the maximum compressive strength for OPFB fibre reinforced laterite bricks was with 3% fibre content and it strength is higher by 1.1% than control bricks. It was strongly believe that the higher strength obtained from OPFB fibre reinforced laterite bricks cause by the form of fibres that had curly form that had successfully reinforced the matrix and have the lower moisture contents of fibres. The brick may behave similarly to the concrete by the addition of the cement in its matrix. Figure 2 shows the comparison the compressive strengths of bricks with the same percentage of fibre content of both types of fibres. Table 9 shows the average percentage of water absorption for OPFB fibre reinforced laterite bricks. Generally from the table below show the water absorption bricks with fibre content for both types are increase than control samples. The water absorption of laterite bricks were related to the density of bricks. In the table shows some water absorption of bricks decrease with increase the addition of fibre. Although the results decreasing, but its still higher than bricks without fibre. The comparison in average water absorption of bricks is illustrated in bar chart Figure 3.

Figure 3 shows the comparison bricks with different type of fibre but same in their percentage fibre content. From the bar chart shows the water absorption OPT fibre reinforced laterite bricks and OPFB fibre reinforced laterite bricks increase with an increase the fibre content. Compare two type of bricks the results show bricks with OPT fibre have higher water absorption than bricks with OPFB fibre. The OPT fibre get high water absorption than OPFB fibre because it is believed that the OPT fibres were more porous and permeable due to the greater width of the fibre. The moisture content of the materials; laterite soil, sand and fibre were obtained to know the consequences to influence whereby to the compressive strength. Generally, the moisture content of the constituent of materials and fibres influence the compressive strength of the OPT fibre laterite bricks and OPFB fibre laterite bricks. By referring to the table 10 the results shows that the moisture content on laterite soil and fibre for bricks with OPT bricks was higher than moisture content in laterite soil for bricks with OPFB. Also in mine sand whereby the moisture content in sand for bricks with OPT bricks was higher than moisture content in

sand for bricks with OPFB. As discussed earlier, the compressive strengths of bricks were influenced by the moisture contents of constituent materials and fibres. In this research, it is believed that the porosity of the bricks was influenced by the presence of moisture content in the constituent materials and fibres. Therefore, the bricks which contained high moisture contents reduce the strength of the bricks. The moisture content caused the high porosity in bricks. The constituent materials and fibres that have more moisture content contribute to the porosity of the bricks and consequently reduce the strength of the bricks.

4. Conclusions

The dimension of the brick in their length, width, depth, area and volume showing the bricks with OPT fibres were more accurate with lower standard deviation than bricks with OPFB fibre. The reason may be due to the OPT fibres causing less balling up and clinging each other and well distributed in the bricks. The density of bricks with OPT fibres was lower than bricks with OPFB fibres. The OPT fibre bricks had lower density than OPFB fibre bricks because the OPT fibres had bigger width than the width of OPFB fibres. Therefore the OPT fibres had displaced more heavy constituent materials, resulted in lower density of OPT fibre bricks. The compressive strength of OPT fibre reinforced laterite bricks was lower than the strength of OPFB fibre reinforced laterite bricks. The OPFB fibres in the form of curly fibres, than the OPT fibres which in straight form of fibre. Therefore the OPFB fibres give better reinforcement than OPT fibres. The moisture content of OPT fibres was higher than OPFB fibres, therefore the strength of the OPT fibres was expected to be lower than OPFB fibres, hence, reduced the compressive strength of OPT fibre bricks. The water absorption of bricks with OPT fibres was higher than the water absorption of bricks with OPFB fibres. The bricks with OPT fibres had higher water absorption than OPFB fibre bricks because it is believed that the OPT fibres were more porous and permeable due to the greater width of the fibre, which expected to have more pores in the fibre strands. On the whole it can be concluded that each type of the bricks has different advantages. OPFB fibres bricks had better physical properties than bricks with OPT fibres. The results showed the density bricks with OPFB fibres were denser and the bricks had lower water absorption characteristics. The OPFB fibres had higher mechanical property that is, compressive strength than bricks with OPT fibres. It can be concluded that the bricks with OPFB fibres had better physical and mechanical properties than bricks with OPT fibres and OPFB fibres is better for reinforcement in the laterite bricks.

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Table 1. Total quantity materials for 20 units of bricks for each type of sample.

| Material | Quantity of material | | | |
|-----------------|-----------------------------|---------------------|----------------------|-----------------|
| | 1 type of sample | 6 types (OPT fibre) | 6 types (OPFB fibre) | Total |
| Soil (70%) | 58.9 kg | 353.4 kg | 353.4 kg | 706.8 kg |
| Sand (24%) | 20.2 kg | 121.2 kg | 121.2 kg | 242.4 kg |
| Cement (6%) | 5 kg | 30 kg | 30 kg | 60 kg |

Table 2. Quantity of oil palm trunk fibres required for 20 units of bricks

| Percentage of fibre content | Cement | Fibres |
|------------------------------------|---------------|-----------------|
| 0% | 5 kg | 0 gram |
| 1% | 5 kg | 50 gram |
| 2% | 5 kg | 100 gram |
| 3% | 5 kg | 150 gram |
| 4% | 5 kg | 200 gram |
| 5% | 5 kg | 250 gram |
| Total | | 750 gram |

Table 3. Quantity of OPFB fibres required for 20 units of bricks

| Percentage of fibre content | Cement | Fibres |
|------------------------------------|---------------|-----------------|
| 0% | 5 kg | 0 gram |
| 1% | 5 kg | 50 gram |
| 2% | 5 kg | 100 gram |
| 3% | 5 kg | 150 gram |
| 4% | 5 kg | 200 gram |
| 5% | 5 kg | 250 gram |
| Total | | 750 gram |

Table 4. Sample descriptions for bricks content with coir fibre

| Sample | Quantity | Descriptions |
|--------|----------|-------------------------|
| AT | 20 | Bricks with no fibre |
| BT | 20 | Bricks with 1% of fibre |
| CT | 20 | Bricks with 2% of fibre |
| DT | 20 | Bricks with 3% of fibre |
| ET | 20 | Bricks with 4% of fibre |
| FT | 20 | Bricks with 5% of fibre |

Table 5. Sample descriptions for bricks content with OPFB fibre

| Sample | Quantity | Descriptions |
|--------|----------|-------------------------|
| AB | 20 | Bricks with no fibre |
| BB | 20 | Bricks with 1% of fibre |
| CB | 20 | Bricks with 2% of fibre |
| DB | 20 | Bricks with 3% of fibre |
| EB | 20 | Bricks with 4% of fibre |
| FB | 20 | Bricks with 5% of fibre |

Table 6. The comparison dimension of OPT bricks and OPFB fibre reinforced laterite bricks

| Dimension Of Bricks | OPT Fibre Reinforced | | OPFB Fibre Reinforced | |
|-----------------------|----------------------|----------------|-----------------------|----------------|
| | Laterite Bricks | | Laterite Bricks | |
| | Average | Std. Deviation | Average | Std. Deviation |
| Length (mm) | 217 | 0.21 | 217 | 0.25 |
| Width (mm) | 97 | 0.12 | 97 | 0.22 |
| Depth (mm) | 72 | 0.56 | 72 | 0.43 |
| Area m ² | 0.0211 | 0.0000 | 0.0211 | 0.0001 |
| Volume m ³ | 0.00152 | 0.00001 | 0.00151 | 0.00001 |

Table 7. The comparison density of OPT fibre reinforced laterite bricks and OPFB fibre reinforced laterite bricks

| OPT Fibre Reinforced Laterite Bricks | | | OPFB Fibre Reinforced Laterite Bricks | | |
|--------------------------------------|----------------|--------------------------------------|---------------------------------------|----------------|--------------------------------------|
| Type | Fibre Contents | Average Density (Kg/m ³) | Type | Fibre Contents | Average Density (Kg/m ³) |
| AT | 0% | 2106.06 | AB | 0% | 2135.62 |
| BT | 1% | 2092.41 | BB | 1% | 2120.19 |
| CT | 2% | 2087.04 | CB | 2% | 2114.44 |
| DT | 3% | 2079.89 | DB | 3% | 2106.28 |
| ET | 4% | 2074.11 | EB | 4% | 2101.99 |
| FT | 5% | 2066.82 | FB | 5% | 2098.75 |

Table 8. The comparison compressive strength of OPT fibre reinforced lateritebricks and OPFB fibre reinforced laterite bricks

| OPT Fibre Reinforced Laterite Bricks | | | OPFB Fibre Reinforced Laterite Bricks | | |
|--------------------------------------|----------------|-------------------------|---------------------------------------|----------------|-----------------------------|
| Type | Fibre Contents | Average Strength(KN/M2) | Type | Fibre Contents | Compressive Strength(KN/m2) |
| AT | 0% | 7.92 | AB | 0% | 8.93 |
| BT | 1% | 7.52 | BB | 1% | 8.57 |
| CT | 2% | 8.49 | CB | 2% | 8.87 |
| DT | 3% | 8.41 | DB | 3% | 9.03 |
| ET | 4% | 8.35 | EB | 4% | 8.47 |
| FT | 5% | 8.00 | FB | 5% | 8.33 |

Table 9. The comparison water absorption of OPT bricks and OPFB fibre reinforced laterite bricks

| OPT Fibre Reinforced Laterite Bricks | | | OPFB Fibre Reinforced Laterite Bricks | | |
|--------------------------------------|---------------|---------------------------|---------------------------------------|---------------|---------------------------|
| Type | Fibre Content | average water Absorption% | Type | Fibre Content | average water Absorption% |
| AT | 0% | 18.88 | AB | 0% | 18.82 |
| BT | 1% | 19.84 | BB | 1% | 19.71 |
| CT | 2% | 19.52 | CB | 2% | 18.89 |
| DT | 3% | 19.46 | DB | 3% | 19.33 |
| ET | 4% | 19.53 | EB | 4% | 19.43 |
| FT | 5% | 19.93 | FB | 5% | 19.39 |

Table 10. The moisture content of laterite soil and sand for bricks with different type of fibre content.

| Type of brick | Material | Mass of Container (gram) | Mass of Container + Wet sample (gram) | Mass of Container + Dry sample (gram) | Mass of water (gram) | Moisture Content (%) |
|---------------------------------------|---------------|--------------------------|---------------------------------------|---------------------------------------|----------------------|----------------------|
| OPT | fibre | 660 | 804 | 786 | 18 | 2.30 |
| OPT Fibre Reinforced Laterite Bricks | Laterite Soil | 650 | 4370 | 3539 | 831 | 23.48 |
| | Sand | 660 | 5650 | 5422 | 228 | 4.21 |
| OPFB | fibre | 660 | 810 | 797 | 13 | 1.63 |
| OPFB Fibre Reinforced Laterite Bricks | Laterite Soil | 670 | 4340 | 3531 | 809 | 22.91 |
| | Sand | 670 | 6120 | 5887 | 233 | 3.96 |



Photo1. Oil palm fibres

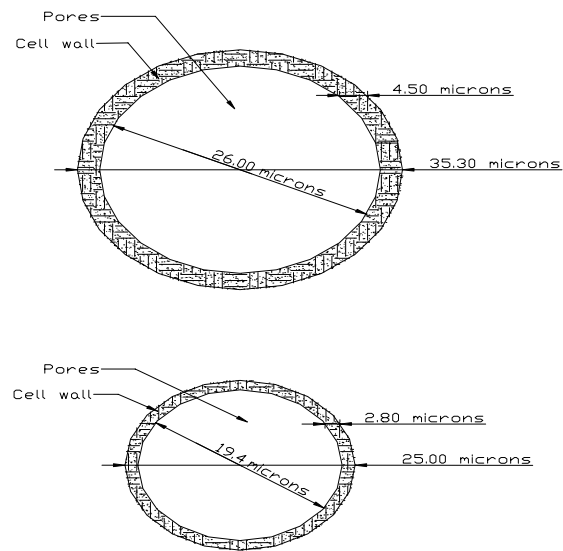


Figure 1. Cross Section of OPT and OPFB Fibre



Photo 2. Sample brick type FT (5% fibre content)

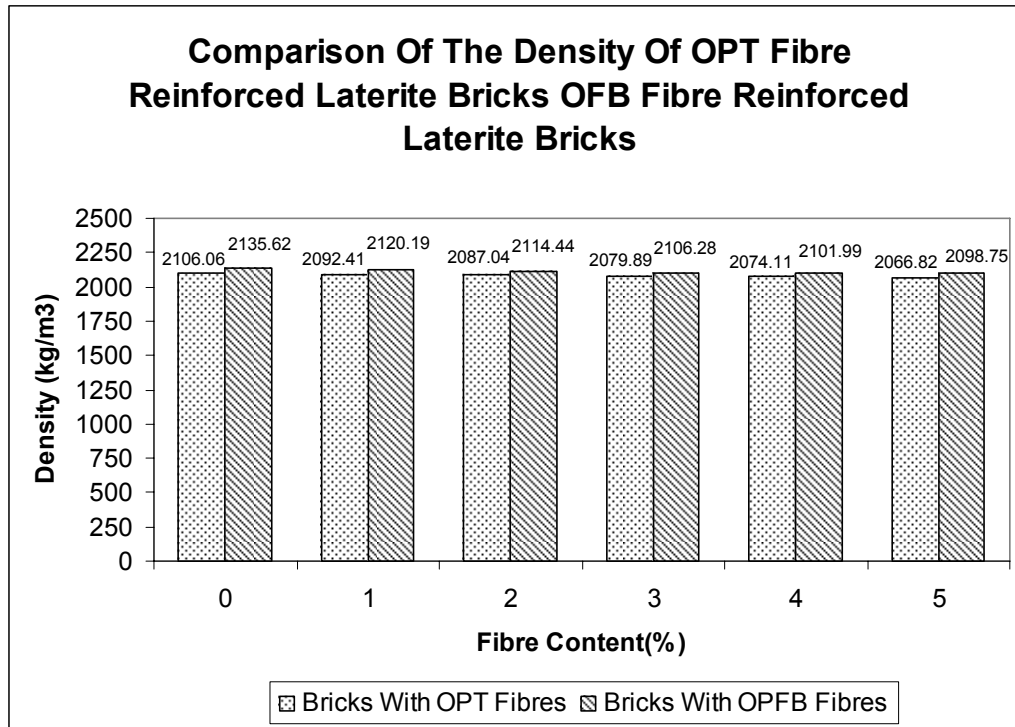


Figure 1. Comparison the density of OPT fibre and OPFB fibre reinforced Laterite bricks

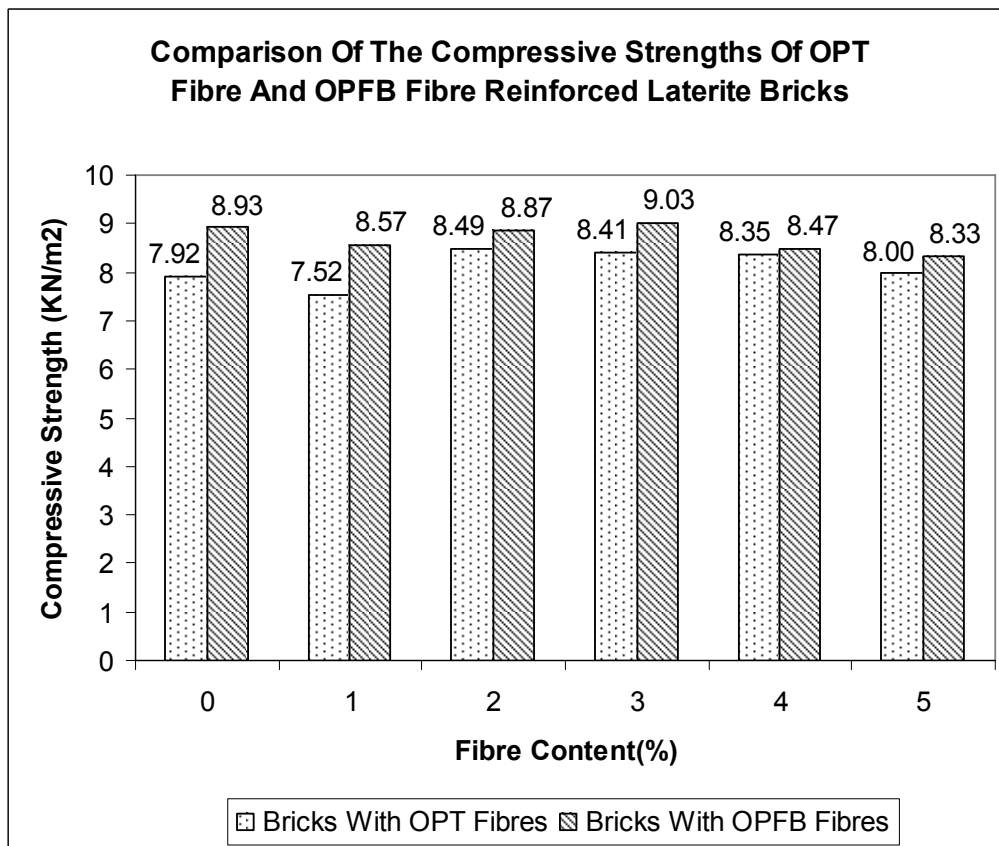


Figure 2. Comparison the compressive strength of OPT fibre and OPFB fibre reinforced laterite bricks

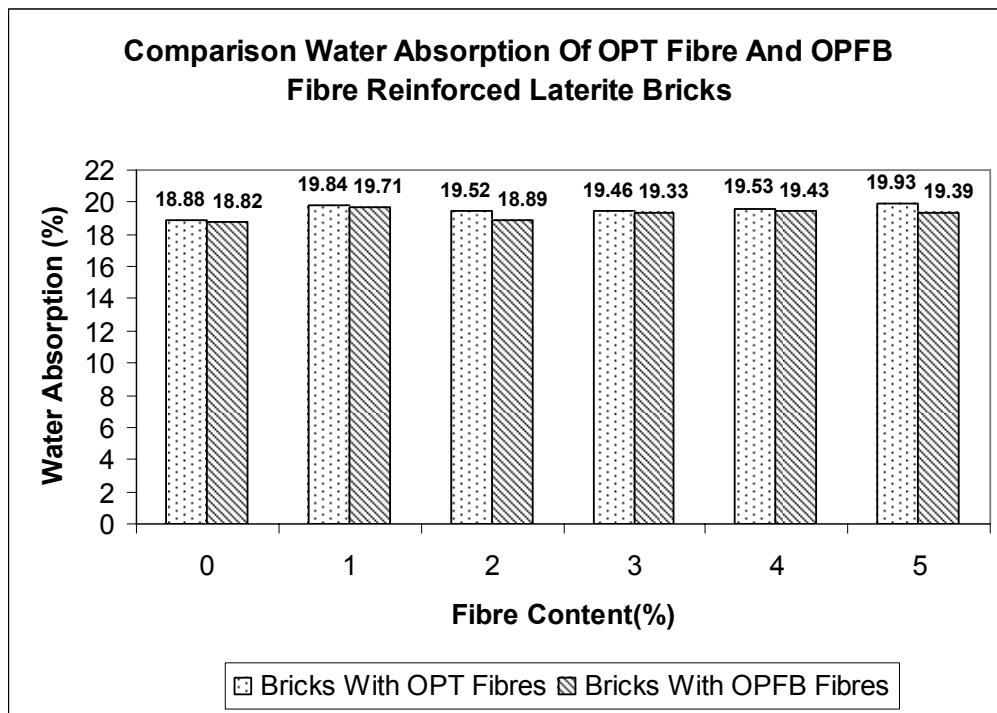


Figure 3. Comparison the water absorption of OPT fibre and OPFB fibre reinforced laterite bricks

Design and Analysis of Automobiles Manufacturing System Based on Simulation Model

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Abstract

The global financial crisis, brewing for a while, really started to show its in automobiles Automotive manufacturing is complex and includes the coordination of design and manufacturing. In the manufacturing approaches over the past few years, assembly has been a key issue and it seems simulation models are usually tailored to address a narrow set of industrial issues. This paper describes the development of manufacturing system design, operation, and maintenance based on Simulation. The model is being developed at two different levels: the supply chain, the assembly plant. A solution that may optimize one performance measure may deteriorate other performance solution difficult. The resulting algorithms are comparable to the simulation in terms of success rate, assembly times, peak forces and moments, and have assembly times superior to those of a benchmark blind search algorithm.

Keywords: Manufacturing assembly, Automotive assembly, Supply chain manufacturing, Simulation manufacturing, Simulation industry

1. Introduction

Manufacturing simulation is one of the most powerful analysis tools available to those responsible for the design and operation of manufacturing systems and the model can be reconfigured for many situations in automotive assembly (A. Dalvi; M. Guay. 2009). Manufacturing application include both facility design, as well as enterprise-wide supply chain modeling. However, typical manufacturing model is usually used either to predict system performance or to compare two or more systems design or scenarios (Scott Miller. 2000).

In the main, Generic simulation identifies common model input and output data interfaces that could be standardized for particular modeling level and simulation case studies. Simulation study is essentially a demanding and resource intensive task involving at least two major activities: Model building and experimentation (Benny Tjahjono; Raúl Fernández. 2008). In an increasingly competitive world, simulation has become a very powerful tool for the planning, design, and control of manufacturing systems to facilitate current and future training, experimentation, and testing of interoperability of software (Poornachandra Rao, Vira Chankong. 2005). Accordingly, many companies had applied simulation to the decision making processes.

As pointed out by Pegden, because of fierce competition, industry is now being forced into implementing expensive factory automation and is, therefore, carefully reexamining it. Operating policies and procedures. Typical manufacturing competitive priorities or strategies are low cost, delivery, flexibility and quality (Fritz J; Dolores H. Russ. 1997).

Vehicles successively pass through three different shops (body, painting and assembly). Each of these shops has specific constraints and perturbations that locally modify the pre-defined sequence of vehicles (Jitesh Kapadia. 1998). The assembly lines consist of a set of stations that produce one or many products. Each product must go through each station in the same order. In order for an assembly line to function properly, the operations in the stations must be balanced with respect to cycle time (Mehrdad Zoroufi. 2004). The analysis evaluated the cost structure for conventional vehicle manufacturing and retailing and assigned shares of the manufacturer's suggested retail price to various cost contributors (Deogratias Kibira; Charles R. McLean. 2007).

This paper focus on development of Vehicle manufacturing system design, operation, and maintenance based on Simulation. The process involves a number of operations, which require assembling together accounts of fabricated and purchased components, subassemblies, and systems. In addition, the overall goal to virtual manufacturing environment process to provide interoperability tests support to the manufacturers, researchers, and standards organizations will be achieve by using ARENA software for simulation model as shown in figure1.

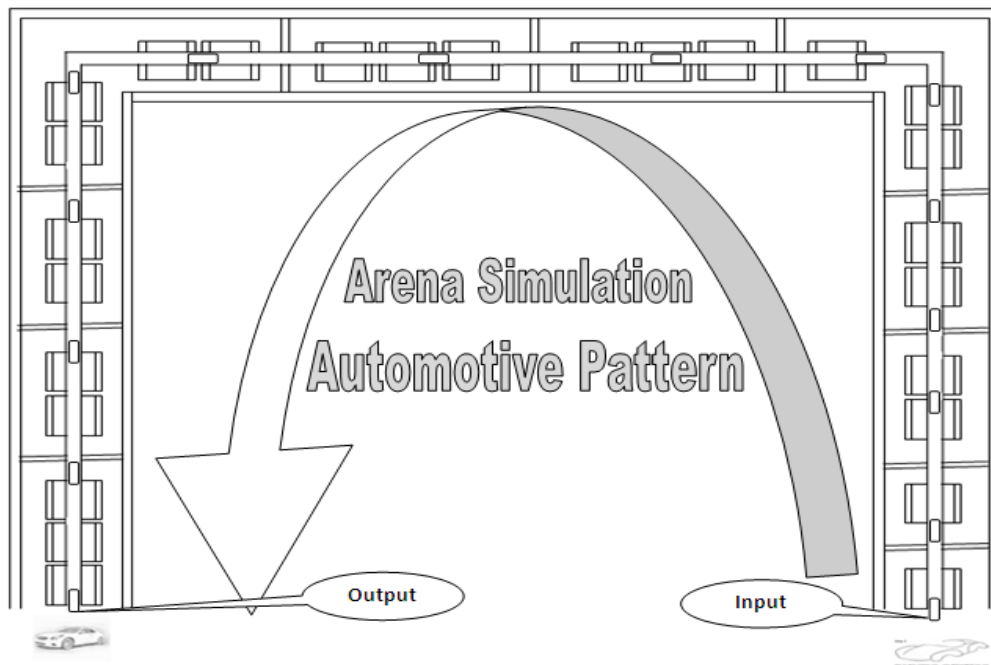


Fig. (1) The product stage Using ARENA Software

The sequence of the work presented here are:

- Identify facilities, systems, operations, parts, and processes in automotive manufacturing assembly to develop the model.
- Develop the simulation model of the final assembly plant.
- Perform conformance and acceptance testing using simulations to create the specified range of inputs for a delivered system or process.
- Evaluate effectiveness of new interface standards and protocols to meet manufacturing industry needs.

Finally, the expected result shows that the company could explore new operating procedures, organizational structures, etc. without disrupting ongoing operations in addition to controlling the time in term of compressed or expanded, allowing the speeding or slowing down of product process in order to achieve the target.

2. Theoretical background

2.1 Manufacturing strategy

Manufacturing strategy has been defined as the pattern of decisions that, over time, enables a business unit to achieve a desired manufacturing structure, infrastructure and set of specific capabilities.

Many older vehicles had separate underlying stiffening structures and bodies for housing the passengers. Therefore, the design requires more materials and results in a heavier car and contributes to raise the costs. Generally, the automotive production process consists of three major sections: the body shop, the paint shop, and the trim assembly shop. In addition, to other sections which are the power train assembly (consisting of the engine, gearbox, clutch, and transmission), and the press shop if body parts are stamped at the plant. Also, there is a final testing process where vehicles are checked for water tightness and a stationary road test (Deogratias Kibira; Charles R. McLean. 2007).

At assembly shop, some parts are usually assembled into the body before it is merged with the power system; the process is called “body drop” since it is the body that is usually lowered onto the chassis/power system. Typically, the most trim assembly operations are carried out manually and it needs a worker or two on either side of the line at a station. On the other hand, there is sufficient space on which to work, equipment and tools specific to the station as well as racks or bins on which the parts are stored for assembly.

An assembly line is a special case of the product layout. Adopting a product layout makes sense when the batch size of a given product or part is large relative to the number of different products or parts produced. Assembly

lines refer to progressive assembly operations linked by some material handling device. Virtually any product that has multiple parts and is produced in large volume is produced on assembly lines to some degree (Jitesh Kapadia. 1998).

A variety of configuration options can be made by the customer. The options on the car are that it can be either two or four door. A two-door car will require a different body side panel from a four-door car. Today most cars are manufactured according to the customer requirement (Deogratias Kibira; Charles R. McLean. 2007).

2.2 Simulation Model

Since the simulation is heavily based upon computer science, mathematics, probability theory and statistics: yet the process of simulation modeling and experimentation remains very much an intuitive art. Simulation is a very general and somewhat ill-defined subject. For the purpose of this paper, we will define simulation as, "the process of designing a computerized model of a system (or process) and conducting experiments with this model for the purpose either of understanding the behavior of the system and/or of evaluating various strategies for the operation of the system." Thus we will understand the process of simulation to include both the construction of the model and the analytical use of the model for studying a problem.

The simulation runs in a computer workstation for it costs a lot of computing resources. The simulation process is: Firstly, design variables is assigned with initial values and then product analysis is executed with ARENA mode; secondly, design variables are extracted from Matlab software.

3. The Proposed Method

Manufacturing simulation has been one of the primary application areas of simulation technology. It has been widely used to improve and validate the design of a wide range of manufacturing system (Jonathan J. Shi. 2000). Hence, Computer simulation is a powerful tool for analyzing and optimizing real-world system with a wide range of successful application (Michael W. Baenet. 2000). In this study, the computer simulation by using ARENA software will be used to improve the production line through supply chain and assemble.

3.1 *Supply chains* are large system consisting of many entities interacting in complex ways. The challenge faced by companies is how to design and manage such system (Angelisa Elisabeth. 2003). The simple pattern of supply chain is shows in figure 2.

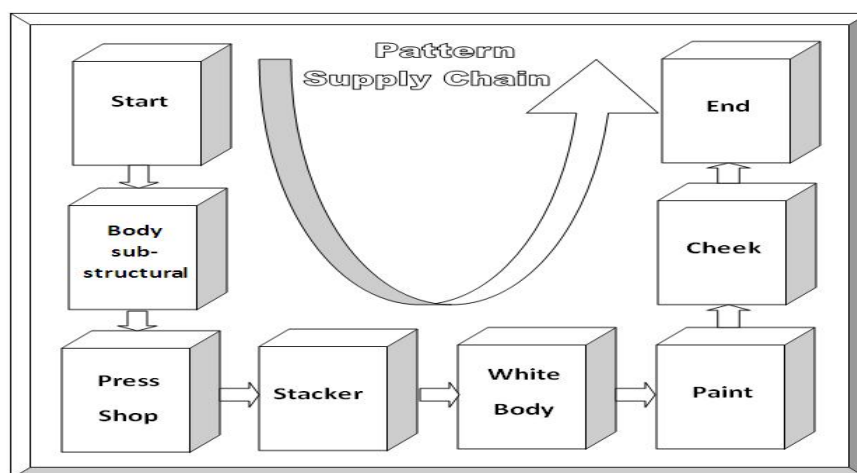


Fig. (2) Pattern for Supply Chain

3.2 *Assembly of operations with production of parts.* From a practical stand point of view it is preferred to have a system design which has a mix of operations and integration efficiencies, compared to a design which outperforms on normal criteria and completely to be distinguished by integration of assembly operations with production of parts. Figure 3 shows the simple pattern for assembly.

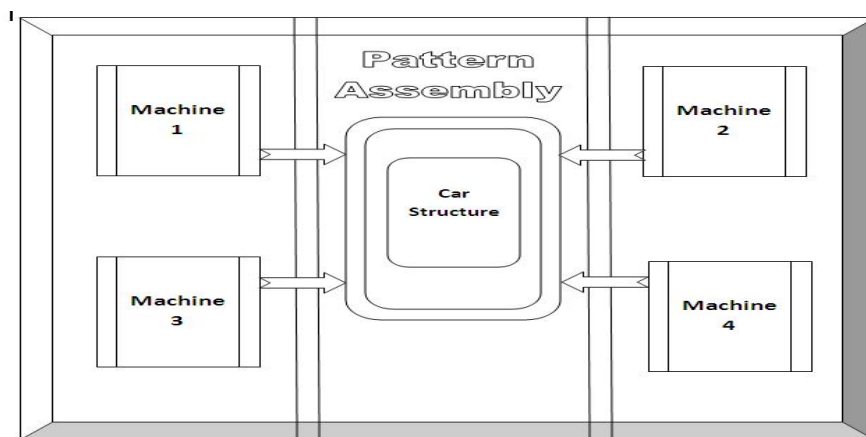


Fig. (3) Pattern for Assembly

4. Simulation Result

The using of simulation model is to estimate objective function values when they are needed during the course of optimization, and uses a new rule for accepting a candidate solution that depends on the individual estimated objective function values.

The automotive manufacturing was applied according to the ARENA software design. The estimated operation time was one month for 24 hours daily. In this month, 4518 cars will be produced as shown in table 1. The table reviews all information about the software. Thus, simulation modeling can be considering as an experimental and applied methodology that seeks to accomplish the use of model to predict future behavior.

The model results are shown bellow to converge rapidly on an inventory management problem.

Replication ended at time: 720 Hours

Statistics were cleared at time: 1.0 Hours

Statistics accumulated for time: 719.0 Hours

Base Time units: Hours

Simulations run time: 2.37 minutes

Table 1. Result application to simulation model

| Identifier | Average | Half Width | Min | Max | Observations |
|-----------------|---------------|------------|-------|------|--------------|
| Production time | 4.67 counters | Corr | 4.66 | 4.67 | 4518 |
| Identifier | | Count | Limit | | |
| Number Produced | 4518 Infinite | | | | |

To clarify the results of applying the model, it can be observe from the table the difference between the production time and the amount of products, as well as the difference between the production times in the normal case where the proposed model is not used. The different in production time before and after using AREANA software is show in figure 4.

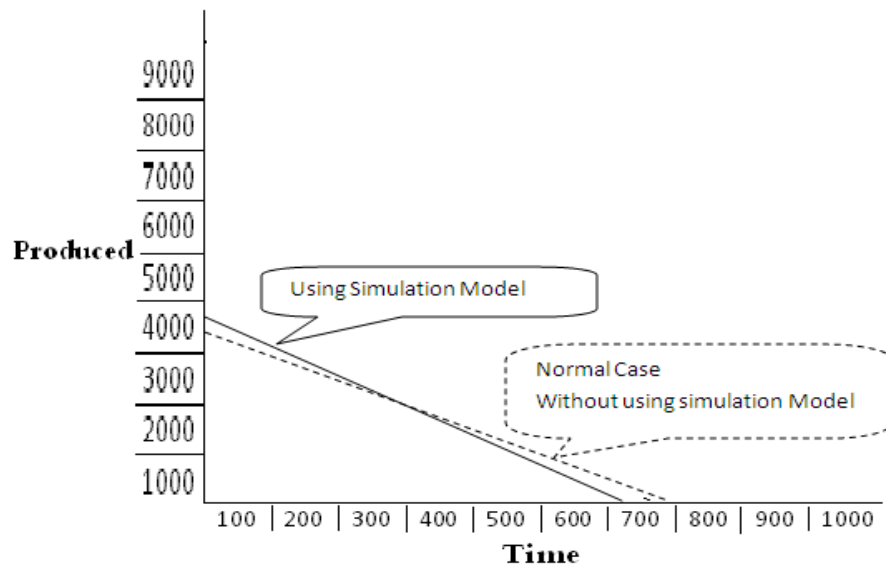


Fig. (4) Chart for deferent time before and after using simulation model

5. Conclusions

The model has been integrated with the supply chain simulation developed in another system by using (ARENA). The main focus of this paper was to simulate a production facility that manufactured car based on simulation model. The amount of products and the time saving showed the difference between before and after using simulation. The obtained data from the model can be applied to select the line produce to achieve optimum product. Finally, by introducing the model the company could explore new policies, operating procedures, and organizational structures without disrupting ongoing operations.

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Moisture-Dependent Physical Properties of Sunflower Seed (SHF8190)

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Abstract

Physical properties are very important in design and manufacturing of harvest and post harvest machines. In this research some physical properties of sunflower seeds (SHF8190 variety) were determined as a function of moisture content in the range of 4-22 % wet basis (w.b.) using standard techniques. The average length, width, thickness, geometric mean diameter, equivalent diameter, arithmetic diameter, sphericity, surface area and angle of repose ranged from 12.14 to 12.57 mm, 5.79 to 6.38 mm, 3.86 to 4.09 mm, 6.47 to 6.85 mm, 6.56 to 6.97 mm, 7.27 to 7.61 mm, 53.33% to 55.42%, 112.16 to 125.01 mm² and 41 to 57° as the moisture content increased from 4% to 22% w.b., respectively. The thousand grain weight (TGW) increased from 80.3 to 96.8 g whereas the bulk density decreased from 410 to 380 kgm⁻³ and the true density from 740 to 980 kg m⁻³ with an increase in the moisture content range of 4–22 % w.b. The data of sunflower seeds showed that the porosity ranged from 44.59 to 61.22%. The static coefficient of friction of sunflower seeds increased linearly against different surfaces of structural materials, namely, plastic (0.29–0.55), plywood (0.36–0.53), and galvanized iron (0.36–0.55) and the static angle of repose increased from 41° to 57°, respectively when the moisture content increased from 4 % to 22% w.b.

Keywords: Sunflower, Physical properties, Moisture content, SHF8190 variety

1. Introduction

Among the most important crops which considered by Iran Agricultural Division are oilseeds, For instance sunflower oil seeds with cultivated area of about 10 thousands hectares in Golestan province, Iran as well as average yield of 1000 kgh⁻¹ (Ghodsevali and Vafaei, 2008). In order to design equipment for handling, conveying, separation, drying, aeration, storing and processing of sunflower seeds, it is essential to determine their physical properties as a function of moisture content. The properties of different types of grains and seeds have been determined by other researchers such as Dutta et al. (1988) for gram seed; Amin et al. (2004) and carman (1996) for lentil seed; Ougt (1998) for white Lupin; Baryeh (2002) for millet; Cetin (2007) for barbungia bean; Ogunjimi et al. (2002) for locust bean seed and Coskun et al. (2006) for sweet corn seed. Bulk density, true density and porosity can be useful in sizing grain hoppers and storage facilities. They can affect the rate of heat and mass transfer of moisture during aeration and drying processes. Grain bed with low porosity will have greater resistance to water vapor escape during the drying process, which may lead to higher power to drive the aeration fans. The static coefficient of friction is used to determine the angle at which chutes must be positioned in order to achieve consistent flow of materials through the chute. Such information is useful in sizing motor requirements for grain transportation and handling (Ghasemi Varnamkhasti et al., 2007).

In this study, some physical properties of sunflower seed were determined, namely, size and shape, bulk and true densities, porosity, static coefficient of friction against the different material surfaces and angle of repose at various moisture contents in the range of 4-22% w.b.

Notations

| | |
|--|--|
| L, length, mm | TGW, thousand grain weight, g |
| W, width, mm | θ_s , static angle of repose, deg |
| T, thickness, mm | ϵ , porosity, % |
| S, surface area, mm ² | D _g , geometric mean diameter, mm |
| R ² , correlation determination | D _p , equivalent diameter, mm |
| R _a , aspect ratio | D _a , arithmetic diameter, mm |
| M, moisture content, % | V, volume, mm ³ |
| M _i , initial moisture content, % | S _p , sphericity, % |
| M _f , final moisture content, % | ρ_b , bulk density, kgm ⁻³ |
| W _t , total weight of sample, g | ρ_t , true density, kgm ⁻³ |
| Q, weight of required water, g | |

2. Materials and Methods

Sunflower (SHF8190) seeds were used for all the experiments in this study (Figure 1). The crop was collected from Plant and Seed Institute in Karaj. The initial moisture content of seeds was determined by oven method (Tabatabaefar, 2003) and the rewetting formula (Equation 1) was used for obtaining the desired moisture level as 12, 16, and 22% w.b. then they were placed in refrigerator to allow the moisture be absorbed by samples.

$$Q = \frac{W_i(M_f - M_i)}{(100 - M_f)} \quad (1)$$

2.1 Size and shape

For determining length, width and thickness of about 40 randomly selected seeds of each sample, a digital caliper was used. The geometric mean, D_g, equivalent, D_p, and arithmetic diameter, D_a, in mm was calculated by using these equations (Mohsenin, 1970):

$$D_g = (LDT)^{\frac{1}{3}} \quad (2)$$

$$D_p = \left[L \frac{(W+T)^2}{4} \right]^{\frac{1}{3}} \quad (3)$$

$$D_a = \frac{(L+W+T)}{3} \quad (4)$$

For obtaining sphericity (S_p), the ratio of the surface area of the sphere having the same volume as that of seed to the surface area of grain was determined using the following formula (Mohsenin, 1970):

$$S_p = \frac{(LDT)^{\frac{1}{3}}}{L} \quad (5)$$

Jain and Bal (1997) used following formulas for obtaining grain volume, V and surface area, S:

$$V = 0.25 \left[\left(\frac{\pi}{6} \right) L (W + T)^2 \right] \quad (6)$$

$$S = \frac{\pi B L^2}{(2L - B)} \quad (7)$$

where:

$$B = \sqrt{WT} \quad (8)$$

Omobuwajo et al. (1999) calculated aspect ratio (R_a) by:

$$R_a = \frac{W}{L} \quad (9)$$

2.2 Thousand grain weight

By counting 100 seeds and weighing them in an electronic balance to an accuracy of 0.001g and then multiplied by 10 to give mass of 1000 grains, thousand grain weight (TGW) was measured.

2.3 Bulk and true densities and porosity

A container was used to determine bulk density which is the ratio of the mass sample of seeds to its total volume by filling to a constant height, striking the top level and then weighing the container (Deshpande et al., 1993). For measuring true density which is a ratio of mass sample of seeds to its pure volume, the toluene displacement method was used (Mohsenin, 1970). The following formula was used for measuring the porosity which is the ratio of free space between seeds to total of bulk grains:

$$\varepsilon = \frac{\rho_t - \rho_b}{\rho_b} \times 100 \quad (10)$$

2.4 Static Coefficient of Friction

By the apparatus which is shown in Figure 2, the static coefficient of friction was determined with respect to different surfaces: plywood, plastic and galvanized iron. It was done by using a small rectangular frame which is open at both ends filled with the seeds at the desired moisture content and placed on adjustable titling surface in a way that the metal cylinder did not contacts the surface. Then the surface was raised gradually until the filled cylinder just started to slide down (Razavi and Milani, 2006).

2.5 Static Angle of Repose

The apparatus which is shown in Figure 3 was used for measuring the static angle of repose. It consists of a plywood box of 140-160-35 mm and two plates (fixed and adjustable). After filling the box with the sample, the adjustable plate was inclined slowly allowing the seeds to follow and assume a natural slope (Tabatabaefar, 2003).

3. Results and discussion

3.1 Size and shape

In Table 1, a summary of the dimensions of SHF8190 sunflower cultivar is shown. All dimensions have similar tendency and first decreased with the increase in moisture content from 4 to 12%, then L started to increase in the range of 12-22% but W and T didn't have this behavior and again decreased with an increase in moisture content from 16 % to 22% w.b. The sphericity, volume, surface area, aspect ratio, geometric mean diameter, equivalent diameter and arithmetic diameter had the same behavior. These behaviors may be due to the lowness of sample numbers or the complexity of moisture content impact on seeds. The increasing trend in axial dimensions, with seed in moisture content was due to the filling of capillaries and voids upon absorption of moisture and subsequent swelling (Table 1).

3.2 Thousand grain weight

As the moisture content increased from 4% - 22% w.b., thousand grain weight (TGW) increased considerably from 80.3 to 96.8 g (Fig. 4). Linear relationship for one thousand grain weight with moisture content, M, was determined as follows:

$$\text{TGW} = 0.952M + 75.18 \quad R^2 = 0.930 \quad (11)$$

Altuntas and Yıldız (2007) observed a linear increase for the thousand grain weight of faba bean from 1140.15 to 1332.67 g when the moisture content increased from 9.89% to 25.08% d.b.

3.3 Bulk and true densities and porosity

The values of the bulk density for different moisture levels varied from 710 to 649 kgm⁻³ (Figure 5). The following relationship was obtained for the bulk density of seed with moisture content:

$$\rho_b = -0.001M + 0.412 \quad R^2 = 0.830 \quad (12)$$

Gupta and Das (1997) reported a similar decreasing trend in bulk density for sunflower seed but Parde et al. (2003) found that the standard bulk density of Koto buckwheat increased significantly from 603.90 to 612.90 kgm⁻³ with an increase in moisture content from 14.8 to 15.8 %.

True density varied from 1250 to 1325 kgm⁻³ when the moisture level increased from 4% - 22% w.b. (Fig. 6). True density and the moisture content of seed can be correlated as follows:

$$\rho_t = 1.739M^2 - 29.19M + 810.3 \quad R^2 = 0.710 \quad (13)$$

With increase in moisture content from 4% - 22% w.b., the porosity of sunflower seeds increased linearly from

43.2% to 51% (Figure 7). The following equation represents the relationship between porosity and moisture content:

$$\varepsilon = 0.104M^2 - 1.594M + 48.01 \quad R^2 = 0.700 \quad (14)$$

Gupta and Das (1997) found linear relationship between porosity and true density with moisture content of sunflower seeds. Baumler et al., 2004, reported an increase in porosity against moisture content and evaluated the relationship between porosity and moisture content for safflower seed as:

$$e = 39.53 + 0.34M \quad R^2 = 0.930 \quad (15)$$

3.4 Static coefficient of friction

For determining the static coefficient of friction of sunflower seed, three surfaces (plastic, plywood and galvanized iron) were selected. The results are presented in Figure 8. From this Figure, it can be seen that the static coefficient of friction increased with an increase in moisture content for all the surfaces. The increased adhesion between the seeds and the material surfaces at higher moisture values may be the reason of this increment. For plastic, plywood and galvanized iron increases of 81.25 %, 46.11% and 52.32% were recorded when the moisture content increased from 4% to 22% w.b. The galvanized iron had the highest static coefficient of friction. Following equations show the relationships between static coefficient of friction and moisture content on plastic, plywood and galvanized iron:

$$\phi_{plyw} = 0.009M + 0.337 \quad R^2 = 0.965 \quad (16)$$

$$\phi_{galv} = 0.010M + 0.338 \quad R^2 = 0.926 \quad (17)$$

$$\phi_{plas} = 0.015M + 0.229 \quad R^2 = 0.966 \quad (18)$$

Gupta and Das (1997) represented a linear increase in friction against mild steel and galvanized iron for sunflower seeds. Sahoo and Srivastava (2002) found similar results for okra. Parde et al. (2003) reported that for the Koto buckwheat cultivar the friction coefficient against plywood, galvanized steel and concrete surfaces increased significantly from 0.26 to 0.31, 0.25 to 0.29 and 0.38 to 0.43 respectively, with increase in moisture content from 14.8 % to 17.9 %.

3.5 Angle of repose

Angle of repose were found to increase significantly from 41° to 58° in the moisture range of 4 to 22% w.b. (Figure 9). The following relationship was obtained with the static angle of repose for sunflower with its moisture content.

$$\theta_{st} = 0.897M + 38.63 \quad R^2 = 0.963 \quad (19)$$

Gupta and Das (1997) reported that the porosity of sunflower seeds and kernels increase linearly from 34.3 to 43.3% and from 45.4 to 50.2%, respectively when the moisture content changed from 4 to 20% d.b. Parde et al., (2003) reported that the emptying angle of repose for Koto buckwheat cultivar remained constant at about 23.5° from 14.8 to 15.8% of moisture content and then increased significantly, the filling angle of repose did not change significantly at 14.8 to 16.6% but increased significantly to 28.4° at 17.9%. For wheat, Tabatabeefar (2003) found that the values of dynamic angle of repose increased from 34.7° to 45° in the moisture range of 0 to 22% d.b.

Conclusions

For sunflower seeds, the conclusions in the moisture content range of 4% to 22% w.b. are as follows: The average length, width, thickness, geometric mean diameter, equivalent diameter, arithmetic diameter, sphericity, thousand grain weight, grain volume, porosity and surface area of sunflower seeds ranged from 12.14 to 12.57 mm, 5.79 to 6.38 mm, 3.86 to 4.09 mm, 6.47 to 6.85 mm, 6.56 to 6.97 mm, 7.27 to 7.61 mm, 53.33% to 55.42%, 80.3 to 96.8 g, 148.96 to 177.81 mm³, 36.89% to 61.22% and 112.16 to 125.01 mm², respectively. Bulk density was found to decrease from 419.59 to 381.6 kgm⁻³ but true density increased with increase in moisture content. The static coefficient of friction of sunflower seeds against different materials (plastic, galvanized iron and plywood) increased with increase in moisture content. The galvanized iron had the highest static coefficient of friction. Increase in moisture content resulted a linear increase in angle of repose from 41° to 57°. From these results, it can be concluded that changes in moisture content of seed have a significant impact on physical properties of sunflower seed and it is important to determine physical properties of sunflower seeds at different moisture levels.

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Table 1. Some physical properties of Shf8190 variety considering moisture content.

| MC (% w.b.) | 4 | 12 | 16 | 22 |
|----------------------|--------------|--------------|--------------|--------------|
| L (mm) | 12.24±1.57 | 12.14±0.93 | 12.38±1.46 | 12.60±1.18 |
| W (mm) | 6.05±0.9 | 5.79±0.69 | 6.37±0.80 | 6.05±0.865 |
| T (mm) | 4.04±0.72 | 3.87±0.87 | 4.09±0.15 | 3.85±1.21 |
| Dg (mm) | 6.68±0.70 | 6.47±0.61 | 6.85±0.38 | 6.64±0.58 |
| Dp (mm) | 6.77±0.65 | 6.56±0.75 | 6.97±0.42 | 6.75±0.61 |
| Da (mm) | 7.44±0.77 | 7.27±0.58 | 7.61±0.39 | 7.49±0.69 |
| Sp (%) | 54.62±3.30 | 53.33±3.75 | 55.42±2.60 | 52.82±1.68 |
| S (mm ²) | 119.27±16.00 | 112.16±12.49 | 125.01±9.94 | 118.09±11.24 |
| V (mm ³) | 164.60±34.11 | 148.96±24.41 | 177.81±22.14 | 162.22±24.95 |
| Ra (%) | 49.48±4.54 | 47.81±4.59 | 51.57±3.31 | 48.10±3.02 |



Figure 1. Sunflower Seeds



Figure 2. Apparatus to determine coefficient of static friction

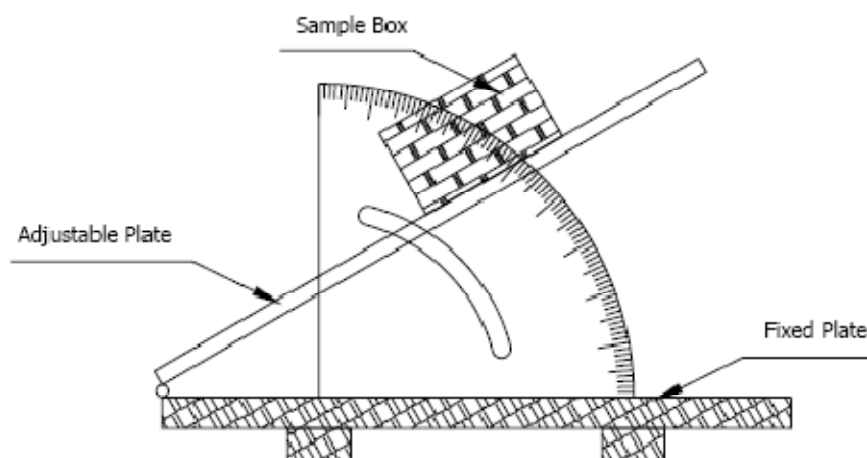


Figure 3. Empting angle of repose device

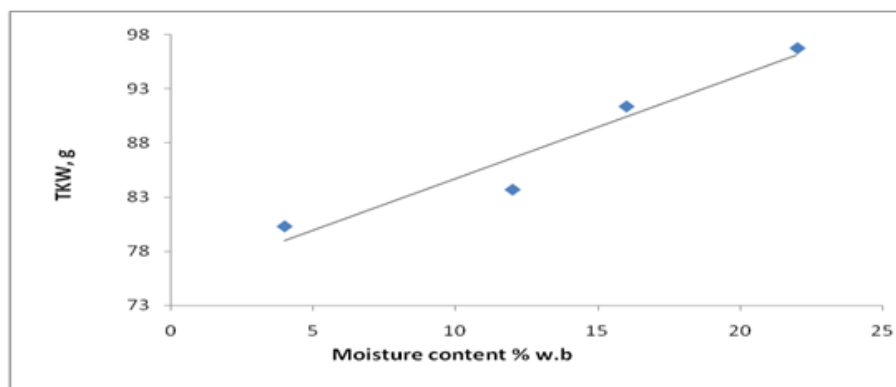


Figure 4. Effect of moisture content on thousand grain weight

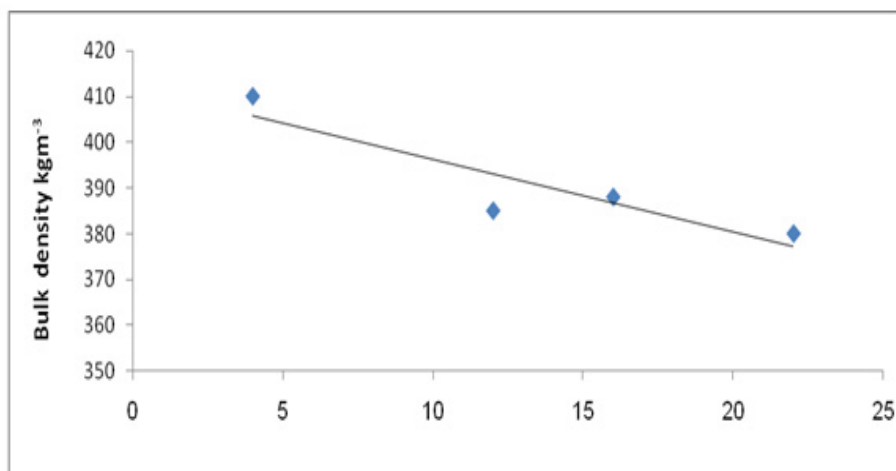


Figure 5. Effect of moisture content on bulk density

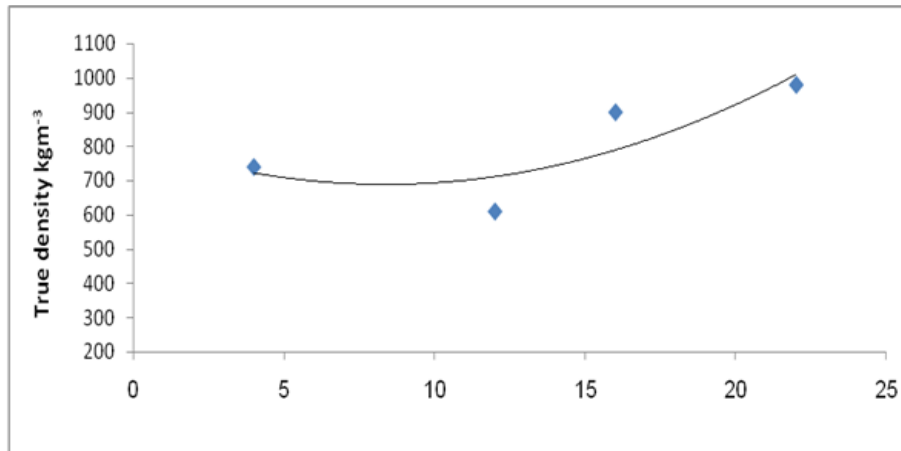


Figure 6. Effect of moisture content on true density

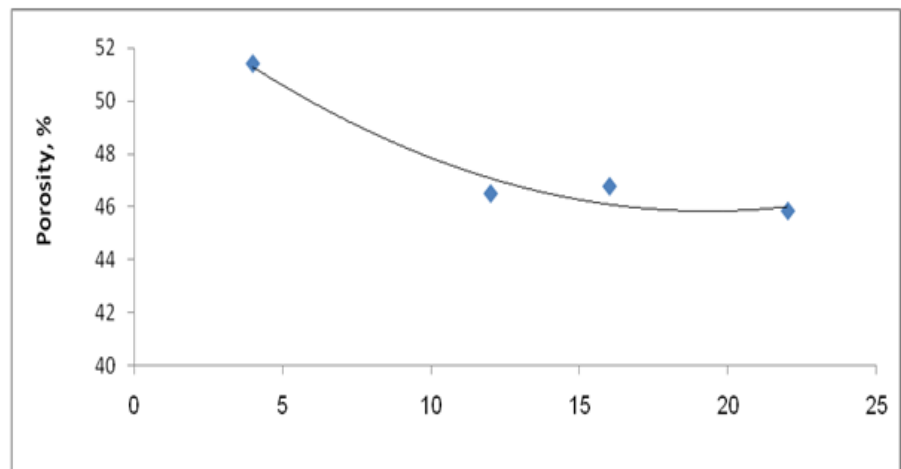
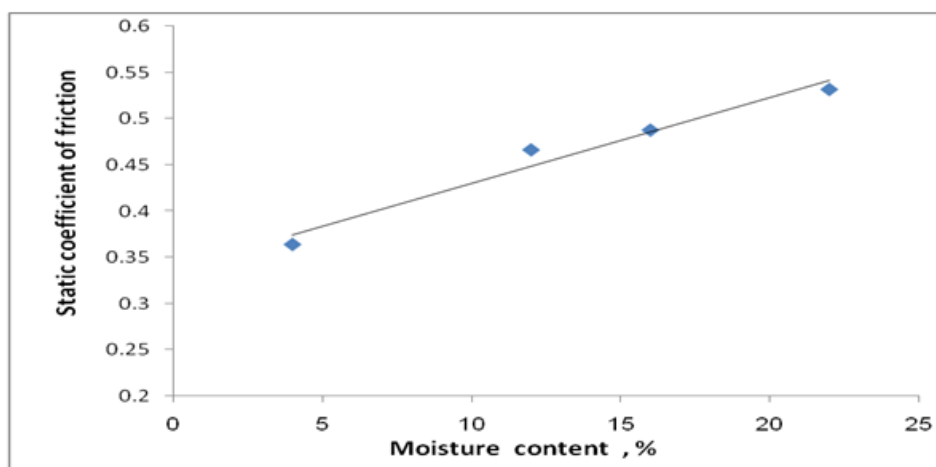


Figure 7. Effect of moisture content on porosity



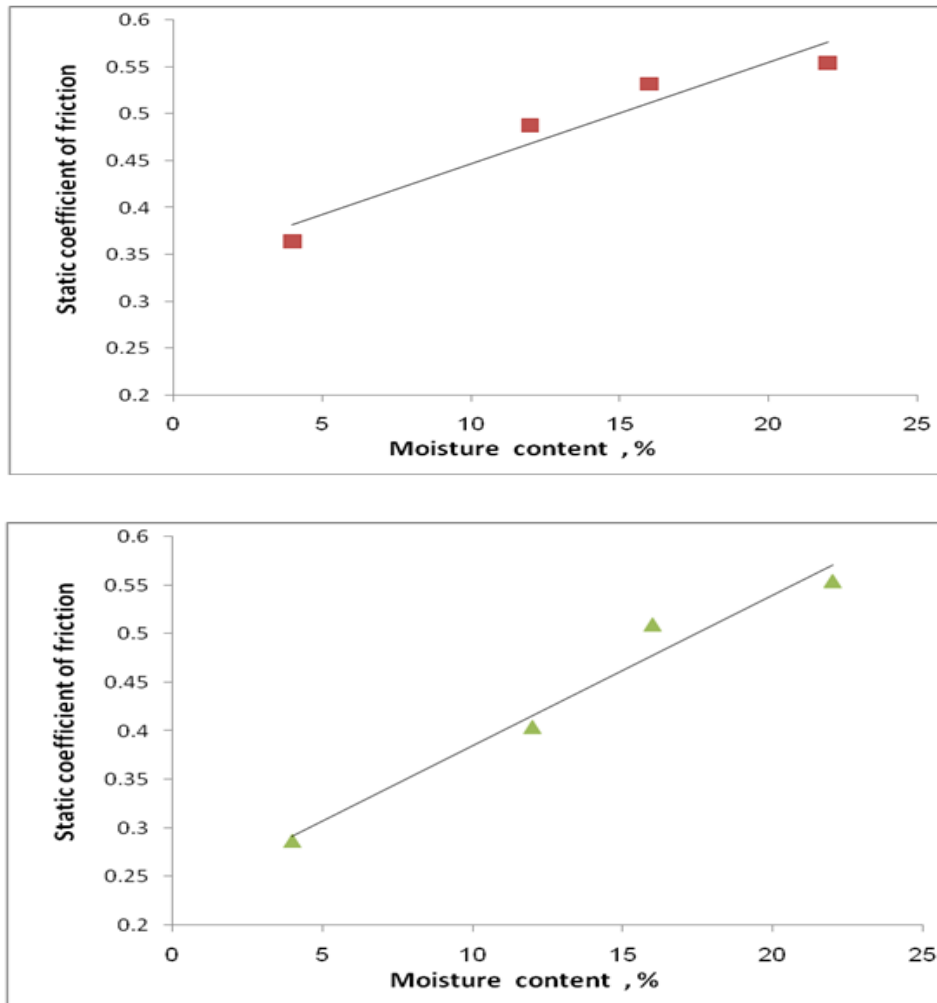


Figure 8. Effect of moisture content on static coefficient of friction: plastic (Δ); galvanized iron (\square) and plywood (\diamond).

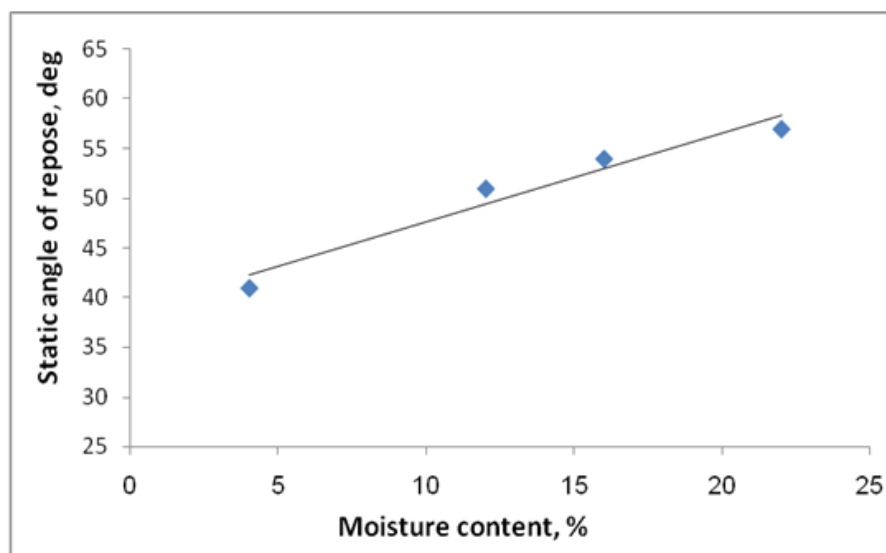


Figure 9. Effect of moisture content on static angle of repose

Solid Wood and Veneer Study of 12-Year Old Sesenduk Clone

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Abstract

Physical and mechanical properties of solid sesenduk clone were studied using physical tests such shrinkage and specific gravity and mechanical tests such as modulus of rupture (MOR), modulus of elasticity (MOE), compression strength, hardness and shear strength. The solid woods were tested under two different conditions (green and air-dried). The grading of solid sesenduk clone was also conducted by using *Acacia mangium* as material for comparison. The sesenduk clone was also transformed to veneer and compared with *Acacia mangium*. From the experiments, it can be concluded that sesenduk clone showed good quality and properties which make it becomes suitable as a supplement raw material in future.

Keywords: Sesenduk clone, Matured sesenduk, Physical, Mechanical, Air-dried and green

1. Introduction

Rubberwood is almost exclusively as a raw material for the production of particleboard and medium density fibreboard (MDF) in Malaysia. This wood species is also responsible for the establishment and growth of the Malaysian wood-based in particular MDF, particleboard, wood lamination and furniture. However, due to the demand of rubberwood that keeps increasing, the price is also increasing since the last decade (Paridah *et al.*, 2009). The increase of the price surely has caused a burden to the wood-based product manufacturers. This situation has urged them to find alternative materials that can help them continuously producing wood-based products with reasonable cost. Sesenduk has been discovered to be a suitable tree species for such purpose. Sesenduk is one of the fast-growing species and possesses good mechanical and physical properties and astonishing wood colour. Other than that, according to MTC (Malaysian Timber Certification), sesenduk is extremely easy to be treated with chemicals (fire retardants or wood preservers) and it has excellent working properties nailing (MTC, 2008). Due to that, sesenduk is suitable for fabrication of wood furniture or wood-based products such particleboard, plywood and veneer. This study is to promote the 12 years old sesenduk clone (**FRIMsrp001**). This species has been selected as one of the potential species for plantation establishment, because of the demand of the species and the rate of the growth, even though its seed germination was found as low as 10% due to the attack of the seed borer, *Dichocrocis punctiferalis* (Darus *et al.*, 1991). The objectives of the project are: 1) To determine the timber recovery and timber grade of 12 years old sesenduk clone, 2) To fabricate solid and veneer products of 12 years old sesenduk clone 3) To determine the veneer recovery and veneer quality, 4) To determine the physical and mechanical properties of solid wood and flat board (plywood board).

2. Materials and Method

2.1 Materials

Raw material used for the study was 12 years old sesenduk clone which was obtained from the Kepong Botanical Garden (KBG), FRIM plot. This project was divided into two different studies i.e. solid and veneer study. Samples for solid study (physical and mechanical properties) were cut in accordance with American Standard Testing Method (ASTM D5536-97).

2.2 Solid Study and Veneer Study

For this study, investigations done were on recovery, physical and mechanical properties, timber grading, product development and furniture testing. The properties were tested under green and air-dried conditions in accordance with BS 373:1957 (method of testing small clear specimen for timber). Tests done on the samples were specific gravity, density, shrinkage, moisture content (MC), modulus of rupture (MOR), modulus of elasticity (MOE), shear strength, compression and hardness. The timber was graded by MTIB's grader and by referring to Malaysian Grading Rules (MGR). As for veneer study, it comprises recovery rate study, veneer quality, physical and mechanical properties, product development and furniture testing.

2.4 Data analysis

The samples were analyzed using ANOVA. The analysis was to determine the effects of different drying conditions to the physical and mechanical properties. The mean values for each parameter under each species were compared to determine significance effects caused by the drying surroundings at $p \geq 0.05$.

3. Results and Discussions

3.1 Solid Study

The physical and mechanical properties of the 12 years old sesenduk clone which were tested under two different environments (green and air-dried) were compared with 40-year old matured sesenduk and rubberwood. The results are exhibited in Table 1.

3.1.1 Mechanical Properties

The MOR, MOE, hardness, shear strength and compression were better when the samples were air-dried prior to the tests. Moisture content was observed as one of the factor that influenced the results. The air-dried matured sesenduk presented the lowest moisture content (n.a) and this is why it showed the best MOR and MOE values. The air-dried mature sesenduk was able to achieve MOR and MOE values as high as 80 N/mm² and 10000 N/mm², which was almost 50% higher than sesenduk clone and rubberwood. The other three tests (hardness, shear strength and compression) were conquered by rubberwood, even though, for these tests, the air-dried rubberwood was having similar moisture content with the air-dried 12 year old sesenduk clone. It recorded 4.3 kN for hardness, 11.0 N/mm² for shear strength and 32.3 N/mm² for compression. As for the green samples, the comparisons were only made between green matured sesenduk and green sesenduk clone. In green condition, still, the matured sesenduk exhibited better mechanical performance in comparison with sesenduk clone (Table 1).

3.1.2 Physical Properties

Shrinkage was evaluated based on the air-dried samples. No value was found for rubberwood. By comparing the shrinkage values, between the green mature sesenduk and the green 12-year old sesenduk clone, it was found that the mature sesenduk was more dimensional stable than the sesenduk clone. The larger percent of shrinkage indicates less dimensional stability. For tangential shrinkage, the values for the matured sesenduk and sesenduk clone were 1.45% and 1.82%, where as for radial shrinkage, the values were 2.22% and 2.50%. This is normal, because naturally, moisture content of a juvenile wood is gradually decreasing as it grows. Hence, it becomes more dimensional stable as the shrinkage value is also decreasing as found by Kretschman and Bendtsen (1993). Other than that, it might be caused by the density difference. According to Guler *et al.*, (2007) density is an important factor which is affecting shrinkage and swelling of a wood. The mature sesenduk has greater density compared to the sesenduk clone and it was able to hold more moisture, which this might explain why it released moisture slower than the sesenduk clone. The overall inferior physical and mechanical properties of the sesenduk clone can be fully understood by evaluating them through the findings of Kretschman and Bendtsen (1993). Kretschman and Bendtsen (1993) explain that a juvenile wood is much lower strength, lower specific gravity, thinner cell walls, lower cellulose content, lower percentage of latewood, higher longitudinal shrinkage, more compression wood, greater fibril angle and higher lignin content compared to a mature wood. These parameters are believe to affect the properties of the sesenduk clone. As for the recovery rate, the comparison was made between sesenduk clone and *Acacia mangium*. The intention of choosing *Acacia mangium* as a threshold for comparison was because *Acacia mangium* is one of the well-known fast-growing species, which is already attain great acceptance among wood-based manufacturers. The recovery rate of sesenduk clone was better than that of *Acacia mangium*. The yield recovery rate for sesenduk clone was 52% and *Acacia mangium* was 41%. Sesenduk clone once again overshadowed *Acacia mangium* for timber grading. There were 7 characteristics assessed for the grading: 1) prime, 2) select, 3) standard, 4) service-able, 5) sound, 6) utility and 7) reject. The values of prime, select, standard, service-able, sound and utility should be high in order to achieve good grading. The

lower the reject value presents better grading. The values for sesenduk clone for those characteristics were: 2.5, 14.7, 73, n.a, 6.1 and 3.6% and slight lower values for *Acacia mangium*: 12.9, 7.9, 36.3, 0.5, 4.5 and 37.8%. Roughly, sesenduk clone was eligible to become a substitute for *Acacia mangium* as an input for the wood-based industry. Sesenduk clone comes with acceptable physical and mechanical properties and short period of growth to achieve harvestable maturity.

3.2 Veneer Study (recovery rate and shrinkage)

For veneer study, the sesenduk clone veneer was compared with *Acacia mangium* veneer. The sesenduk clone veneer properties were greater than that of *Acacia mangium*. The properties were evaluated through recovery rate and shrinkage (thickness, parallel and perpendicular). Higher recovery and lower shrinkage values indicate good properties. The recovery rate for sesenduk clone and *Acacia mangium* were 76 and 46%, whereas the shrinkage rates were 3.9% (thickness), 3.75% (parallel) and 0.25% (perpendicular) for sesenduk and 2.8% (thickness), 4.22% (parallel) and 2.75% (perpendicular) for *Acacia mangium*. The sesenduk clone veneer also was found resistance to defects such as pin holes, worm tracks and open slits. This probably due to the high lignin content that sesenduk clone has which it acts as defence against the wood borers. The physical and mechanical properties of the flat board from sesenduk were decreasing as the resin loading and pressing time was increased. The heat of the pressing was believed to affect the strength of the wood fibres and caused decrease to the strength of the veneer. However this is subject to the pressing duration. The pressing duration is frequently adjusted to be longer as resin loading is increased. The intention of this act is to eliminate moisture available in the resin as well as in the wood to help the resin cure faster, thus create bonding between veneer and resin. The effects of resin loading to pressing time are studied in details by Izran (2009) and Izran *et al.*, (2010b), even though the final product of his research was particleboard. The pressing duration is also not only affected by resin loading, but it is also may be affected by the chemical composition of the material. This had been confirmed by Izran *et al.*, (2010a) and Zaidon *et al.*, (2004).

4. Conclusions

This study concluded that the rubberwood is still incomparable by the mature sesenduk solid wood and sesenduk clone solid wood, in terms of physical and mechanical properties. However the matured sesenduk was better than the sesenduk clone. Sesenduk clone also having a better grading compared to *Acacia mangium* which has made it compatible to be a successor or an alternative to *Acacia mangium*. With all the advantages it has, the sesenduk clone should be further promoted to provide wider selection of raw material for the wood-based product manufacturers in continuously producing wood-based products that have received non-stop demand. It may prevents the manufacturers from just concentrating to a species which, without warning may cause distinction to the species.

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Table 1. Physical and mechanical properties of the solid sesenduk clone, mature sesenduk and rubberwood

| Properties | 12-year old sesenduk clone | | Mature sesenduk | | Rubberwood |
|---|----------------------------|-----------|-----------------|---------------|---------------|
| | Green | Air-Dried | Green (1) | Air-Dried (2) | Air-dried (1) |
| MC (%) | 103 | 17 | 76 | n.a | 17 |
| Density (Kg/m ³) | 311 | 323 | 400 | 500 | 640 |
| MOR (N/mm ²) | 38.13 | 48.21 | 39 | 80.57 | 66 |
| MOE (N/mm ²) | 4472 | 5618 | 8500 | 10678 | 9240 |
| Hardness (KN) | 1.2 | 1.3 | 1.6 | n.a | 4.3 |
| Shear (N/mm ²) | 4.7 | 6.1 | 5.4 | 9.7 | 11.0 |
| Compression (N/mm ²) | 18.4 | 24.2 | 20.8 | n.a | 32.3 |
| Specific gravity | 0.31 | 0.32 | 0.33 | n.a | 0.55 |
| Tangential shrinkage (%) – Air Dried | 1.82 | | n.a | 1.45 | n.a |
| Radial Shrinkage (%) – Air Dried | 2.50 | | n.a | 2.22 | n.a |

Samples of 12 for each portion (bottom, middle and top)

Note:

- (1) The Strength Properties of Some Malaysian Timbers, 1979.
- (2) Poster Presented at IUFRO, Taiwan by Hamdan *et. al.*, 2007.

Ontology Based Fuzzy Document Clustering Scheme

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Abstract

Document clustering is the technique used to group up the document with the reference to the similarity. It is widely used in web mining and digital library environment. Documents are represented in vector space model. Each document is a vector in the word space and each element of the vector indicates the frequency of the corresponding word in the document. Documents are presented as high dimensional data elements. It is a very complex task to cluster documents using K-means clustering algorithm. The sub space clustering schemes can be adopted to cluster documents. The document clustering uses the term weights from the similarity measure. The sub space model uses the relevant attributes for the similarity estimation. The fuzzy logic is used to cluster the documents. The fuzzy document clustering scheme is enhanced with semantic analysis mechanism. Semantic analysis is carried out with the support of the ontology. The ontology is used to maintain term relationships. Term relationships are represented using the synonym, meronym and hypernym factors. Ontology is manually collected by the users. Domain based ontology is used for the document clustering process. The system uses the data mining domain based ontology for the semantic analysis. Semantic weights are used in the similarity measure. Fuzzy based text document clustering scheme uses the stop word filters and stemming process under the document preprocess. Term clustering and semantic clustering operations are performed in the system.

Keywords: Fuzzy clustering, Fuzzy, Document clustering, Data mining, Fuzzy ontology, Semantic web

1. Introduction

Document clustering has been studied intensively because of its wide applicability in areas such as web mining and information retrieval. In document clustering, unlabeled documents are typically represented in vector space model (VSM), where each document is a vector in the word space and each element of the vector indicates the frequency of the corresponding word (also called term or feature) in the document. Generally, the data are of very high dimensional and sparse, which poses a big challenge to conventional clustering algorithms such as k-means (S.B.Kotsiantis and P.E.Pintelas. 2004). In high dimensional data, clusters often exist in subspaces rather than in the entire space (L.Jing, M.K.Ng, and J.Z.Huang. 2007). For example, in document clustering, clusters of documents of different topics are categorized by different subsets of keywords. Moreover, the keywords for one cluster may not occur in the documents of other clusters. One solution to this problem is text subspace clustering (L.Jing, M.K.Ng, J.Xu, and J.Z.Huang. 2005), which aims to discovering the document clusters in different subspaces of the original word space. In the past few years, soft subspace clustering algorithms have been developed and successfully applied to clustering large document collections. Examples includes LAC (C.Domeniconi, D.Gunopulos, and S.Ma. 2006), FWKM (L.Jing, M.K.Ng, J.Xu, and J.Z.Huang. 2005), [5] and EWKM (L.Jing, M.K.Ng, and J.Z.Huang. 2007) etc. In these algorithms, each term is assigned with a desired set of weighting values to distinguish its different contributions to document categories. Since the weighting values are ranged between 0 and 1, the subspaces discovered by these algorithms are of soft. With k-means type methods (L.Jing, M.K.Ng, J.Xu, and J.Z.Huang. 2005), (C.Domeniconi, D.Gunopulos, and S.Ma. 2006), (L.Jing, M.K.Ng, and J.Z.Huang. 2007), (J.Z.Huang, M.K.Ng, H.Rong, and Z.Li. 2005), the algorithms iteratively group the documents into hard partitions.

1.1 Literature Review

In many applications, a document may include multiple topics and thus may relate to multiple categories at the same time, resulting in the requirement of fuzzy document clustering. On the other hand, due to its effectiveness in discovering clusters with overlapping boundaries, fuzzy clustering algorithms are able to reveal more accurate cluster structures within the document collections (Q.Wang, Y.Ye, and J.Z.Huang. 2006). In (J.Li, X.Gao, and L.Jiao. 2005), a feature-weighting algorithm combined with the fuzzy k prototypes algorithm was presented. The steps of feature weighting and data partitioning are separated in this algorithm. Recently, an algorithm named fuzzy W-k-means (Q.Wang, Y.Ye, and J.Z.Huang. 2006) was proposed. In this algorithm however, the dimensions are assigned with a uniform value for different clusters. Additionally, the fuzzy W-k-means (Q.Wang, Y.Ye, and J.Z.Huang. 2006) introduces two user defined parameters α and β , which are difficult to estimate in practice. In order to perform fuzzy clustering on high dimensional data, a new algorithm named FPC (Fuzzy Projected Clustering) was studied in our previous work (L.Chen, Q.Jiang, and S.Wang. 2008). This parameter free algorithm can generate “soft” partitions of the high dimensional data. In this paper, we will present some theoretical analysis of the FPC algorithm for document clustering. Furthermore, we will deal with a common problem of the existing methods, i.e., the robustness of the algorithms. It is widely known that the performances of the k-means type algorithms are highly dependent on their initial states. Unfortunately, most of the above methods make little of these in the context of high dimensional clustering that lead to unstable clustering results. We will improve the FPC to a new version R-FPC (Robust FPC), by introducing a new technique called R-Greedy to build a robust initial condition for the algorithm. The remainder of this paper is organized as follows. In Section 2, we describe the R-FPC algorithm. The R-Greedy technique is presented in Section 3. Section 4 presents the experiments and the performance results. The conclusions are given in Section 5.

2. The R-FPC Algorithm

Given a vector space model, the documents vectors may be presented by $\mathbf{x}_1, \mathbf{x}_2, \dots, \mathbf{x}_n$, where $\mathbf{x}_i = (x_{i1}, x_{i2}, \dots, x_{id})$ and d stands for the number of unique words in the model, n denotes the total number of documents, x_{ij} is the normalized word frequency of the j^{th} term in the document. We also call \mathbf{x}_i a data point in the d -dimensional space. Let $\{C_1, C_2, \dots, C_K\}$ be the K document clusters, where C_k denotes a partition of document collections. The membership of \mathbf{x}_i to C_k is denoted as u_{ki} .

In text subspace clustering, each category of documents is characterized by a subset of terms in the vocabulary that corresponds to a subset of dimensions in the data space. In this sense, we say that a cluster of documents is situated in a subspace of the original space. It is clear that a term may play unequally important roles to all the clusters. To measure such special correlations, an individual weighting value w_{kj} that ranges in $[0,1]$ is assigned to $j^{\text{th}} (j=1,2,\dots,d)$ term of cluster $C_k (k=1,2,\dots,K)$, indicating how much the term is relevant to the cluster, with of more relevance, and larger weight. FPC finds the weight for each term from each cluster by minimizing the following objective function in the clustering process (L.Chen, Q.Jiang, and S.Wang. 2008):

$$J(C, V, W) = \sum_{k=1}^K \sum_{j=1}^d \sum_{i=1}^n u_{ki} w_{kj} / 2\sigma_k^2 (\mathbf{x}_{ij} - \mathbf{v}_{kj})^2 - \sum_{k=1}^K d \ln \alpha_k / \sqrt{2\pi\sigma_k} \sum_{i=1}^n u_{ki} + d \sum_{k=1}^K \sum_{i=1}^n u_{ki} \ln u_{ki} \quad (1)$$

subject to

$$\left\{ \begin{array}{l} \sum_{j=1}^d \sqrt{w_{kj}} = 1, 0 \leq w_{kj} \leq 1, 1 \leq k \leq K \\ \sum_{k=1}^K u_{ki} = 1, 1 \leq i \leq n \\ \sum_{k=1}^K \alpha_k^d = 1 \\ \alpha_k \geq 0, u_{ki} \geq 0, \sigma_k > 0, 1 \leq k \leq K, 1 \leq i \leq n \end{array} \right.$$

We have built an extended Gaussian model for subspace clustering and derived the above objective function (referred to (L.Chen, Q.Jiang, and S.Wang. 2008) for more details). Here α_k is the mixture coefficient of k^{th} Gaussian component, $\mathbf{v}_k = (v_{k1}, v_{k2}, \dots, v_{kd})$ and σ_k denote mean and covariance of the k^{th} Gaussian, respectively. V and W denote the mean and weight matrix for all the K clusters, respectively.

Since all inputs $\mathbf{x}_1, \mathbf{x}_2, \dots, \mathbf{x}_n$ are available, the learning of all the parameters via minimizing Eqn.(1) can be implemented by the Expectation Maximization (EM) algorithm in a batch way. The algorithm R-FPC is summarized as follows, which is based on our previous algorithm FPC (L.Chen, Q.Jiang, and S.Wang. 2008) and introduces a new procedure called R-Greedy to build a robust initial condition for the algorithm. The R-Greedy

method will be described in next section.

Algorithm 1 R-FPC

Input: $\mathbf{x}_1, \mathbf{x}_2, \dots, \mathbf{x}_n$, K and a termination criterion ε

Output: $U = \{u_{ki} | k=1, 2, \dots, K; i=1, 2, \dots, n\}$ and the associated weights matrix W .

begin

1 Initialization

1.1 Let p be the number of iteration, $p = 0$;

1.2 Call R-Greedy to initialize the $V^{(0)}$ and $W^{(0)}$;

1.3 Set $u_{ki} = 1/K$ for $k=1, 2, \dots, K$ and $i=1, 2, \dots, n$;

Set α_k and σ_k to an constant.

2 Repeat

2.1 Set $p=p+1$

2.2 Use Eqn.(3) to calculate $U(p)$

2.3 Use Eqn.(2) to calculate $W(p)$

2.4 Update $\alpha_k (k=1, 2, \dots, K)$ using Eqn.(5)

2.5 Update $\sigma_k (k=1, 2, \dots, K)$ using Eqn.(6)

2.6 Use Eqn.(4) to calculate $V(p)$

until $\|V(p) - V(p-1)\|_\infty < \varepsilon$

and $\|W^{(p)} - W^{(p-1)}\|_\infty < \varepsilon$

3 Output $U(p)$ and $W(p)$

end

Starting from the initial conditions, the algorithm updates U , W , V , α_k and σ_k ($k=1, 2, \dots, K$) iteratively. The process is repeated until no significant changes can be made for the partitions. In each step, the optimal values of parameter are computed to minimize J on the assumption that other parameters are fixed. Using Lagrange multiplier technique, we can solve the feature weight w_{kj} by

$$w_{kj} = (1/X_{kj} + \delta)^2 / (\sum_{j=1}^d 1/X_{kj} + \delta)^2 \quad (2)$$

with

$$X_{kj} = \sum_{i=1}^n u_{ki} (x_{ij} - v_{kj})^2.$$

Following FWKM (L.Jing, M.K.Ng, J.Xu, and J.Z.Huang. 2005), (J.Z.Huang, M.K.Ng, H.Rong, and Z.Li. 2005), to ensure that the denominator of Eqn.(2) is always larger than 0, we adjust the denominator by adding an additional factor $\delta = 1 / nd \sum_{i=1}^n \sum_{j=1}^d (x_{ij} - o_j)^2$ (L.Jing, M.K.Ng, J.Xu, and J.Z.Huang. 2005), where o_j is the mean feature value of the entire data set. The proof of Eqn.(2) can be found in (L.Chen, Q.Jiang, and S.Wang. 2008). Similarly, the membership matrix U in each iteration is updated by

$$u_{ki} = \left(\sum_{l=1}^K \alpha_l / \sigma_l \exp \left(-1/2d\sigma_l^2 \sum_{j=1}^d w_{lj} (x_{ij} - v_{lj})^2 \right) \right)^{-1} \times \alpha_k / \sigma_k \exp \left(-1/2d\sigma_k^2 \sum_{j=1}^d w_{kj} (x_{ij} - v_{kj})^2 \right) \quad (3)$$

The above measurement of fuzzy membership degree is in an exponential type and is based on the weighted Euclidean distance, which is quite different from the one used in the FCM-based algorithm, such as the classical FCM (H.Sun, S.Wang, and Q.Jiang. 2004) and the newly designed algorithm fuzzy W-k-means (Q.Wang, Y.Ye, and J.Z.Huang. 2008). The means of Gaussian, i.e., the cluster center V , can be calculated by

$$v_{kj} = \sum_{i=1}^n u_{ki} x_{ij} / \sum_{i=1}^n u_{ki} \quad (4)$$

The Eqn.(4) is the same as the one defined in FCM (H.Sun, S.Wang, and Q.Jiang. 2004) (in case of the fuzzifier equals to 1). Fix U , V and W , we can derive the following equations to update α_k and σ_k :

$$\alpha_k = (u_{k+}/n)1/d \quad (5)$$

$$\sigma_k^2 = 1 / d \sum_{i=1}^n u_{ki} \sum_{j=1}^d w_{kj} \sum_{i=1}^n u_{ki} (x_{ij} - v_{kj})^2 \quad (6)$$

It can be seen that the R-FPC is an extension to the FCM algorithm by adding multiple steps to estimate the parameters of the clustering model. Therefore the algorithm is able to converge within a finite number of iterations. The time complexity is $O(hndK)$, where h is the total number of iterations.

2.2 The R-Greedy Method

The R-Greedy aims to provide a method for choosing the stable K cluster centers and their initial subspaces for RFPC. Most existing algorithms only consider the selection of initial K cluster centers by random selection (L.Jing, M.K.Ng, J.Xu, and J.Z.Huang. 2005)(L.Jing, M.K.Ng, and J.Z.Huang. 2007)(J.Z.Huang, M.K.Ng, H.Rong, and Z.Li. 2005)(Q.Wang, Y.Ye, and J.Z.Huang. 2008) or the Greedy technique (C.Domeniconi, D.Gunopulos, and S.Ma. 2006). For example, the Greedy technique choose the first center random, and selects the others such that they are far from one another, and from the first chosen center. It is important to remark that such technique measures the distance between data points by considering all features of the space. In high dimensional spaces, the data are inherently sparse; the distance between every pair of points is almost the same for a wide variety of distance functions. As we can see from the experimental results (presented in next section), using these traditional techniques for document clustering would lead to instability and poor accuracy of the clustering results.

We also argue that the subspaces where the initial clusters are situated should be taken into account at the initialization stage. It is because the true distances between data points will be distorted by noisy attributes in the high dimensional data space. Virtually all-existing soft subspace clustering algorithms evenly set the feature weights with all entries equal to a constant. The R-Greedy is an extension of the Greedy technique by considering these special characteristics of high dimensional data clustering, as follows.

Algorithm 2 R-Greedy

Input: $\mathbf{x}_1, \mathbf{x}_2, \dots, \mathbf{x}_n$, and K

Output: $V^{(0)}, W^{(0)}$.

begin

1 Initialization

1.1 Use Eqn.(8) to choose the first cluster center \mathbf{v}_1 ;

1.2 Use Eqn.(7) to calculate w_{1j} for $j=1,2,\dots,d$;

2 For $k=2$ to K do

2.1 For each point $\mathbf{x}_i \notin \{\mathbf{v}_1, \mathbf{v}_2, \dots, \mathbf{v}_{k-1}\}$, calculate $\text{dist}(\mathbf{x}_i) = \min_{l=1,2,\dots,k-1}$

$$\sum_{j=1}^d w_{lj} (x_{ij} - v_{lj})^2$$

2.2 Choose the point \mathbf{x}_l as the k^{th} cluster center using the following rule:

$$l = \arg\max_{i=1,2,\dots,n} \text{dist}(\mathbf{x}_i)$$

2.3 Use Eqn.(7) to calculate w_{kj} for $j=1,2,\dots,d$;

3 Output V as $V(0)$ and W as $W(0)$

end

There are two major extensions in R-Greedy comparing with the traditional Greedy technique. Since the cluster centers with random selection may result in unstable clustering results, especially on the high dimensional data, we choose a determinable point as the first center at first. Secondly, R-Greedy searches other well-scattered centers using the weighted Euclidean distance function, which calculates the distances between data points in individual subspaces. The initial subspaces for all chosen cluster centers are computed based on Eqn.(2). In particular,

$$w_{kj}^{(0)} = (1/X_{kj}^{(0)} + \delta)^2 / (\sum_{j=1}^d 1/X_{kj}^{(0)} + \delta)^2 \quad (7)$$

with

$$X_{kj}^{(0)} = \sum_{i=1}^n (x_{ij} - v_{kj})^2$$

The task of step 1.1 is to choose a point from the dataset that candidates to be one of the centers of the underlying document clusters. Since we use tf representation for documents, each entry of the data is proportional to the term frequency and has been normalized in range of [0,1]. Therefore, the length of a vector in such representation is able to measure the relevance degree of the corresponding document with its topic, to some extent. Based on this observation, we can choose the first cluster center according to the following rule:

$$v_1 = \operatorname{argmax}_{x_1, x_2, \dots, x_n} \sum_{j=1}^d x_{ij}^2 \quad (8)$$

The time complexity of R-Greedy is $O(ndK)$. More importantly, the R-Greedy can always generate determinable initial conditions for the clustering algorithm. Since fuzzy clustering is generally better than hard clustering at avoiding local minima, using R-Greedy the R-FPC can achieve the robust clustering results with better performance than existing text subspace clustering algorithms..

3. Proposed System

The proposed system is designed to perform the document clustering using the semantic analysis mechanism. The ontology is used for semantic analysis. The fuzzy logic technique is used for the clustering process. The fitness analysis is performed to verify cluster accuracy. The sub space clustering scheme is used in the system. The document attributes are collected and grouped with relevancy. The similarity measurement is estimated on the sub space model. The sub space similarity model reduces the computation complexity and increases the accuracy. The sub space model also reduces the process time.

The clustering system is developed as a stand alone tool. The document preprocessing and clustering operations are handled by the system. The system uses the text documents for the clustering process. The text documents are collected from the benchmark datasets provided in UCI machine learning repository. The system is divided into four major modules. They are Document preprocessing, Term cluster, Semantic Cluster and Performance analysis.

The document-preprocessing module is designed to convert the documents into structured data sets format. The term cluster module is used to perform the document clustering using the term weights. The semantic clustering module is designed to cluster the documents using semantic weights. The performance analysis module is designed to analyze the cluster accuracy and process time. The system uses the Oracle relational database system as back end.

3.1 Document Preprocess

The documents are maintained in text file format. The contents of the documents are parsed and converted into the vector space model. The stop word elimination and stemming process are used to reduce the vector size. The system maintains a stop word repository. The stop words in the documents are removed using the repository. The stemming process analyzes the suffix value for the terms. The base term is extracted using the stemming process. The porter-stemming algorithm is used in the system. The document details are updated into the database. The system also updates the term list into the database.

3.2 Term Cluster

The system performs two types of clustering operations. They are term clustering and the semantic clustering. The term clustering task is performed using the term weights. The term frequency is estimated and updated into the database. The term frequency and inverse document frequency are calculated for each term. The term weights are used for the similarity measurement process. The fuzzy clustering scheme is applied on the sub space of the term collection. The term weights are used for the comparison process. The term cluster requires high vector size for the clustering process.

3.3 Semantic Cluster

The semantic clustering is performed with the term relationship based comparison. The term cluster does not consider the term relationship. The semantic cluster uses the term relationship for the clustering process. The ontology is used to maintain the relationship for the term collection in a domain. The terms are maintained with synonym, meronym and hypernym relationships. The terms are analyzed with the ontology collections. The term category is used for the weight estimation process. The semantic weight is estimated for each concept. The clustering process uses the semantic weights.

3.4 Performance Analysis

The performance analysis module is designed to analyze the performance of the term clustering and semantic clustering techniques (Figure1). The memory, process time and accuracy metrics are used for the performance analysis. The memory requirement for each clustering is analyzed. The accuracy is estimated using the fitness function.

4. Experiments and Performance Results

The text documents are denoted as unstructured databases. It is very complex to group the text documents. The document clustering requires a preprocessing task to convert the unstructured data values into a structure one. The documents are large dimensional data elements. The dimension is reduced using the stop word elimination and stemming process. The ontology fuzzy document is the process of extracting the frequent and popular contents of the text document collection. The document grouping tasks require the content relationship factors. The semantic analysis is the technique that uses the term and its relationship with a collection of terms. The relationships are represented as synonym, meronym and hypernym. The system is implemented to perform fuzzy text document grouping with the support of semantic analysis. Table1 shows the analysis of term cube versus semantic cube. The benchmark document collection is selected as the testing environment for the system.

The system is tested with benchmark document collection from 20 newsgroup dataset. Initially the documents are updated to the database with preprocessed information. The stopword elimination and stemming operations are performed in the preprocessor. All the document analysis operations are carried out on the database information. The porter-stemming algorithm is used in the system. The term frequency is estimated for all terms. The terms for each document are updated into the database. The clustering process is performed on the basis of term weights and semantic weights. The term weights are estimated using the term frequency values. The ontology is used for semantic weight estimation process. Concept relationship is considered in the semantic analysis.

5. Conclusion

Text clustering is about discovering novel, interesting and useful patterns from textual data. In this paper we have discussed how to introduce the method of building ontologies into unsupervised text learning in order to consider the text semantics in the preview of linguistics. The fuzzy document clustering uses the sub space-clustering model. The relevant attributes are used for the comparison process. The semantic analysis is used to reduce the vector size. The relevancy is also improved by the semantic analysis. The system can be enhanced with multi domain ontology to analyze documents with any domain. This also applied to distribute clustering on web document and in XML document. In Future work will consider the fuzzy clustering scheme under the direction of ontologies, after all, most of the documents simultaneously belong to more than one category. Furthermore, the method of calculating the term mutual information in this paper can be used to create the ontology in different field.

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Table 1. Process Time Analysis- 3 Clusters K-means Vs Fuzzy

| S.No | Documents | K-means(msec) | Fuzzy (msec) |
|------|-----------|---------------|--------------|
| 1 | 500 | 162 | 97 |
| 2 | 1000 | 336 | 196 |
| 3 | 1500 | 494 | 281 |
| 4 | 2000 | 658 | 372 |
| 5 | 2500 | 825 | 466 |

Description for the above table.

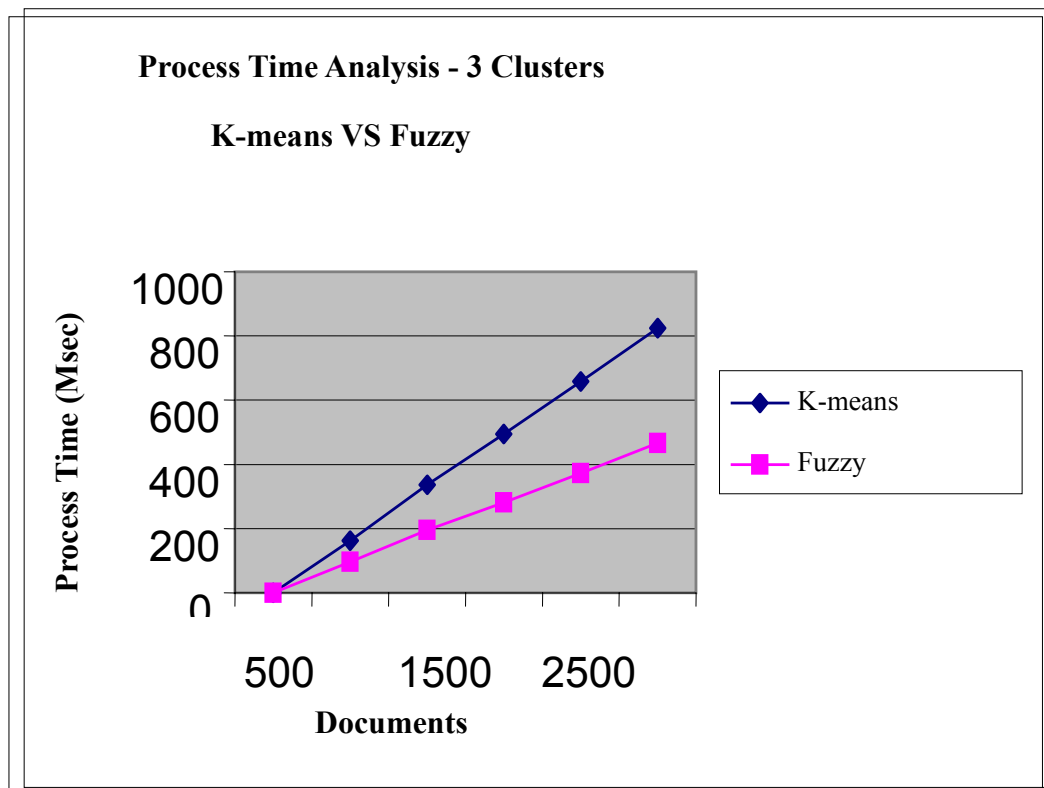


Table 2. Memory Usage Analysis – 3 Clusters K-means Vs Fuzzy

| S.No | Documents | K-means (kb) | Fuzzy(kb) |
|------|-----------|--------------|-----------|
| 1 | 500 | 9 | 12 |
| 2 | 1000 | 17 | 23 |
| 3 | 1500 | 26 | 34 |
| 4 | 2000 | 37 | 45 |
| 5 | 2500 | 45 | 54 |

Description for the above table.

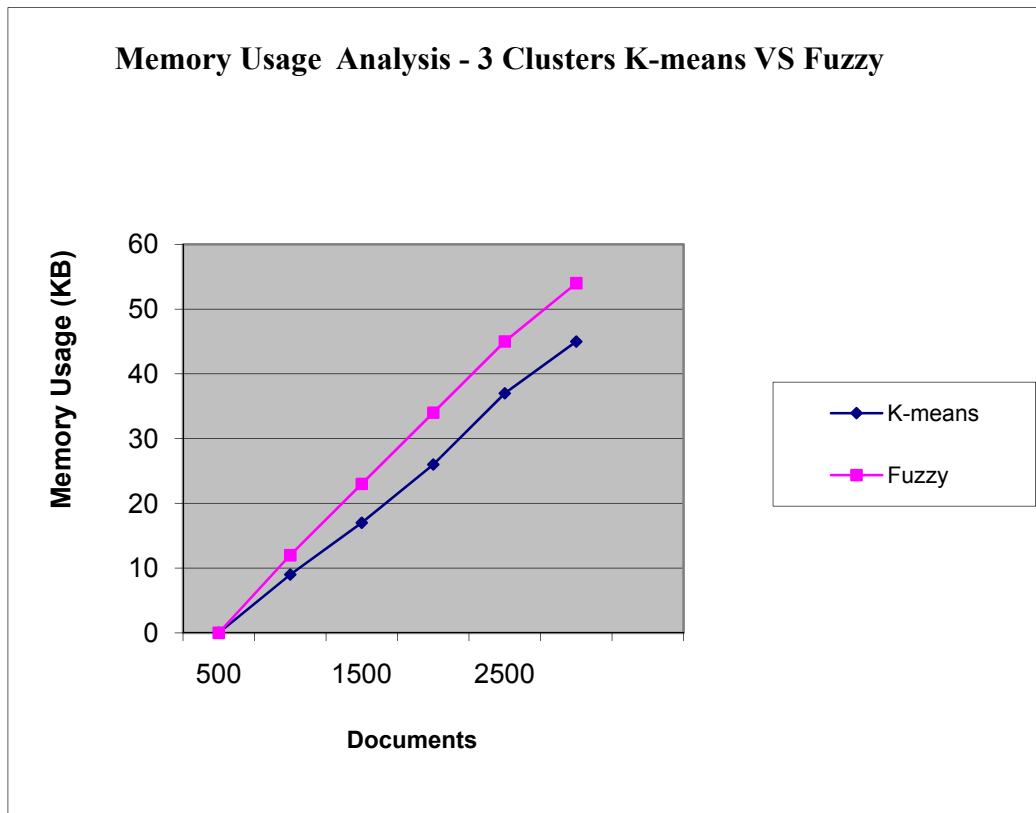
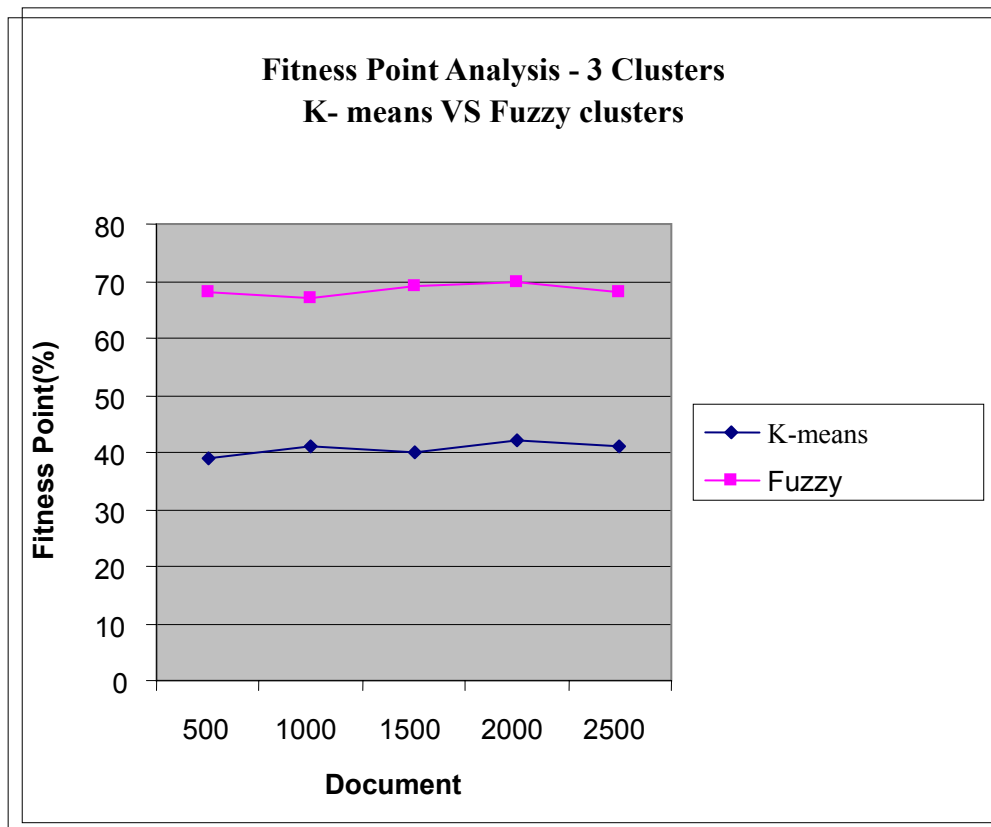


Table 3. Fitness Point Analysis-3 Clusters K-means Vs Fuzzy

| S.No | Documents | K-means | Fuzzy |
|------|-----------|---------|-------|
| 1 | 500 | 39 | 67 |
| 2 | 1000 | 41 | 68 |
| 3 | 1500 | 40 | 69 |
| 4 | 2000 | 42 | 70 |
| 5 | 2500 | 41 | 68 |

Description for the above table.



Sum and Difference Squeeze Properties of Entangle Coherent States

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Abstract

A kind of entangle coherent states is constructed. According to dual mode field's sum and difference operators defined by Mark Hillery, its squeezing properties are investigated by means of numerical calculation. Results show that the states appear sum and difference squeezing effect under the given conditions.

Key words: Entangle coherent, Sum operator, Different operator, Quantum optics

1. Introduction

The quantum entangle is a basic characteristics different with non-classical physics in quantum mechanics. Since entangle states have been put forward by Einstein, Podolsky(Einstein A, Podolsky B, Rosen N. 1935), Rosen and Schrödinger(Schrödinger E. 1935) to verify completeness of quantum mechanics, they have been attracting extensive attention in physical field. Recently, following the development of quantum information, the entangle states are considered as a kind of important physical resource. Up to now, they have been applied in the region such as quantum computation, teleportation (Bennett C H, Brassard G, Crepeau C, et al. 1993), dense coding(Bennett C H, Wiesner S J. 1992) and quantum key distribution(Ekert A K. 1991).

The research on non-classical effects of optical field is one of important subject in quantum optics. Squeezing effects of optical field reflects a kind of non-classic properties. They have extensive application in optical communication, high precision measurement and weak signal detection (Loudon R, Knight P L. 1987)(Wall D F. 1983). They have become focus in quantum optics.

In the paper (Zhou Lan, Kuang Leman. 2002), entangle degree, dual and single mode squeezing of entangle coherent states have studied and their relations have been discussed. In the paper (Fu H C, Wang X G, Solomon A I. 2001), the relations of entangle degree, squeezing and ant-bunching of entangle coherent states have investigated. In the paper, sum and difference squeeze effects of entangle coherent states are discussed by using sum and difference operator introduced by Mark Hillery (Hillery M. 1989).

2. Entangle coherent states

According to paper (Mann A, Sanders B C, Munro W J. 1995)(Wang Xiao-guang. 2002), a kind of entangle coherent states is considered

$$|\psi\rangle = \frac{1}{N} [\mu |\alpha, \alpha\rangle + \nu e^{i\phi} |-\alpha, \alpha^*\rangle], \quad (1)$$

where μ and ν are complex constants, $\alpha = re^{i\delta}$, α^* is complex conjugation, $|\alpha, \alpha\rangle = |\alpha\rangle \otimes |\alpha\rangle$ and $|-\alpha, \alpha^*\rangle = |-\alpha\rangle \otimes |\alpha^*\rangle$, $|\alpha\rangle$ is Glauber coherent states, ϕ is the phase difference between μ and ν , N is normalized coefficient. For convenience, μ and ν are assumed real. Using complete property, N can read

$$N = \{\mu^2 + \nu^2 + 2\mu\nu \cos(r^2 \sin 2\phi - \phi) \exp(-3r^2 + r^2 \cos 2\phi)\}^{-1/2}. \quad (2)$$

For convenience, the first and second mode of dual mode coherent states (1) are notated as a and b , respectively.

3. Sum and difference squeezing of entangle coherent states

3.1 Sum squeezing of entangle coherent states

By the paper (Hillery M. 1989), two orthogonal hermite operators are introduced

$$V_1 = \frac{ab + a^+b^+}{2}, \quad V_2 = \frac{ab - a^+b^+}{2}, \quad (3)$$

Where a, a^+, b and b^+ are annihilation and creation operator of a and b mode of dual mode radiation field, respectively. They satisfy with

$$[V_1, V_2] = i \frac{a^+a + b^+b + 1}{2}, \quad (4)$$

$$\langle (\Delta V_1)^2 \rangle \cdot \langle (\Delta V_2)^2 \rangle \geq \frac{1}{4} |[V_1, V_2]|^2, \quad (5)$$

If the inequality is right

$$\langle (\Delta V_i)^2 \rangle < \frac{1}{2} |[V_1, V_2]|, \quad (i = 1, 2) \quad (6)$$

there is squeeze effect in optical field component V_i ($i = 1, 2$). With the view of description degree of squeeze, squeezed degree S_i is defined

$$S_i = \langle (\Delta V_i)^2 \rangle - \frac{1}{2} |[V_1, V_2]|. \quad (i = 1, 2) \quad (7)$$

If $S_i < 0$, it indicates that there is squeezing effect in the component V_i ($i = 1, 2$).

From the expression (7), the squeezing degrees S_i can read

$$S_1 = \frac{1}{4} [\langle a^2b^2 \rangle + \langle a^{+2}b^{+2} \rangle + 2\langle a^+ab^+b \rangle - (\langle ab \rangle + \langle a^+b^+ \rangle)^2], \quad (8)$$

$$S_2 = \frac{1}{4} [\langle a^2b^2 \rangle + \langle a^{+2}b^{+2} \rangle - 2\langle a^+ab^+b \rangle - (\langle ab \rangle - \langle a^+b^+ \rangle)^2]. \quad (9)$$

In order to get values of (8) and (9), according to (1), the below expressions are obtained

$$\begin{aligned} \langle a^2b^2 \rangle + \langle a^{+2}b^{+2} \rangle &= \frac{2r^4}{N^2} \{ \mu^2 \cos 4\varphi + \nu^2 + \mu\nu \exp(-3r^2 + r^2 \cos 2\varphi) \cdot \\ &[\cos(r^2 \sin 2\varphi - \phi) + \cos(r^2 \sin 2\varphi - \phi + 4\varphi)] \} \end{aligned} \quad (10)$$

$$\begin{aligned} \langle ab \rangle + \langle a^+b^+ \rangle &= \frac{2r^2}{N^2} \{ \mu^2 \cos 2\varphi - \nu^2 + \mu\nu \exp(-3r^2 + r^2 \cos 2\varphi) \cdot \\ &[\cos(r^2 \sin 2\varphi - \phi + 2\varphi) - \cos(r^2 \sin 2\varphi - \phi)] \} \end{aligned} \quad (11)$$

$$\begin{aligned} \langle ab \rangle - \langle a^+b^+ \rangle &= i \frac{2r^2}{N^2} \{ \mu^2 \sin 2\varphi + \mu\nu \exp(-3r^2 + r^2 \cos 2\varphi) \cdot \\ &[\sin(r^2 \sin 2\varphi - \phi) + \sin(r^2 \sin 2\varphi - \phi + 2\varphi)] \} \end{aligned} \quad (12)$$

$$\langle a^+ab^+b \rangle = \frac{r^4}{N^2} [\mu^2 - \nu^2 - 2\mu\nu \exp(-3r^2 + r^2 \cos 2\varphi) \cos(r^2 \sin 2\varphi - \phi + 2\varphi)] \quad (13)$$

After (10)-(13) are put into (8) and (9), the sum squeezing properties of entangle coherent state are investigated by means of numerical calculation technique. Under μ , ν and r given certain value, some of graphs are obtained, which show squeeze degree varying with parameter δ and ϕ .

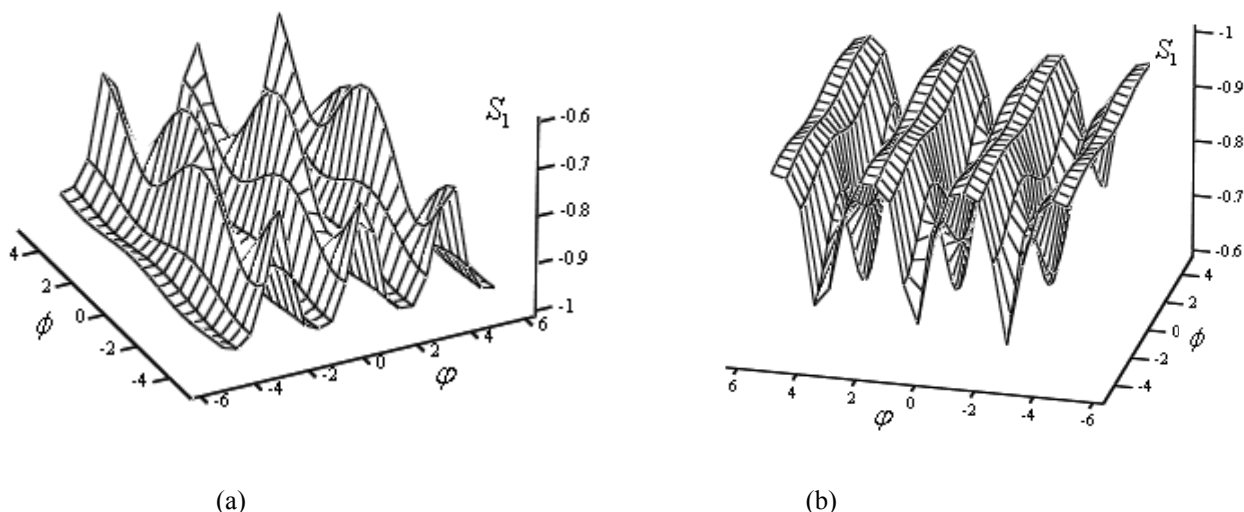


Figure 1. The sum squeezing degree S_1 vary with φ and ϕ when $\mu = 5$, $\nu = 20$, $r = 1$

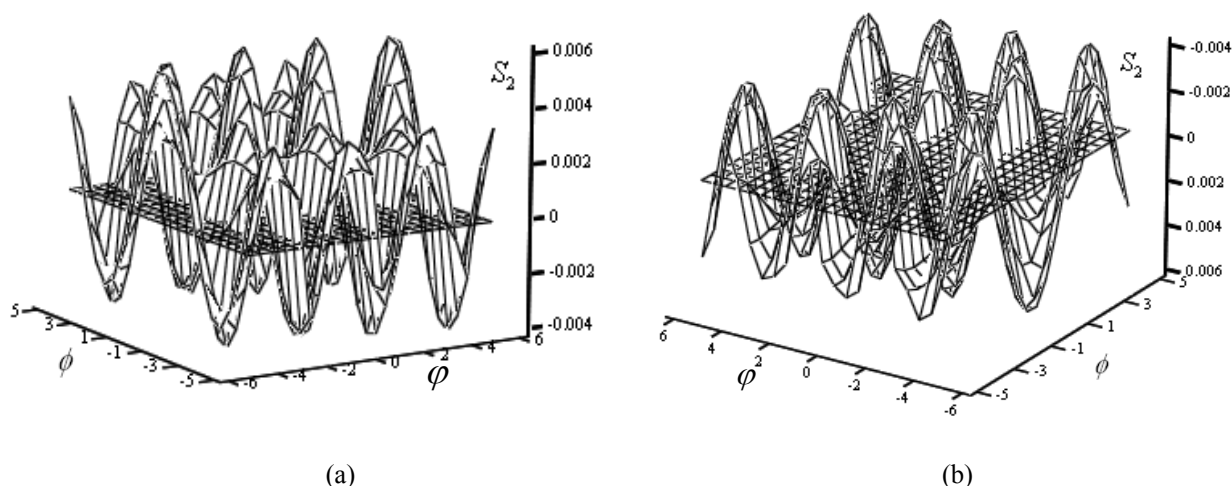


Figure 2. The sum squeezing degree S_2 vary with φ and ϕ when $\mu = 2$, $\nu = 30$, $r = 0.8$

In fig 1, sub-fig (a) and (b) display that S_1 varies with φ and ϕ under $\mu = 5$, $\nu = 20$ and $r = 1$ from different direction of S_1 respectively. They show that $S_1 < 0$ in all change range of φ and ϕ and that S_1 gets its minimum -0.95 at $\varphi = (2n+1)\pi/2$, hence there is squeezing effect in the component V_1 .

In fig 2, sub-fig (a) and (b) display that S_2 varies with φ and ϕ under $\mu = 2$, $\nu = 30$ and $r = 0.8$ from the direction of S_2 . They show that $S_2 < 0$ in some range of φ and ϕ , but squeezing effect is weak in the component V_2 . In addition, S_1 and S_2 vary with φ and ϕ periodically.

3. Difference squeezing of entangle coherent states

Other pair of normal hermite operator is defined

$$W_1 = \frac{a^+b + ab^+}{2}, \quad W_2 = \frac{a^+b - ab^+}{2}, \quad (14)$$

They satisfy with

$$[W_1, W_2] = i \frac{a^+a - b^+b}{2}, \quad (15)$$

$$\langle (\Delta W_1)^2 \rangle \cdot \langle (\Delta W_2)^2 \rangle > \frac{1}{4} | [W_1, W_2] |^2, \quad (16)$$

If the inequality is right

$$\langle (\Delta W_i)^2 \rangle \cdot \langle \frac{1}{2} | [W_1, W_2] | \rangle \quad (i=1,2) \quad (17)$$

then there is squeeze effect in optical field component W_i . With the view of description degree of squeeze, squeezed degree S_i is defined

$$S_i = \langle (\Delta W_1)^2 \rangle - \frac{1}{2} | [W_1, W_2] | \quad (i=1,3) \quad (18)$$

From the expression (17), the squeezing degrees S_i can read

$$S_3 = \frac{1}{4} [\langle a^{+2} b^2 \rangle + \langle a^2 b^{+2} \rangle + 2 \langle a^+ a b^+ b \rangle + 2 \langle b^+ b \rangle - (\langle a^+ b \rangle + \langle a b^+ \rangle)^2] \quad (19)$$

$$S_4 = \frac{1}{4} [\langle a^{+2} b^2 \rangle + \langle a^2 b^{+2} \rangle - 2 \langle a^+ a b^+ b \rangle - 2 \langle b^+ b \rangle - (\langle a^+ b \rangle - \langle a b^+ \rangle)^2] \quad (20)$$

In order to obtain value of (19) and (20), according to (1), the below expressions are got

$$\begin{aligned} \langle a^{+2} b^2 \rangle + \langle a^2 b^{+2} \rangle &= \frac{2r^4}{N^2} \{ \mu^2 + \nu^2 \cos 4\delta + \mu\nu \exp(-3r^2 + r^2 \cos 2\delta) \cdot \\ &[\cos(r^2 \sin 2\delta - \phi + 4\delta) + \cos(r^2 \sin 2\delta - \phi)] \} \end{aligned} \quad (21)$$

$$\langle b^+ b \rangle = \frac{r^2}{N^2} \{ \mu^2 + \nu^2 + 2\mu\nu \exp(-3r^2 + r^2 \cos 2\phi) \cos(r^2 \sin 2\delta - \phi) \} \quad (22)$$

$$\begin{aligned} \langle a^+ b \rangle + \langle a b^+ \rangle &= \frac{2r^2}{N^2} \{ \mu^2 - \nu^2 \cos 2\delta + \mu\nu \exp(-3r^2 + r^2 \cos 2\phi) \cdot \\ &[\cos(r^2 \sin 2\delta - \phi + 2\delta) - \cos(r^2 \sin 2\delta - \phi)] \} \end{aligned} \quad (23)$$

$$\begin{aligned} \langle a^+ b \rangle - \langle a b^+ \rangle &= \frac{i2r^2}{N^2} \{ \nu^2 \sin 2\delta - \mu\nu \exp(-3r^2 + r^2 \cos 2\phi) \cdot \\ &[\sin(r^2 \sin 2\delta - \phi) + \sin(r^2 \sin 2\delta - \phi + 2\delta)] \} \end{aligned} \quad (24)$$

After (13), (21)-(24) are put into (19) and (20), the difference squeezing properties of entangle coherent state are investigated by means of numerical calculation technique. Under μ , ν and r given certain value, some of graphs are obtained, which show squeeze degree varying with parameter δ and ϕ .

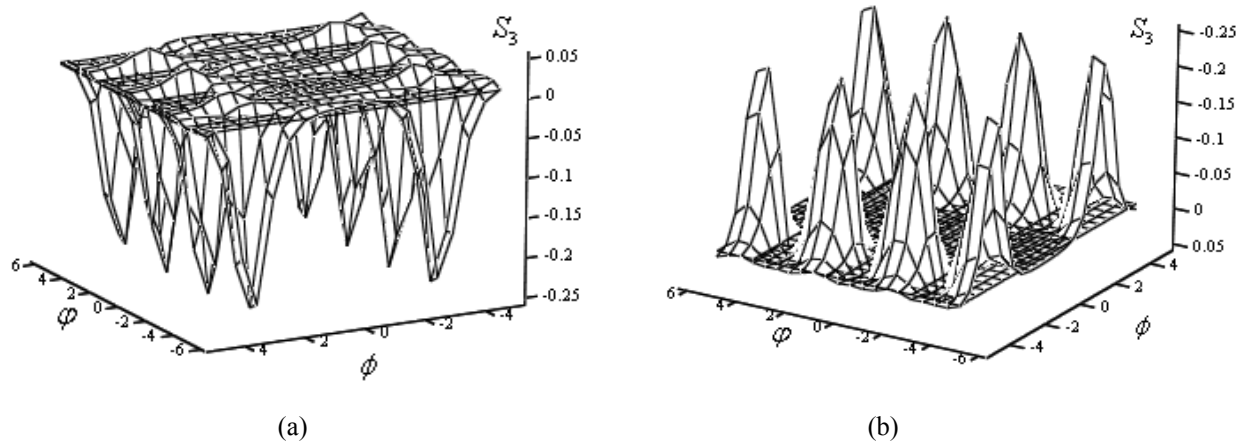


Figure 3. The sum squeezing degree S_3 vary with φ and ϕ when $\mu = 8$, $\nu = 8$, $r = 0.3$

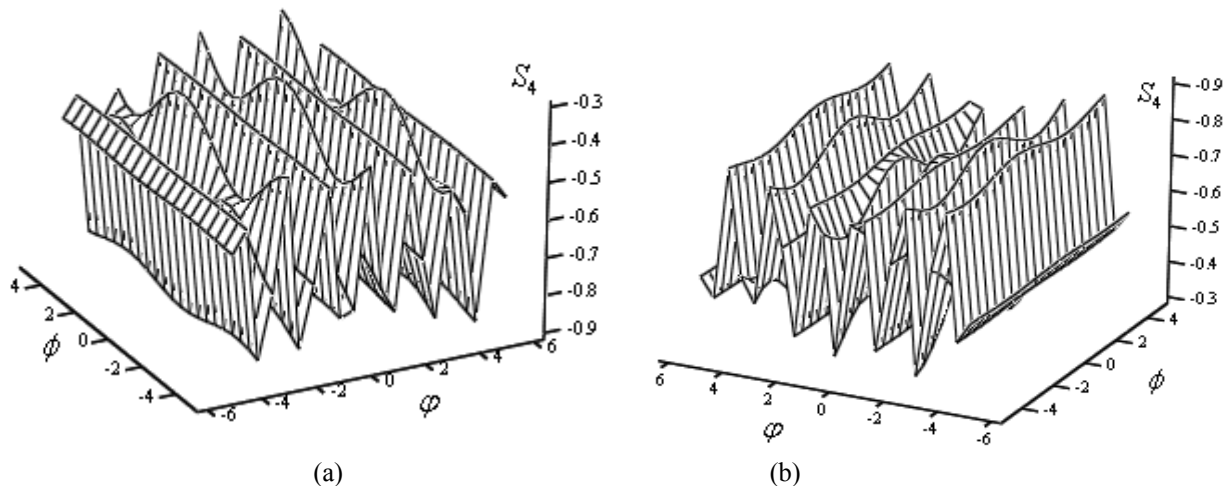


Figure 4. The sum squeezing degree S_4 vary with φ and ϕ when $\mu = 20$, $\nu = 30$, $r = 1.2$

In figure 3, sub-figure (a) and (b) display that S_3 varies with φ and ϕ under $\mu = 8$, $\nu = 8$ and $r = 0.3$ from different direction of S_3 , respectively. They show that $S_3 < 0$ in some change range of φ and ϕ , hence there is squeezing effect in the component W_1 . In fig 4, sub-figure (a) and (b) display that S_4 varies with φ and ϕ under $\mu = 20$, $\nu = 30$ and $r = 0.8$ from different direction of S_4 , respectively. They show that $S_4 < 0$ in all change range of φ and ϕ , therefore there is squeezing effect in the component W_2 . And meantime S_3 and S_4 vary with φ and ϕ periodically.

4. Conclusions

In the paper, a kind of entangle coherent states is introduced. According to the concepts of sum and difference operator introduced by Mark Hillery about two mode radiation field, by means of using numerical theology, non-classical properties of entangle coherent states are investigated. Results show that the entangle coherent states may appear sum and different squeezing effect under given conditions.

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Treatment Induced Germination Improvement in Medicinal Species of *Foeniculum vulgare* Miller and *Cuscuta epithymum*(L.) L

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Abstract

The purpose of this study was to investigate the effects of different treatments on seed germination in two medicinal species (*Foeniculum vulgare* and *Cuscuta epithymum*). Both species are known to have low seed germination. An experiment was performed with 9 treatments and 4 replications in a completely randomized design. Treatments included KNO₃ with concentrations of 0.1, 0.2 and 0.3 percent, immersion in boiling water for five and ten minutes, acetylsalicylic acid 50 and 100 mg L⁻¹ and prechilling for 10 days. Tap water was used as the control. Our findings indicate that 0.1 KNO₃ and 50 mg L⁻¹ acetylsalicylic acid were the most effective treatments for improvement of seed germination percentage in both species.

Keywords: Acetylsalicylic Acid, *Cuscuta epithymum*(L.) L, *Foeniculum vulgare* mill, Germination, KNO₃, Prechilling

1. Introduction

Germination is a critical stage in the life cycle of weeds, medicinal and crop plants, and often controls population dynamics, with major practical implications (Keller and Kollmann, 1999). Plant growth regulators such as GA (gibberellic acid) and IAA (indoleacetic acid) (Hilhorst and Karssen, 1992); chemicals such as KNO₃ (potassium nitrate) (Kevseroglu, 1993; Hartmann *et al.*, 1997) and hot water treatments (Hermansen *et al.*, 1999) have been recommended to break dormancy and enhance germination. The objectives of this study were to determine the effect of acetylsalicylic acid, boiling water and prechilling applied KNO₃ on germination in finding effective methods for improving seed germination characteristics of *Foeniculum vulgare* and *Cuscuta epithymum*. Medicinal plants have been widely used to treat a variety of infectious and non-infectious ailments. According to one estimate, 25% of the commonly used medicines contain compounds isolated from plants. Several plants could offer a rich reserve for drug discovery of infectious diseases (Muhammad *et al.*, 2008). Over 60% of the world's population, 80% in developing countries depends directly on plants for their medical purposes. Medicinal plants have been harvested from the wild since ancient times (Dhillon and Ampornpan, 2000; Dhillon *et al.*, 2002). *Cuscuta epithymum* is a parasitic plant assigned to the Cuscutaceae or Convolvulaceae families, depending the taxonomy. This kind of plants are red-pigmented, because are not photosynthetically active. Its leaves are very little, like flakes. It is a mild laxative. Traditional Western claims for *cuscuta* are that it is a mild diuretic, and that it can be used to treat sciatica and scurvy. Externally, it can be gathered fresh and applied to the skin to treat scrofula derma. They are associated with the liver and kidneys and are used in formulas that help both yin and yang deficiencies, depending on the patient's condition and the other herbs in the formula. *Foeniculum vulgare* has a thick, perennial root-stock, stout stems, 4 to 5 feet or more in height. *F.vulgare* not only improves digestion, but also can reduce bad breath and body odor that originates in the intestines. *F.vulgare* also acts as an excellent digestive aid to relieve abdominal cramps, gas and bloating. *F. vulgare* teas are useful for chronic coughs and act as an expectorant to help clear mucus from the lungs. Oil of *F. vulgare* relieves muscular or rheumatic pains and is warming and soothing in massage oil blends. Women may also benefit from the estrogenic properties of *F.vulgare* (Mozafarian, 1996).

(Keshtkar et al., 2009) Studied the Effect of prechilling and GA3 on seed germination of *Ferula assa-foetida* and *Prangos ferulacea* and reported In the case of *F. assa-foetida* the highest germination percentage (52%) was obtained when the seeds were treated with 250ppm GA-prechilling. For *P. ferulacea* seeds, the highest germination percentage (73%) was found when exposed to 1000ppm GA-prechilling. (Razmjoo et al., 2009) surveyed Breaking seed dormancy of *Prangos uloptera* DC., a medicinal plant of the Iran with Fifteen treatments using sulfuric acid, GA3, ethephon, IBA, ethanol, 2, 4-D, dry heat and chilling and results shown treatments that broke dormancy with the greatest degree of success were GA3 (2500 ppm, 48h) and sulfuric acid (98%, 30 sec) and to a lesser degree IBA (500 ppm, 50 sec) and ethephon (250 ppm, 48h) as well. Hilton (2006) reported that KNO3 treatment in dark situation had every weak influence on seed germination *Avena fatua* while KNO3 with concentrations of 0.2, 0.002 and 0.0002 percent, in light situation induce seed germination. (Nadjafi, et al., 2006) study to species of medical plant *Ferula gumossa* and *Teucrium poliu* concluded that using KNO3, H2-SO4 and gibberelin acid had a significant effect on seed dormancy breaking and germination of two species. (Pérez-Fernández et al., 2006) Seed germination in response to chemicals: effect of nitrogen and pH in the media that *F. vulgare* was on of the species. Their results showed that Nitrogenous compounds increased percent germination (level) and High pH negatively affected the germination rate of seeds from most species, but had no effect on the per cent germination of any of the species.

(Tavili et al., 2009) analyzed the effect of gibberellins acid and KNO3 on germination on *Salsola rigida* and reported that pretreatment with KNO3 0.2% had most influence on seed germination. According to low germination seeds of mentioned species, also considering their medical importance, in this study effect of various treatments on effect seed germination on *F. vulgare* and *C. epithymum* was investigate to find the most effective treatments. *F. vulgare* and *C. epithymum* are valuable medicinal species of rangeland ecosystems and are frequently used in Middle East countries, especially in Iran, for remedy of neurological and women related diseases, so these species are considered to be cultivated in field conditions. Since their seed germination is low therefore it is needed to study and find germination improvement procedures which could help producers to cultivate and harvest big masses of mentioned species with no barrier.

2. Materials and Methods

Seed samples of two medicinal species namely *F. vulgare* and *C. epithymum* were collected from rangelands of Tehran province in 2009. Initial germination test indicated that germination percentage was low in both species. Therefore we decided to test different treatments effects on seed germination of mentioned species. For this purpose, an experiment with a Factorial Randomized Complete Block Design was done. Germination test was conducted by four replications and 9 different treatments. Twenty five seeds for each treatment were put in 10 centimeters Petri dishes. The treatments included 1- pretreatment with KNO3 (0.1, 0.2 and 0.3 percent) for 48 hours 2- add acetylsalicylic acid to the moisture in the petri dish (50 and 100 mg L-1) 3- prechilling (4 degrees centigrade for 10 days) 4- immersion in Boiling water (for Five and Ten minutes) before sowing 5- Control treatment (irrigation with distilled water). To sterilize the seeds Carboxin Tiram was used. Germination percentage was recorded daily during the study period. Rate of germination was estimated using modified Timpson's index of germination velocity (Khan and Ungar, 1984). Mean Germination Time (MGT) was calculated to assess the rate of germination (Ellis and Roberts, 1981).

$$MGT = \frac{\sum D.N}{n}$$

Where N is the number of seeds which in D day grow, n the total number of seeds grown and D is the number of days from the date of germination and the germination rate index was obtained by reversing MGT at the end of this period, final germination percentage was recorded. There are no outliers, normality of data was checked and non-normal data transformed by arc sin to verification of this hypothesis Arc Sin transformation was used for germination percentage before analysis (Khan et al., 2006). Experimental data was analyzed by MSTAT-C program (MSTAT-C, 1990). The difference between the means was compared using Duncan's multiple range tests at %5 level of probability.

3. Results

The results showed that the properties of mean germination time and germination percentage of both species significantly different ($p < 0.05$) under different treatments (Table 1). As table1 interactions of treatment \times species shows germination rate was not significantly affected by interaction of treatment \times species. For this reason, species and treatment affects were survey separately. Germination rate of *C. epithymum* was higher than *F. vulgare* (figure4). Among understand treatments, the highest germination rate belongs to KNO3 (0.1%). As it has been represented in figure 3 mentioned treatment has a significant difference with control.

Germination percentage was significantly affected by different treatments (figure2). Using KNO₃ 0.1, 0.2 and 0.3 percent associated with acetylsalicylic acid 50 and 100 mg L⁻¹ resulted in increasing germination percentage in *F.vulgare* KNO₃ 0.3% affect was not significantly difference. Decrease of germination percentage occurred when seeds of *F.vulgare* were put under treatments of prechiling (for 10 days) and pretreatment with boiling water (for 5 min). Boiling water for 10 minutes of *F.vulgare* had no effect on germination percentage. The results from different treatments on *C.epithymum* seeds revealed that KNO₃ 0.1, 0.2 and 0.3 percent, acetylsalicylic acid 50 and 100 mg L⁻¹, prechiling for 10 days and boiling water for five minutes have had a positive affect on germination percentage of mentioned species while the effect of acetylsalicylic acid 100 mg L⁻¹, prechiling for 10 days and boiling water for 5 minutes was not significantly different. Boiling water for 10 min resulted in decrease of germination percentage in *C.epithymum* seeds.

Mean germination time in *F.vulgare* seeds decreased with using all of the treatment compared to control. Among the treatments, KNO₃ 0.1, 0.2 and 0.3 percent and boiling water 5 min significantly decreased mean germination time. Decrease of mean germination time happened when different treatments were applied except to KNO₃ 0.2% and boiling water. In comparison of mean germination time between control and applied treatments, it was resulted that mean germination times of *C.epithymum* decreased under effect all of the treatments. In separately survey this case, boiling water 10 min and KNO₃ 0.1%, prechiling and acetylsalicylic acid 50 and 100 mg L⁻¹ significantly decreased mean germination time. (figure1).

Figure 3 explains that KNO₃ (0.1%) and boiling water 10minutes had the most and least effect on germination rate of medicinal species respectively. Comparing germination rate of *F.vulgare* and *C.epithymum* (figure4) shows that *C.epithymum* contains higher germination rate (0.16 against 0.12).

4. Discussion and Conclusion

Based on obtained results, it was cleared that suitable treatment for germination properties improvement in two medicinal species were approximately similar. KNO₃ 0.1 and 0.2 percent in addition to acetylsalicylic acid 50 mg L⁻¹ were effective treatments for *F.vulgare* and KNO₃ 0.1, 0.3 percent and associated with acetylsalicylic acid 50 mg L⁻¹ were suitable treatments for *C.epithymum*. In both species, although there were no significant differences between KNO₃ (0.1%) and acetylsalicylic acid 50 mg L⁻¹ in view point of their influence on germination properties but KNO₃ (0.1%) results were better when compared to acetylsalicylic acid 50 mg L⁻¹. This result is like what some other researchers have found (Hilton, 1984) and (Nadjafi et al; 2006). (Pérez-Fernández et al., 2006) showed that Nitrogenous compounds increased percent germination of *F. vulgare* in response to chemicals. *Foeniculum vulgare* showed higher germination percentage compared with *C.epithymum*. This may be due to soft coat of *F.vulgare* existence of thin and soft coat in *F.vulgare* facilitates imbibitions and gas entrance and stimulates germination. ISTA (International Seed Testing Association) recommended KNO₃ 0.1 and 0.2 percent and for seed germination improvement. In current research it was revealed that KNO₃ (0.1%) suitable level for *F.vulgare* and *C.epithymum* germination improvement. Positive effect of KNO₃ could be due to its role on balancing hormonal portion within seed which in turn results germination inhibitors ratio like A.B.A. (Absciscic Acid), Derkan and Karssen (1993) believed that the reaction of seeds against KNO₃ is related to their sensitivity. Germination decreased in both medicinal species when boiling water (5 and 10min) was used. This might be because of destructive effect of boiling water on embryo. The results showed that boiling water 10min had negative effect compared to 5min. Destructive effect of boiling water depends on two properties: the temperature of water and the time length. In this research the temperature was the same (100° c) but times were different. The effect of acetylsalicylic acid on endogenous phytohormones levels has been mentioned by (Tompsett and Schwabe, 1974). Acetylsalicylic acid treatment could be recommended to enhance plant growth and productivity also to induce plant resistance against biotic and abiotic stresses as well (Raskin et al., 1995).

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Table 1. Variance effect analysis of treatments on measured characteristics of two medicinal species, *F. vulgare* and *C. epithymum*

| Source of Changes | Degrees of freedom | Mean Square of Germination percentage | Mean Square of Mean germination time | Mean Square of Germination rate |
|---------------------|--------------------|---------------------------------------|--------------------------------------|---------------------------------|
| replication | 3 | 144.406 | 1.533 | 0.001 |
| species | 1 | 1180.518** | 0.054** | 0.030** |
| treatment | 8 | 2569.692** | 30.722** | 0.021** |
| species × treatment | 8 | 418.447** | 12.904** | 0.003 ^{ns} |
| Test error | 51 | 46.745 | 2.074 | 0.001 |

*, ** and ns Significant level, refer to %0.1, %0.5 and no significant, respectively.

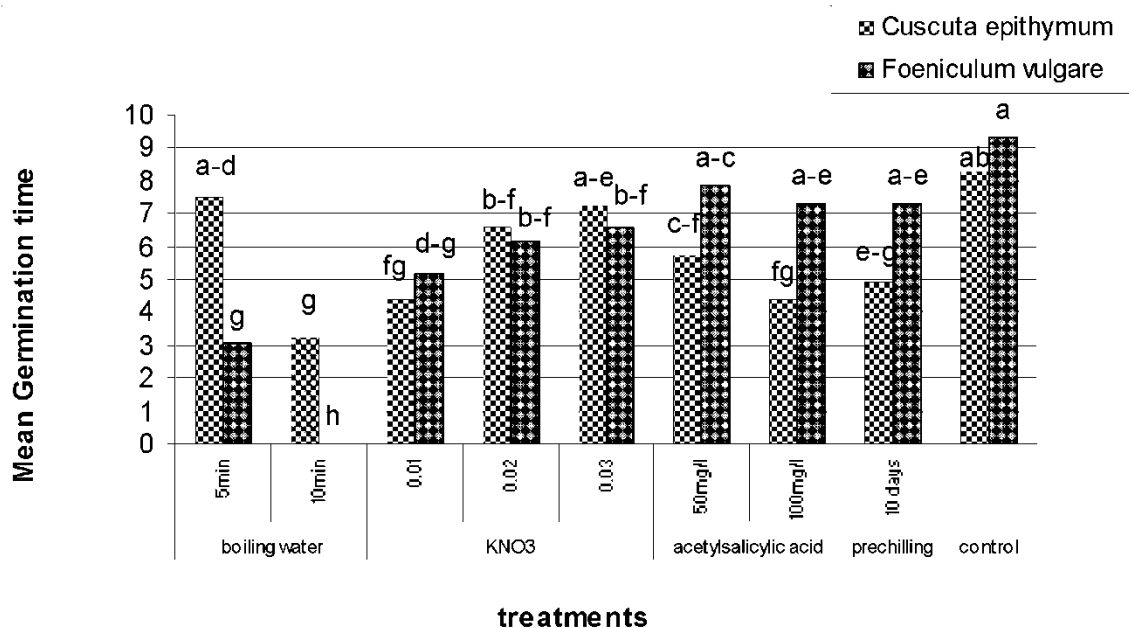


Figure 1. Comparison of mean germination time of *C. epithymum* and *F. vulgare* under effect various treatments

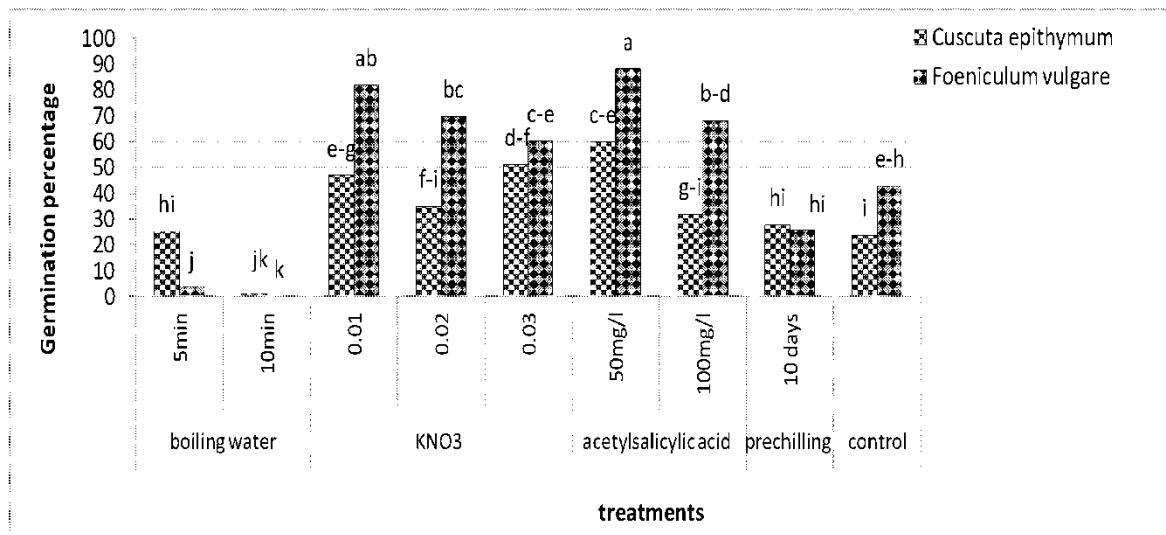


Figure 2. Comparison of average germination percentage of *C. epithymum* and *F. vulgare* under effect various treatments

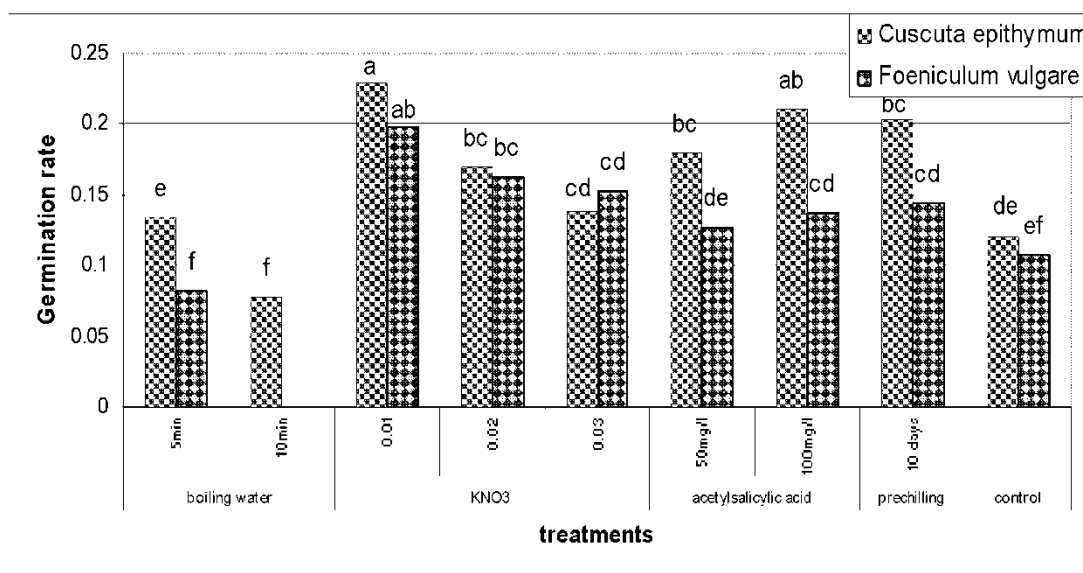


Figure 3. Comparison of germination rate of *C. epithymum* and *F. vulgare* under effect of various treatments

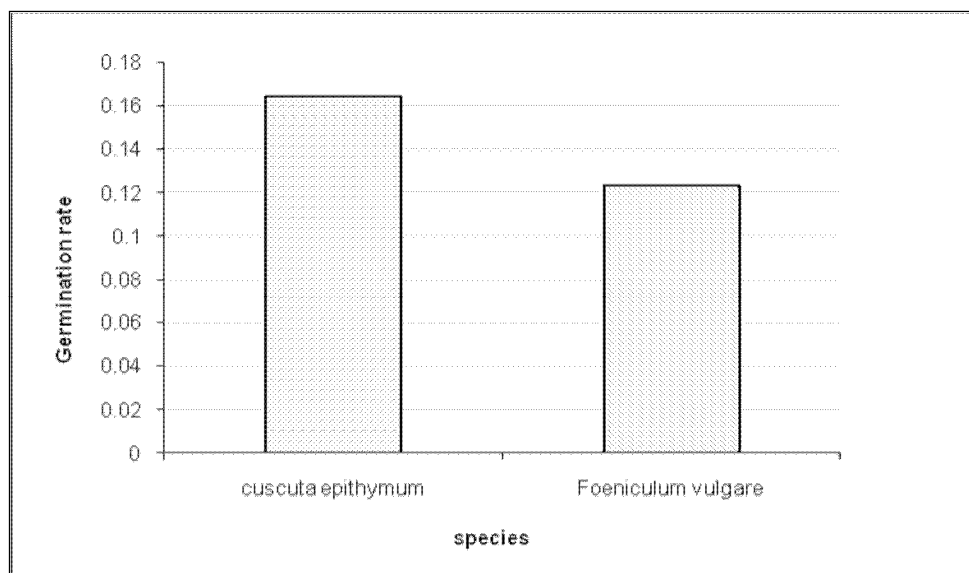


Figure 4. Comparison of average germination rate in two medicinal species *C. epithymum* and *F. vulgare*

The Weak Stable Sets for Fuzzy Cooperative Games

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Abstract

In this paper, by expanding the definition of dominance, we present the new concepts of weak core and weak stable set for fuzzy cooperative game, and study the properties of them.

Keywords: Fuzzy game, Weak dominance, Core, Weak stable set

1. Introduction

Since J.V. Neumann and O. Morgenstern introduced cooperative game in 1944 (Neumann and Morgenstern, 1944), cooperative game has received a generous concern from scholars and become a research focus in academia. Half a century has witnessed the formation of the mature theory of cooperative game. As an emerging branch of game theory, fuzzy game theory started with work of Aubin in 1974 (Aubin, 1974, pp. 891-984), where special attention is paid to the core concept. The purpose of this paper is to give the new notion of weak dominance and weak stable set for fuzzy cooperative game, and discuss the properties of them.

2. Basic definitions

Give a finite set $N = \{1, 2, \dots, n\}$ of players, a fuzzy coalition is a vector d in $[0, 1]^n$. The i -th coordinate d_i of d is called the participation level of player i in the fuzzy coalition d . Instead of $[0, 1]^n$, we also write F^N for the set of fuzzy coalitions. The fuzzy coalition $e^N = (1, 1, \dots, 1)$ is called the grand coalition, and the fuzzy coalition (the n -dimensional vector) $O = (0, 0, \dots, 0)$ corresponds to the empty crisp coalition. From now on we use the notation $K(d) = \{i \in N : d_i > 0\}$.

A fuzzy cooperative game with player set N is a function $v : F^N \rightarrow R$ with the property $v(O) = 0$, assigning to each fuzzy coalition the value achieved by cooperation. The set of fuzzy games with player set N will be denoted by FG^N .

Let $v \in FG^N$ and let $I(v)$ be the imputation set of v , i.e.

$$I(v) = \left\{ x \in R^n : \sum_{i \in N} x_i = v(e^N), x_i d_i \geq v(d|i), \forall d \in [0, 1]^n \right\}$$

Here $d|i = (0, 0, \dots, d_i, 0, \dots, 0)$.

The core of a fuzzy game v is the subset of imputations which are stable against any possible deviation by fuzzy coalitions (Tijs, Branzei & Ishihara, 285-296), i.e.

$$C(v) = \left\{ x \in R^N \mid \sum_{i \in N} x_i = v(e^N), \sum_{i \in N} d_i x_i \geq v(d), d \in F^N \right\}.$$

Now we give the new definitions.

Definition 1. Let v be a fuzzy game, $x, y \in I(v)$ and $d \in F^N$ ($d \neq 0$), we say x weakly dominates y through d , denoted $x \succ_d^w y$, if

$$(1) \sum_{i \in K(d)} d_i x_i > \sum_{i \in K(d)} d_i y_i;$$

$$(2) \sum_{i \in N} d_i x_i \leq v(d).$$

We simply say x weakly dominates y ($x \succ^w y$) if there exists a fuzzy coalition sequence d such that $x \succ_d^w y$. The negation of $x \succ^w y$ is denoted here by $\overline{x \succ^w y}$.

The difference of weak dominance and dominance is $\sum_{i \in K(d)} d_i x_i > \sum_{i \in K(d)} d_i y_i$ which weakens the condition $x_i > y_i$ for every $i \in K(d)$. Obviously, if $x \succ y$ then $x \succ^w y$, but the contrary is uncertain.

The weak dominance core of the fuzzy game v is the set of imputations which are not weakly dominated by any other imputation, i.e.

$$\overline{DC}(v) = \{x \in I(v) \mid \overline{y \succ^w x}, \forall y \in I(v)\}.$$

Definition 2. The weak stable set of a fuzzy game v is a nonempty set \overline{F} of imputations satisfying the properties:

(1)(Internal Stability) $\overline{x \succ^w y}$ for every $x, y \in \overline{F}$;

(2)(External Stability) For every $z \in I(v) \setminus \overline{F}$, there is an imputation $x \in \overline{F}$ such that $x \succ^w z$.

3. The weak stable sets for fuzzy games

Lemma Let v be a fuzzy game and $x, y \in I(v)$. We have $x \succ^w y$ if and only if there exists a coalition $d \in F^N$ and

$$\sum_{i \in N} d_i y_i < v(d). \quad (1)$$

Proof: It is obvious that if $x \succ^w y$ then we have $\sum_{i \in N} d_i y_i < v(d)$.

On the contrary hand, if $d \in F^N$ and $\sum_{i \in N} d_i y_i < v(d)$, then there exists ε such that $\sum_{i \in N} d_i y_i \leq v(d) - \varepsilon$, that is $\sum_{i \in N} d_i y_i + \varepsilon \leq v(d)$. Therefore, we have a coalition x such that $\sum_{i \in K(d)} d_i x_i > \sum_{i \in K(d)} d_i y_i$, where $x_i \geq y_i$. Hence, $x \succ_d^w y$.

Theorem 1. If v is a fuzzy game, then $\overline{DC}(v) \subset DC(v)$.

Proof: Let $\forall y \in \overline{DC}(v)$. If $y \notin DC(v)$, then there exist $d \in F^N$ and $x \in I(v)$ such that $\forall i \in K(d), x_i > y_i$ and $\sum_{i \in N} d_i x_i \leq v(d)$. So we have $\sum_{i \in K(d)} d_i x_i > \sum_{i \in K(d)} d_i y_i$, and $x \succ_d^w y$. This is a contradiction. Hence $y \in DC(v)$.

Theorem 2. Let $x \in I(v)$. $x \in \overline{DC}(v)$ if and only if for all $d \in F^N$ we have

$$\sum_{i \in N} d_i x_i \geq v(d). \quad (2)$$

Proof: If for all $d \in F^N$ we have $\sum_{i \in N} d_i x_i \geq v(d)$, then $x \in \overline{DC}(v)$. Otherwise there exist a coalition $d \in F^N$ and $y \in I(v)$ such that $y \succ_d^w x$. Hence we have $\sum_{i \in K(d)} d_i y_i > \sum_{i \in K(d)} d_i x_i$ and $\sum_{i \in N} d_i y_i \leq v(d)$, then $\sum_{i \in N} d_i x_i \leq v(d)$. This is contradict with (2).

If $x \in \overline{DC}(v)$, we have the fact all $d \in F^N$ satisfy (2). Otherwise, if $\sum_{i \in N} d_i x_i < v(d)$ for a coalition $d \in F^N$, then there is an imputation $y \in I(v)$ such that $y \succ_d^w x$. This also is a contradiction.

From Theorem 2 we obtain the following corollary.

Corollary The weak dominance core of a fuzzy game ν is the core of it, i.e.

$$\bar{DC}(\nu) = C(\nu).$$

Theorem 3. If ν is a fuzzy game, then for every weak stable set \bar{T} , $C(\nu) = \bar{DC}(\nu) \subset \bar{T}$.

Proof: Let \bar{T} be the stable set. Since $\bar{DC}(\nu)$ consists of undominated imputations and each imputation in $I(\nu) \setminus \bar{T}$ is dominated by some imputation by the external stability property, it follows that $\bar{DC}(\nu) \subset \bar{T}$.

Theorem 4. If the core $C(\nu) = \bar{DC}(\nu)$ is the weak stable set of a fuzzy game ν , then it is unique.

Proof: Suppose the core $C(\nu) = \bar{DC}(\nu)$ is the weak stable set of ν , and K is the other one. By Theorem 3 we can know $C(\nu) = \bar{DC}(\nu) \subset K$. It follows that $C(\nu) = \bar{DC}(\nu) = K$. Because $y \in K \setminus C(\nu)$ implies there exist $x \in K$ and $d \in F^N$ such that $x \succ_d^w y$. This is contradict with the internal property of K .

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Strength Behavior Study of Apples (cv. *Shafi Abadi* & *Golab Kohanz*) under Compression Loading

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Abstract

The mechanical properties data of fruits are important in the design of various handling, packing, storage and transportation systems. In this research some mechanical properties of two Iranian apple varieties (*Golab Kohanz* and *Shafi Abadi*) were analyzed in moisture contents 86% and 84% (W.b) for *Golab Kohanz* and *Shafi Abadi* varieties, respectively. Mechanical properties including rupture force and energy, deformation to rupture point, failure stress and strain, Young's modulus (initial tangent modulus, secant modulus, tangent modulus and chord modulus), toughness and hardness were studied under compression loading using standard methods and so firmness was determined by puncture test. Average values of rupture force and energy, failure stress, failure strain, deformation, toughness and hardness were determined, 57.81 N, 285.88 mJ, 0.37 MPa, 31.2%, 7.77 mm, 0.06 J/cm³, 9.14 N/mm for *Shafi Abadi* variety, respectively. The corresponding values for *Golab Kohanz* variety were obtained 51.11 N, 157.51 mJ, 0.32 MPa, 23.36%, 5.6 mm, 0.04 J/cm³ and 7.79 N/mm, respectively. Initial tangent modulus, secant modulus, tangent modulus and chord modulus were obtained 0.93, 1.76, 2.27 and 2.11 MPa for *Shafi Abadi* variety and 0.81, 1.52, 2.08 and 2.04 MPa for *Golab Kohanz* variety, respectively. The firmness obtained 59.26 N for *Shafi Abadi* variety and corresponding value was 47.69 N for *Golab Kohanz* variety, respectively. According to results *Shafi Abadi* variety had stiffer and resisterer issue to mechanical forces than *Golab Kohanz* variety.

Keywords: Mechanical properties, Elasticity modulus, Firmness, Rupture force, Rupture point

1. Introduction

The apple, with scientific name of *Malus domestica* is a pomaceous fruit from *Rosaceae* family. There are more than 7500 known cultivars of apples in world (Dobrzański *et al.*, 2006). Iran, with 190000 ha of cultivation area (2.8% of the world production area) is tertiary country of apple producer posterior China and USA countries in world. In spite of 2.66 million tons of annual Iranian apple production, exportation of that is very low (FAO, 2009). One of the most important export problems is quality decrease of fruits in postharvest operations such as handling, processing, grading and packaging. These mechanical treatments are eventually related to the external forces exerted on each apple fruit. Existence of the external forces makes mechanical damages in apple texture. Crushing and fracture caused by forces exerted on an apple fruit that increase the susceptibility to deterioration during storage can be analysed with knowledge of the mechanical properties such as failure stress and strain as well as modulus of elasticity under the static loading (Garcia *et al.*, 1995). Force deformation characteristics of fruits beyond the elastic limit may be important to simulate the destruction that occurs in bruising. Elastic modulus or Young's modulus is often used by engineers as an index of product firmness. Toughness and

hardness are other important attributes of fruits and often use for fruits quality assessment (Vursavuş *et al.*, 2003). Therefore the postharvest mechanical properties data of fruits are important in adoption and design of various handling, packaging, storage and transportation systems. The fruit compression test simulates the condition of static loading that fruit can withstand in mechanical handling and storage. Research has been carried out for several years to determine the resistance of fruits and vegetables to compression force. Witz, (1954) reported resistance to bruising of potatoes to puncture by using a plunger. Studies on bruises to apples resulting from dropping and from application of pressure were reported by Gaston and Levin, (1951). Braga *et al.* (1999) investigated force, specific deformation, and energy required for the initial rupturing of macadamia nut shell under compression as a function of moisture content, nut size, and compression loading position. Aydın, (2002) reported the several physical properties of hazelnut and kernels as a function of moisture content and found rupture force of nut and kernel decreased with an increase in moisture content. Similarly, Gezer *et al.*, (2002) evaluated some physical properties of *Hacihaliloglu* apricot pit and its kernel and found the applied force decreased with the increase of moisture content for apricot pit and its kernel. The maximum rupture force was found to be 656.2 N through length for pit and 118.80 N through width thickness for kernel. Kheiralipour *et al.* (2008) investigated some mechanical and nutritional properties of two varieties of apple in Iran. Ozturk *et al.* (2009) studied some chemical and physico-mechanical properties of pear cultivars (Deveci & Santa Maria). Therefore, in this research mechanical properties of two apple varieties (Golab Kohanz & Shafi Abadi) investigated for establishing convenient reference tables by using mechanical data for mechanization and processing in agricultural operations.

2. Materials and methods

2.1 Material

Two Iranian apple varieties (Golab Kohanz & Shafi Abadi) were prepared in 2009 summer season from an orchard located at the Horticultural Research Center, Agricultural Faculty, University of Tehran, Karaj, Iran. Golab Kohanz and Shafi Abadi are premature and middle maturing varieties, respectively. The experiments were carried out during the period of July–August in 2009. The fruits were harvested carefully by hand at their commercial maturity stage and transferred to the laboratory in plastic bags to reduce water loss during transport. The fruits were cleaned to remove all foreign matters such as dust, dirt and chaff as well as immature and damaged fruits. After removing from the cool store apples were kept during 24 h at 23 °C before testing. The analysis was carried out at a room temperature of 23°C. The initial moisture content of fruit was determined by using dry oven method at 77°C for 10 days (Kheiralipour *et al.*, 2008).

2.2 Methods

Experiments are divided in two parts: first part was compression test and other part was puncture test. The tests were performed by Universal Testing Machine (Santam, MRT-5). This machine has three main components, which are a stable forced and moving platform, a driving unit (AC electric motor, electronic variable and reduction unit) and a data acquisition (load cell, PC card and software) system.

2.2.1 Compression test

All mechanical properties of apples exception firmness were evaluated using 20 cylindrical specimens of each variety. Samples are taken in vertical and horizontal orientations with diameter as 14 mm and height as 24 mm (Fig. 4). Vertical orientation was along length (equivalent distance of the stem to the calyx) and horizontal orientation was in radial direction, tangent to the stem-calyx axis. The Universal Testing Machine was equipped with a load cell of 20 N and two parallel plates that one is fixed and the other is versatile that moves at a compressive rate of 25.4 mm/min (Fig. 1). The individual sample was loaded between two parallel plates of the machine and was compressed under the present conditions and the curve of force-deformation is simultaneously curved until the curve arrived to rupture point (A point in Fig. 2).

Failure stress and strain of apples are calculated by following equations (Vursavuş *et al.*, 2006):

$$\sigma_r = \frac{F_r}{A} \quad (1)$$

$$\varepsilon_r = \frac{D_r}{L_i} \times 100 \quad (2)$$

where: σ_r is rupture stress (MPa), ε_r is rupture strain (%), F_r is rupture force (N), A is cross section of sample (mm^2), D_r is deformation of sample to the failure point (mm) and L_i is specimen length of fruits (mm).

Modulus of elasticity is ratio of stress to corresponding strain below the proportional limit. For biological materials where the stress- strain relationship is curvilinear rather than linear,

One of the four following terms may be used (Fig. 3):

- 1) Initial tangent modulus (I.T.M): the slope of the stress- strain curve at the origin (OA slope).
- 2) Tangent modulus (T.M): the slope of the stress- strain curve at any specified stress or strain (CD slope)
- 3) Secant modulus (S.M): the slope of the secant drawn from the origin to any specified point on the stress- strain curve (OB slope).
- 4) Chord modulus (Ch.M): the slope of the chord drawn between any two specified points on the stress- strain curve (EF slope)

The specified point in calculation of secant modulus was 50% of rupture point and for chord modulus were 25% and 75% of rupture point (Kheiralipour *et al.*, 2008). The rupture energy (mJ) was calculated by the area under the force- deformation curve to the rupture point (A point in Fig. 2). The work required to cause rupture in the material can be approximated by the area under the stress- strain curve up to the point selected as the rupture point (J/mm^3) that was calculated by Eq. (3), (Gupta and Das, 2000):

$$P = \frac{E_r}{V} \quad (3)$$

Where: P is Toughness (J/mm^3), E_r is rupture energy (mJ) and V is sample volume (mm^3).

Hardness (Q) was calculated by dividing the rupture force (F_r) by the deformation to the rupture point (D_r), (Sirisomboon *et al.*, 2007):

$$Q = \frac{F_r}{D_r} \quad (4)$$

2.2.2 Puncture test

The Magness-Taylor firmness test was used to obtain apple firmness and was measured force required for indenter penetration to determined depth (Abbott *et al.*, 1976; Bourne, 1974). A cylindrical indenter, 11 mm in diameter, with a hemispherical tip was used in this experiment. Penetration speed was set 25.4 mm/min and test was stopped after penetration to 10 mm depth in equatorial line region of the whole apple. Penetration test on equatorial line of the whole apple was first carried out at two opposite points with skin (a and b in Fig. 4) and two opposite peeled points between two previous points (c and d in Fig. 4). The round tip of the plunger was pressed in to the apple to a marked depth (10 mm), and force- deformation curve was traced in the computer simultaneously. The penetration force was calculated to 10 mm depth by force- deformation curve and penetration energy was obtained by measurement of area under the force- deformation curve to 10 mm depth. Lastly, All data were subjected to statistical analysis using the analysis of variance (ANOVA) test, and means were compared using Duncan's multiple range tests at 5% level of significance.

3. Results and discussion

The mass and dimensional attributes of *Golab Kohanz* and *Shafi Abadi* varieties used in compression and puncture tests are shown in table 1. As seen in Table 1, the moisture contents were 86% and 84% (w.b.), for *Golab Kohanz* and *Shafi Abadi* varieties, respectively. Based on the results of Duncan's multiple range tests, the dimensions of the two apple varieties were significantly different ($p < 0.01$). These significant findings could be the result of the individual properties of apple varieties, and environmental and cultivation conditions. Initial moisture contents were 86% and 84% (w.b) for *Golab Kohanz* and *Shafi Abadi* varieties, respectively. Results of variance analysis about effect of variety and sample orientation on mechanical properties of two apple varieties were shown in Table 2. According to Table 2, effect of variety on rupture energy (E_r), rupture point (D_r), rupture strain (ϵ_r), toughness (P) and firmness was significant in 1% statistical level. The effect of variety on these five mechanical properties were shown in Figure 5 (A- E). Effect of sample orientation (with skin and without skin) and interaction effect of variety \times orientation sample on none mechanical properties were not significant. The mean and standard deviation values of obtained mechanical properties in compression test were shown in Table 3. As seen in Table 3, the values average of rupture force, rupture energy, deformation, rupture stress and strain obtained, 57.82 N, 285.88 mJ, 7.77 mm, 0.37 MPa and 31.2% for *Shafi Abadi* variety and corresponding values for *Golab Kohanz* variety obtained, 51.11 N, 157.51 mJ, 5.6 mm, 0.32 MPa and 23.36%, respectively. According to these results *Shafi Abadi* variety has stiffer issue than *Golab Kohanz* variety therefore durability of *Shafi Abadi* variety in relative to compression loading is more and placement height of *Shafi Abadi* variety in boxes is more than *Golab Kohanz* variety (Sitkei, 1986). In research of Kheiralipour *et al.*, (2008), the mean values of the failure stress and strain for the *Redspar* variety obtained 0.43 MPa and 20%, respectively, and corresponding

values for *Delbarstival* variety were 0.41 MPa and 15%, respectively. In comparison with results of Kheiralipour *et al.*, (2008) is specified texture of *Golab Kohanz* and *Shafi Abadi* varieties are softer than *Redspar* and *Delbarstival* varieties. Masoudi *et al.*, (2004), reported results for failure stress and strain relative to *Red Delicious* (0.39 MPa and 7%), *Golden Delicious* (0.42 MPa and 13%) and *Grani Smith* (0.44 MPa and 11%). The mean values of toughness and hardness for *Shafi Abadi* variety were 0.06 Jcm⁻³ and 9.14 N/mm, respectively, and for *Golab Kohanz* obtained 0.04 Jcm⁻³ and 7.79 N/mm, respectively. Apparent elasticity modulus in four technique, initial tangent modulus, secant modulus, tangent modulus and chord modulus obtained, 0.93, 1.76, 2.27 and 2.11 MPa for *Shafi Abadi* variety and 0.81, 1.52, 2.08 and 2.04 for *Golab Kohanz* variety, respectively. In total techniques, elasticity modulus of *Shafi Abadi* variety was obtained bigger than elasticity modulus of *Golab Kohanz* variety. These results too shown that *Shafi Abadi* variety texture is stiffer than *Golab Kohanz* variety texture. According to Table 4, affect of variety on firmness and penetration energy were significant in 1% statistically level ($P < 0.01$) and affect of with skin and skinless sample was not significant. The mean and standard deviation values of firmness and penetration energy were shown in Table 4. The average values firmness and penetration energy were obtained 59.26 N and 370.84 mJ for *Shafi abadi* variety and corresponding values for *Golab Kohanz* variety were obtained 47.69 N and 306.33 mJ, respectively. According to results, the firmness of *Golab Kohanz* was lower than *Shafi Abadi* variety therefore *Shafi Abadi* variety has more durability than *Golab Kohanz* variety. In compartion The force- deformation curves in puncture test was shown in Fig. 6. In this figure, A and B curves are related to *Golab kohanz* variety and C an D curves are related to *Shafi Abadi* variety. These results showed force required for penetration in *Golab Kohanz* texture is lower than *Shafi Abadi* variety (Fig 5E). For example in *Golab Kohanz* variety, the output from a whole apple (with skin) at constant strain rate primary presents a linear part with a maximum force (F_i). After this, the load falls to a lower level as the indenter moves through the tissue. The affect of friction on the side of the indenter may have been the primary cause of the slight rise in force for additional displacement. The first and largest peak (F_i) representing skin bursting occurs when the flesh elasticity limit is reached and then the flesh collapses. In skinless state primary the penetration force increased almost linear and reached to F_d , respectively, after that with increase displacement the force increase slowly. This is because the primary penetration force is more than force required for movement continuance. In spite of effect of with skin and skinless apples was not significantly on firmness but in with skin state, firmness was more than skinless state. This is because force addition for skin bursting. This results are not agree with those result that obtained by Shafiee *et al.* . (2008) that skin firmness was higher than flesh firmness. It's seem this difference is for difference between condition of growers and storage of apples.

4. Conclusions

This paper concludes with information on mechanical properties of *Golab Kohanz* and *Shafi abadi* varieties which may be useful in design a specific machine for harvesting and post harvesting operation. Therefore, the differences between the mechanical properties of apple varieties should be considered in optimizing apple mechanization and processing. It is recommended that other engineering properties be measured or calculated to prepare comprehensive information fairly in design parameters.

- Failure force and energy, young's modulus, failure stress and strain, toughness, hardness and firmness for *Shafi abadi* variety were bigger than *Golab Kohanz* variety.
- Effect of sample orientations (horizontal and vertical) on discussed mechanical properties was not significant for two varieties.

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Table 1. The mass and dimensional attributes of *Golab Kohanz* and *Shafi Abadi* varieties

| Properties | Number of observations | Shafi Abadi | | | Golab Kohanz | | | Significant level |
|-----------------------|------------------------|-------------|-------|--------------------------|--------------|-------|-------------------------|-------------------|
| | | Max | Min | Mean±SD | Max | Min | Mean±SD | |
| Moisture , %w.b | 3 | 84.7 | 83.5 | 83.9±0.7 ^b | 86 | 84.94 | 85.61±0.58 ^a | * |
| Fruit mass, (g) | 100 | 123.13 | 44.11 | 75.67±14.42 ^a | 97.33 | 46.61 | 64.22±13.2 ^b | * |
| Fruit length, (mm) | 100 | 62.77 | 43.05 | 53.09±3.86 ^a | 60.32 | 44.41 | 51.56±3.82 ^b | * |
| Fruit width, (mm) | 100 | 71.6 | 51.8 | 59.37±3.83 ^a | 64.28 | 48.85 | 54.86±3.83 ^b | * |
| Fruit thickness, (mm) | 100 | 67.6 | 46.36 | 57.02±3.97 ^a | 63.76 | 40.41 | 53.03±3.98 ^b | * |

*Corresponding to 1% significance level.

a and b: means followed by different letters are significantly different from others (P<0.05).

Table 2. Analysis of the variance of mechanical properties considered for *Golab Kohanz* and *Shafi Abadi* varieties

| Mean Squares | | | | | | | | | | | | | |
|------------------|----|----------------------|------------------------|--------------------|------------------------|----------------------|--------------------|---------------------|--------------------|--------------------|-----------------------|--------------------|---------------------|
| Variation source | DF | F _r | E _r | D _r | σ_r | ε_r | I.T.M | S.M | T.M | Ch.M | P | Q | Firmness |
| Treatment | 3 | 75.07 ^{ns} | 29702.79 ^{**} | 8.92 ^{**} | 0.002 ^{ns} | 109.12 ^{**} | 0.1 ^{ns} | 0.13 ^{ns} | 0.1 ^{ns} | 0.04 ^{ns} | 0.0015 ^{ns} | 5.28 ^{ns} | 211.36 [*] |
| A | 1 | 224.91 ^{ns} | 82387.22 [*] | 23.5 [*] | 0.008 ^{ns} | 311.41 [*] | 0.06 ^{ns} | 0.3 ^{ns} | 0.18 ^{ns} | 0.02 ^{ns} | 0.0042 [*] | 9.11 ^{ns} | 633.03 [*] |
| B | 1 | 0.15 ^{ns} | 4520.87 ^{ns} | 1.69 ^{ns} | 0.000045 ^{ns} | 8.24 ^{ns} | 0.07 ^{ns} | 0.008 ^{ns} | 0.02 ^{ns} | 0.02 ^{ns} | 0.00024 ^{ns} | 3.05 ^{ns} | 0.57 ^{ns} |
| A×B | 1 | 0.15 ^{ns} | 2200.27 ^{ns} | 1.59 ^{ns} | 0.000005 ^{ns} | 7.71 ^{ns} | 0.16 ^{ns} | 0.09 ^{ns} | 0.1 ^{ns} | 0.08 ^{ns} | 0.00012 ^{ns} | 3.68 ^{ns} | 0.49 ^{ns} |
| Error | 16 | 202.91 | 6827.1 | 2.3 | 0.008 | 39.66 | 0.08 | 0.11 | 0.19 | 0.22 | 0.0005 | 5.65 | 10.8 |

A: apple variety (Shafi Abadi and Golab Kohanz), B: sample orientation (horizontal and vertical orientation for compression test and with skin and skinless for puncture test)

ns: Corresponding to no significant difference

** Corresponding to confidence of interval, 95%

* Corresponding to confidence of interval, 99%

Table 3. The mean and standard deviation values of obtained mechanical properties in compression test.

| | Variety | | | | |
|--------------------------------|----------------------------|---------------------------|----------------------------|----------------------------|-------------------|
| | Shafi Abadi | | Golab Kohanz | | |
| Sample orientation | Vertical | Horizontal | Vertical | Horizontal | |
| Mechanical properties | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD | Significant level |
| Rupture force (N) | 58 ^a ±9.52 | 57.64 ^a ±14.36 | 51.11 ^a ±15.65 | 51.11 ^a ±16.42 | ns |
| Rupture energy (mJ) | 260.35 ^a ±95.41 | 311.4 ^a ±99.75 | 152.97 ^b ±57.47 | 162.06 ^b ±70.34 | * |
| Deformation (mm) | 7.19 ^a ±2.09 | 8.34 ^a ±1.39 | 5.59 ^b ±1.02 | 5.61 ^b ±1.34 | * |
| Rupture stress (MPa) | 0.37 ^a ±0.06 | 0.36 ^a ±0.09 | 0.33 ^a ±0.1 | 0.32 ^a ±0.1 | ns |
| Rupture strain (%) | 30 ^a ±8.74 | 32.52 ^a ±5.7 | 23.34 ^b ±4.25 | 23.39 ^b ±5.61 | * |
| I.T.M | 1.08 ^a ±0.2 | 0.84 ^a ±0.21 | 0.78 ^a ±0.42 | 0.77 ^a ±0.28 | ns |
| S.M | 1.85 ^a ±0.15 | 1.68 ^a ±0.34 | 1.47 ^a ±0.36 | 1.57 ^a ±0.4 | ns |
| T.M | 2.38 ^a ±0.31 | 2.16 ^a ±0.47 | 2.05 ^a ±0.46 | 2.11 ^a ±0.54 | ns |
| Ch.M | 2.2 ^a ±0.4 | 2.07 ^a ±0.47 | 2.01 ^a ±0.46 | 2.01 ^a ±0.55 | ns |
| Toughness (J/mm ³) | 0.064 ^a ±0.02 | 0.07 ^a ±0.02 | 0.04 ^b ±0.01 | 0.042 ^b ±0.01 | * |
| Hardness (N/mm) | 9.1 ^a ±2.58 | 9.18 ^a ±1.7 | 8.61 ^a ±2.41 | 6.97 ^a ±2.67 | ns |

*Corresponding to 1% significance level.

ns: Corresponding to no significant difference.

a and b: means followed by different letters are significantly different from others (P<0.05).

Table 4. The mean and standard deviation values of firmness in puncture test.

| Mechanical properties | variety | | | |
|-----------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| | Shafi Abadi | | Golab Kohanz | |
| | skin | skinless | skin | skinless |
| Firmness | Mean \pm SD | Mean \pm SD | Mean \pm SD | Mean \pm SD |
| | 59.28 ^a \pm 5.8 | 59.26 ^a \pm 2.1 | 48.34 ^b \pm 1.37 | 47.69 ^b \pm 1.77 |
| Penetration Energy | 382.13 ^a \pm 43.36 | 359.56 ^a \pm 34.45 | 316.84 ^b \pm 11.75 | 295.82 ^b \pm 13.62 |

a and b: means followed by different letters are significantly different from others ($P < 0.05$).

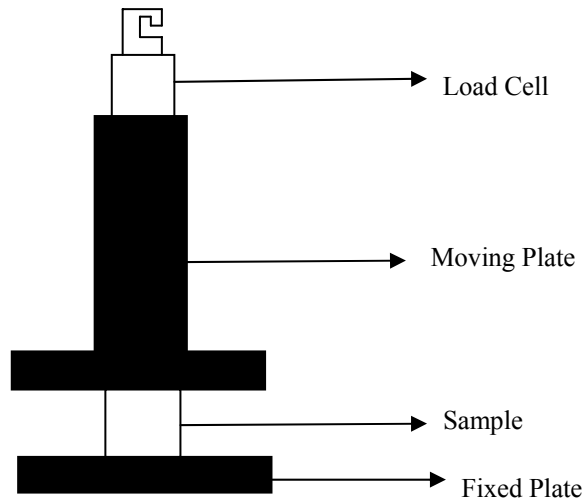


Figure 1. Universal Testing Machine.

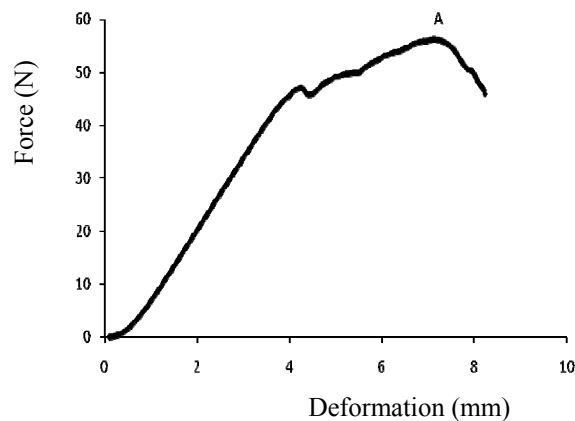


Figure 2. The curve of Force-Deformation in compression test (A is rupture point).

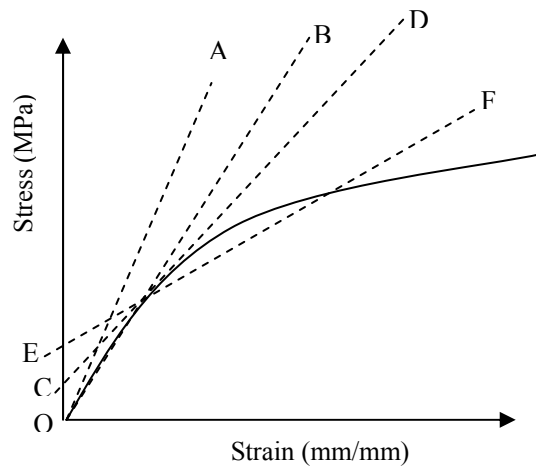


Figure 3. Methods for defining the modulus in non-linear stress-strain diagrams.

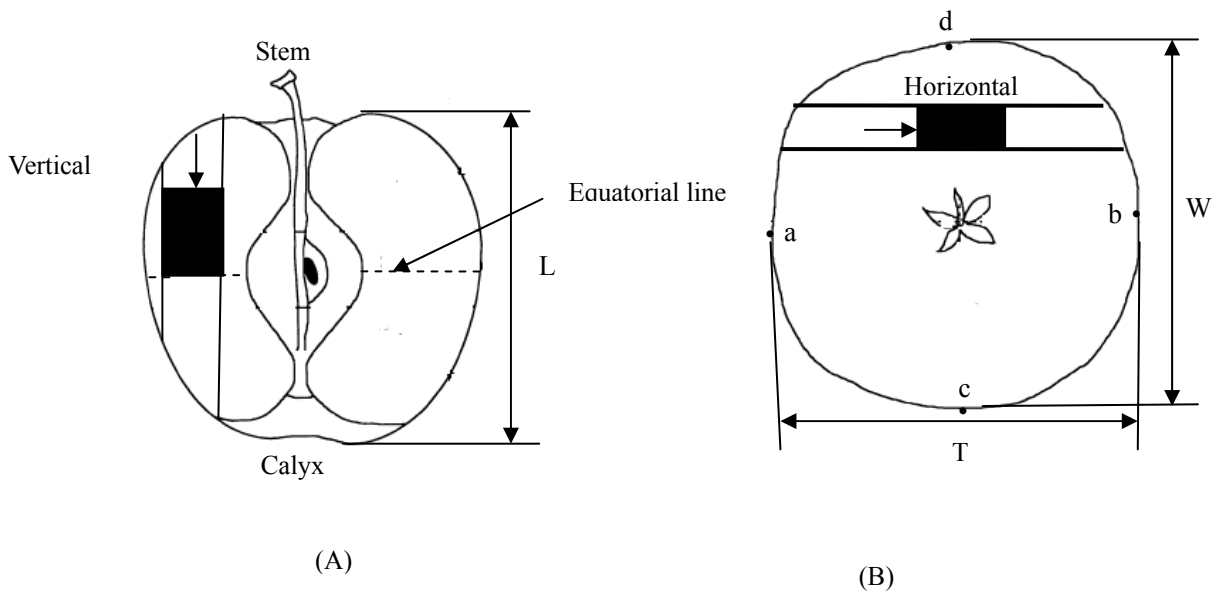


Figure 4. Sample orientations in two directions of vertical (A) and horizontal (B) vertical for compression test and the indenter penetration location on equatorial line of apple, a and b with skin, c and d skinless.

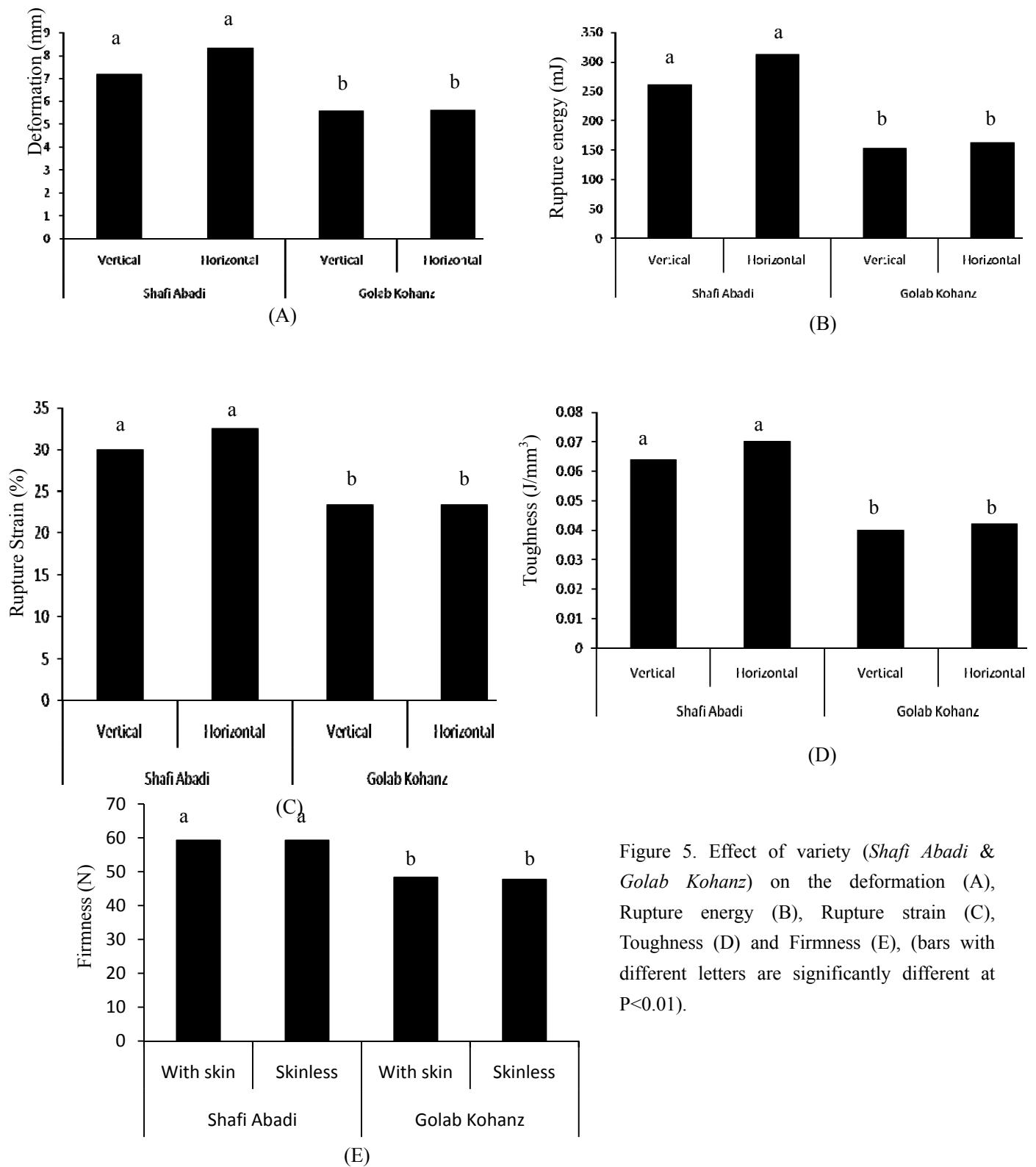


Figure 5. Effect of variety (*Shafi Abadi* & *Golab Kohanz*) on the deformation (A), Rupture energy (B), Rupture strain (C), Toughness (D) and Firmness (E), (bars with different letters are significantly different at $P < 0.01$).

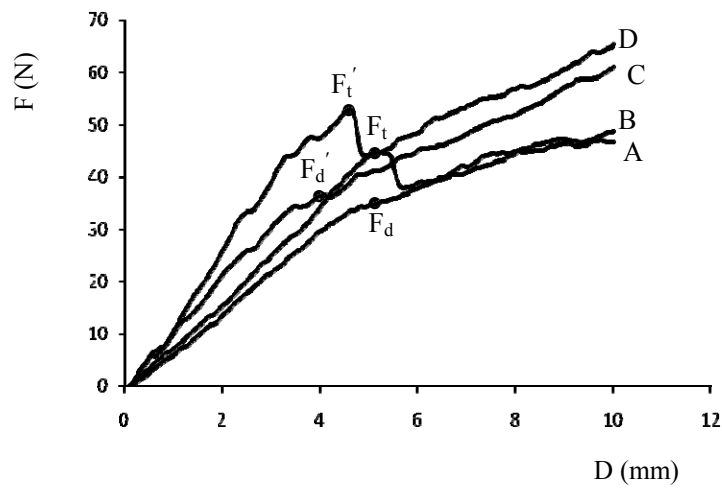


Figure 6. Force- deformation curve related to puncture test, (A) related to without skin and (B) related to with skin for Golab Kohanz variety and (C) related to without skin and (D) related to with skin for Shafi Abadi variety, F_t and F'_t are bursting skin forces, F_d and F'_d are Forces corresponding to the elasticity limit of the flesh.

Strategies to Prohibit Intruders Eluding the Detection of Snort through SSH

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Abstract

This paper introduces a method to avoid the detection of snort, a kind of Network Intrusion Detection System (NIDS) software, by using SSH. It also brings up a synthetic strategy, snort collaborating with Intrusion Detection System based on Host(HIDS), to detect this kind of intrusion.

Keywords: Snort, SSH, Intrusion detection, Encrypt

1. Snort Brief introduction

Snort is a cross-platform and lightweight network intrusion detection software. It is one kind of open source code software written by C Language, according to GPL(General Public License). The snort has three kinds of work modes: a Smell explore machine, a wrapping data register, a network intrusion detection system. Smell explore machine mode just reads the wrapping data from network and is successive to flow to the terminal. The wrapping data register mode with the smell explore machine mode grasp a pack, differently being a wrapping data to write to hard drive daily record. Network's intrusion detection mode is the most complicated, and can be installed. We can make the snort analytical network flowed data to match with some rules of a customer defined, and adopt certain action according to the detection.

Snort mainly detect suspicious discharge through a characteristic, logarithms according the head data of a wrapping data and suspicious clean lotus to match the mode and discover a behavior of intrusion detection from it, for example: Buffer overflows and stealth port scans and CGI attacks and SMB probes etc.. It still make use of a statistics packs abnormality detection engine (SPADE) mold to detect no the suspicious discharge of be able to match a characteristic, namely abnormality detection. The latest snort edition is 2.4.3. (Han, Dong-hai, Wang, Chao and Wang, Qun. 2002)

Snort can install at one pedestal machine to carry on surveillance to the whole ether net, through an order to hand over with each other. Snort can be divided into 5 main modules, its data process such as figure 1. Each module is very important to intrusion detection. The first is catch packing equip. It made use of the share characteristic of ether net, because the ether net usage Carrier Sense Multiple Access and Collision Detection (CSMA/CD) technique, adopt a commonly shared channel. Snort makes use of an exterior catching wrap procedure database libpcap (what to use is its Win32 edition winpcap in this text) to grasp a pack. After the original packing data is succeeded in catching, then being send to the second module-pack decoding machine. Decode machine to translate special agreement chemical element into the internal data structure of the snort system. After at the beginning catching pack to reach agreement code completion, the preprocessor handles discharge. Many Plug-in type preprocessors hand pack over to the next module: Examine engine after carry on check or operation. Examine engine match its rules in order to examine invades of each pack. The last module is a plug-in outputs. It produces an alert to the suspicious behavior. (Jack Koziol, and Wu Bo-feng et al. 2005)

2. SSH and its use

All of SSH Englishes calls to is Secure Shell, is IETF (Internet Engineering Task Force) drawn up a clan negotiate by Network Working Group, its purpose wants on the not-safe network to provide safe telnet and other safe network service. Through using SSH, you can carry on all datas for delivering to encrypt, so attack method in "agent" impossible realization, and can also prevent from DNS and IP beguilement. The attack method of so-called "agent" is "agent" and pretends to be a real server and receives the data that you pass a server, then

The F-SECURE supports 3 kinds of conjunctions of modes, the second is so-called SFTP. SFTP uses the SSH connect tunnel of 22 ports to deliver document, the whole process only have a port 22 work in the long range, with traditional FTP's needing active and passive ports to work compare, it is a different mode, so very safety and easily control.

After Linking the server for the first time, we need to accept the KEY document(Public Key) to save locally.After keeping the server public key, then inputting an user's name to carry on an identification.After attestation completes, we need to provide the client 's password of the long range host to make sure the identity of the client.If the password is correct, then we can get into SFTP mode.In this experiment, it delivers a malicious executable programe from customer's interface. In the whole process, Snort has never produced alert document. Open the log catalogue of Snort2.0, the recorded data delivers process as follows:

02/24-09:57:40.611775 172.18.25.108:1036 -> 172.18.25.110:22

TCP TTL:128 TOS:0x0 ID:193 IpLen:20 DgmLen:128 DF

```
***AP*** Seq: 0x580C45B5 Ack: 0x5BBB23D Win: 0x4470 TcpLen: 20
```

A6 DA 9A A3 20 C4 6F AD 37 21 A6 0C 48 22 46 62o.7!..H"Fb

33 0C C8 AE D0 D3 0C 59 3C 1C 83 DA D9 EC EB 72 3.....Y<.....r

DE DB A4 31 28 A7 21 75 1C 5D 1D 4B 41 83 26 6E ...l(!u.]KA.&n

9A D2 C4 1F 2B 7C ED 83 B5 7F 7F 08 C3 96 6A 9E+|.....j.

C4 91 A1 32 F3 3E 54 FB 7D EB C4 F7 43 E8 6F 79 ...2.>T.}...C.oy

67 73 2D 99 25 C1 76 7B gs-.%.V{

=====

02/24-09:57:40.612673 172.18.25.110:22 -> 172.18.25.108:1036

TCP TTL:128 TOS:0x0 ID:550 IpLen:20 DgmLen:136 DF

```
***AP*** Seq: 0x5BBB23D Ack: 0x580C460D Win: 0xFE27 TcpLen: 20
```

AC 55 64 F8 8E C0 79 50 EC 2E A9 45 52 83 B2 40 .Ud...yP...ER..@

05 26 62 A0 C4 79 D7 65 37 63 5F EE 6D A5 BC 1D .&b..y.e7c .m...

54 1C 4E F3 9C AF AA 3B B5 0F 5B F6 FA BD 74 AD T.N....;[...t.

CC B5 0C DC 0B 01 00 20 21 C5 83 4A F6 46 7E 55 !.J.F~U

```
89 F2 C5 5B F3 F9 82 61 E6 2B D9 10 B2 D0 45 1B ...[...a.+...E.
```

```
87 B5 EF 38 2E E5 B4 DB 42 90 F4 52 73 CE DB 74 ...8....B..Rs.t
```

=====

It is thus clear that Snort can only obtain disorderly code form of application layer data after encrypting, but it can not discover a real data. Even the client add malicious code this transmission, Snort then can not identifies them in time either, also can not make use of mode match method to detect the invasion.

4. Counterplans

Current Snort is use of sniffer capture form, mainly in the way of matching by the mode examination and analysis invade, but it can not handle and analytical wrapping data after encrypting.SSH can adopt 1024 bite RSAs to carry on a data operation, Snort basically can not break.If aggressor then slowly and soon scan and much change the shell code, and fragment overlap...etc. evades the knot of examination method handiness to put together, still can very easily evade a Snort examination.

However from above test we can see, the SSH application carries at the client -server mode. The customer carries if want to carry to carry on a safety and encrypt correspondence with server, have to acquire the identity attestation of the server carries. If oneself's machine up installed a SSH server, have to strictly work well each item to defend to invade measure, can not make the invader easily obtained SSH the applied legal power of service.

For canning in time examine a invade that make use of SSH, the following severals order is need to be noticed:

(1) Allocation reasonable fire wall

The fire wall contributes to protecting a computer, prevent unauthorized users access to computer access through the network or Internet.

In the Evade experiment above, if the host opened a installed perfect fire wall, client need a long time to get into an user's name verification, some time basically can not carry on a verification, so the good fire wall is the first barrier for a system safety.

(2) enabled antivirus software update

when a SSH's encrypted information attain a server, has to carries on decrypting with the private key of server, so all client original informations will pass by the system memory of the server host. Antivirus software enabled memory monitoring, vulnerability monitoring, file monitoring and other functions, to find the disease in a timely alarm. The memory supervision can supervise and control the running procedure of the computer, when discovers a virus running can obstruct it's running and clearance in time; The loophole attack supervision can intercept the attack which make use of system loophole in the computer ; The document supervision can supervise and control whether the document in the computer is been infected by the virus and keep virus from dissemination through the document.

(3) The software of SSH server carries use 22 as the default port, but this constitution can be changed and suggest that changing to a secret port is more safe, can lower several rates that the quilt invader makes use of.

(4) Intrusion detection system Snort according to the network and other intrusion detection system based on host add each other, Snort can as early as possible provide the warning of aiming at the attack, while the host part then can make sure whether the attack succeeds.

HIDS can completely control a customer's behavior

HIDS mainly through surveillance and analysis audit record and log document of host to examine invades. Log include not and usually on the system and proof of don't expect activity. These proof can point out that someone is invading or has already successfully invaded system. Through inspect a log document, can discover the attempt of invade or successfully invade, and very soon start correspond meet an emergency to respond to procedure. In addition, HIDS can monitor system, affairs, safe record on Windows NT and system record in UNIX environment, discover suspicious behavior from it. Many HIDSs still wiretap the activity of host port, and report to the managing person when the particular port is visited. (Luo Shou-shan. 2005)

HIDS can also supervise and control some activities of system very easily, such as to the access of the sensitive document, catalogue and procedure or the port. For example it can examine all circumstance of customer logging and withdraws, can also monitor the implementation of the non-normal behavior that usually a managing person only can carry out. Snorts basically could not monitor these activity, but HIDS can report invade in time. The most important one is, because of HIDS install at host which wanting to supervise and control, so still can collect information which in environment of SSH encrypted.

The HIDS main advantage includes:

(1) Be applicable to encrypt and exchange environment very much.

(2) Near solid of examination and should answer.

(3) Don't need additional hardware.

Snort and HIDS all have respectively of advantage, both add mutually. These two kinds of methods can discover the other party can not examine of some invade behavior. Snort carry on an detection through checking head of pack and payload, while HIDS doesn't look into the head of a pack. Many refused serve attack and fragment attack according to the IP, can only be identified through looking into the pack head that they deliver through a network. Snort can study the contents of load, check to seek order or phrasing to be used in the particular attack, such attacks can be quickly identified by Snort real-time checks packet sequences. And HIDS can not see a load, therefore can not also identify embedded load attacks. Unite an usage according to the host and according to network these two kinds of methods can attain better examination effect. For example HIDS uses the daily record of system as an examination basis, therefore they compare with Snort to have larger accuracy while making sure if the attack has already obtained success. In this aspect, HIDS is good to add to Snort, people completely could use Snort to provide to alert in early days, but used HIDS to verify if the attack obtains success. Big parts of bureau area nets in now intrusion detection system, is all way that adopted NIDS and HIDS cooperation, switch part deployment NIDS, at important server host deploy HIDS, protect the host safety. Such as figure 2.

Test verification, this detection system can availably detect invasion which made use of SSH.

5. Conclusion

In this paper, by analyzing Snort should not use the weakness to gain access to encrypted information to avoid the surveillance of the experiment, and for current network intrusion detection system to put forward what time reasonable suggestion. Although the malice invader can make use of the loophole of the NIDS software to evade its examination, However, we do a good job as long as stringent precautions, a adoption synthesizes examination means, all establish examination mold piece from network to hosts, can examine a malice to invade in time.

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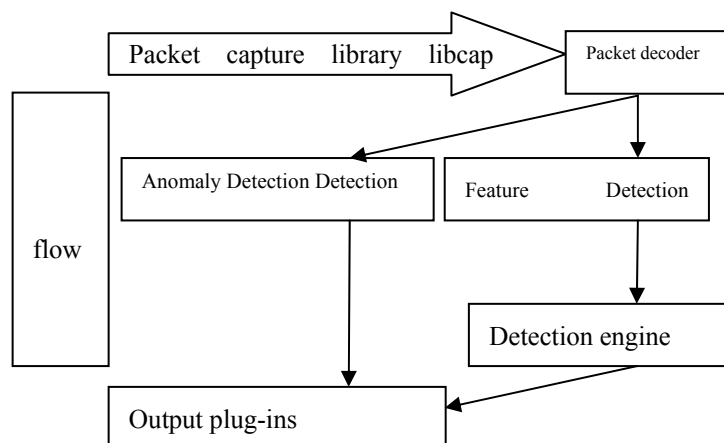


Figure 1. Snort data flow chart

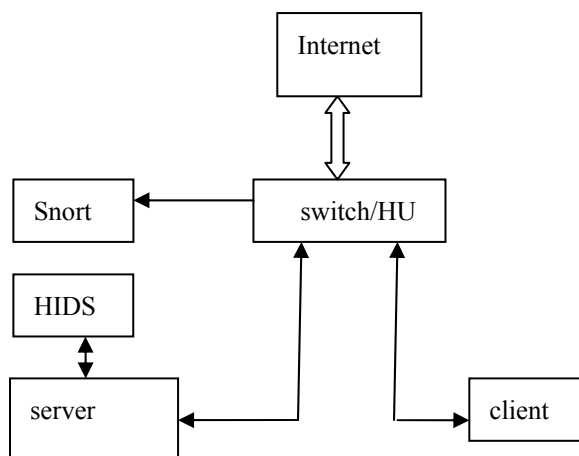


Figure 2. sketch plan of LAN intrusion detection system

Application of Constriction Factor Particle Swarm Optimization to Optimum Load Shedding in Power System

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Abstract

Load shedding is an important action during contingency situations in electrical power systems. This paper presents a new application of constriction factor particle swarm optimization (CPSO) technique for solving the steady state load shedding (SSLs) problem, due to capacity deficiency conditions caused by unscheduled outages in the bulk generation and transmission system. The problem is formulated to minimize the sum of curtailed load in contingency situations and restore the power system to its normal security and operation conditions. The feasibility of the proposed approach is demonstrated and compared with genetic algorithm (GA) in terms of solution quality and convergence properties over realistic test systems.

Keywords: Load shedding, Optimization, Particle swarm

1. Introduction

The phenomenal growth in load demand both in developing and developed countries has emerged as a potential challenge to the power system planners and operators. Projections show that the growth in load demand is always going to be ahead of the growth in generation. The main objective of an electrical power system is to supply its customers with an acceptable level of reliability, quality, continuity, and economy requirements. Sudden increase in system load demand and unexpected outage of a generator or other equipments are the main sources to cause emergency case in an electric power system which operates near its operating margins. During an emergency situation, control actions such as load management, re-adjustment of transformer taps, re-forwarding of generators are held to alleviate the violation of system security constraints. But, when these procedures are not effective enough to return system to its normal operating conditions, load curtailment is inevitable.

Various numerical optimization techniques have been proposed to solve load shedding problem. Specifically, there are Kuhn-Tucker method (L.P. Hajdu, J.Peschon, W.F.Tinney & D.S.Piercy. 1968), second-order gradient method (K.A.Palaniswamy & J.Sharma. 1979), linear programming (D.K.Subramanian. 1971)(S.M. Chan & E. Yip. 1979)(S.M. Chan and F.C. Schweppe. 1979)(M. Abdullah Khannand & K.Kuppuswamy. 1979), nonlinear optimization method (M.A.Mostafa, M.E.El-Hawary, G.A.Mbamalu, M.M. Mansour, K.M.El-Nagar & A.N.El-Arabaty. 1997), and artificial neural networks (Damir Novosel & Roger L.King. 1994). Among these methods, the linear programming method is one of the earliest and simplest approaches to address the load shedding problem. Due to nonlinear nature of power system problems, approximation is necessary for applying linear programming techniques which affect the accuracy of the solution. Nonlinear optimization techniques can be applied to any network configuration. If the problem is well-formulated these techniques can find the optimal solution accurately. However, for application in bulk power systems, they have been proved to be computationally very costly.

Nowadays, stochastic search algorithms are used to solve the combinatorial optimization problems in power system. The genetic algorithm (GA) is an optimization and search technique based on the principles of genetics and natural selection (Randy L. Haupt & Sue Ellen Haupt. 2004) and is a well-established technique applied to the problem of load shedding problem (Wael M.AL-Hasawi & Khaled M.EL.Naggar. 2002)(Luan, W.P. Irving & M.R. Daniel, J.S. 2002). In(A A.R.Malekpour & A.R.Seifi. 2009) authors applied a GA optimization method for

load shedding in distribution networks with distributed generation units considering capacity deficiency modeling of bulked power supply.

Particle swarm optimization (PSO), first introduced by Eberhart and Kennedy in 1995, is a form of stochastic search techniques in which the behavior of a biological social system is simulated. PSO has been compared to other stochastic methods and its shorter computation time and better convergence characteristic are addressed by many researchers (Kennedy J & Eberhart R. 1995)(Gaing ZL. 2003)(Yoshida H, Kawata K & Fukuyama Y.). It has been found that the PSO method quickly finds the high-quality optimal solution for many power system optimization problems (Amgad A. EL-Dib, Hosam K.M. Youssef, M.M. EL-Metwally & Z. Osman. 2006)(J. Olamaei, T. Niknam & G. Gharehpetian. 2008).

In (Manoj Kumar, Maharana & Shanti Swarup K. 2009), a PSO based generation rescheduling and load shedding to alleviate overloads of transmission lines is presented. In (Rad, B.F & Abedi, M. 2008), a meta-heuristic discrete model for steady state load shedding (SSLS) is addressed. In a bulk power system distribution feeders which are connected to a transmission bus are treated as an equivalent load in transmission system. Therefore, discrete modeling of connected and disconnected loads by 1 and 0 cannot effectively simulate load shedding in power system with diverse commercial, residential and industrial feeders and continuous modeling is needed for accurate simulation. Besides, maintaining original power factor of each transmission load bus after load shedding should be considered as an operation and security constraint.

Like other stochastic search methods, PSO may trap in a local minimum. If we do nothing to solve this tendency to converge quickly, we could end up in a local rather than a global minimum.

To overcome the mentioned problems and increase the performance of PSO in solving SSLS problem, we propose a new approach of the continuous constriction factor particle swarm optimization (CPSO) technique with considering continuous modeling of power system load and the original power factor of each transmission load bus after load shedding. However, the new stochastic search method, CPSO, has not been applied to steady state load shedding problem yet. The problem is formulated to minimize the sum of curtailed load in contingency situations (Parsopoulos KE, Plagianakos VP, Magoulas GD & Vrahatis MN. 2001). The penalty function approach (PFA) (Levitin, G. Kalyuzhny, A. Shenkman, A & Chertkov, M. 2000) is also addressed to reduce the number of infeasible solutions that appear in the subsequent iterations. The method is tested on the 6 bus, 3 generator case from Wood & Wollenberg (Allen. J. Wood & Bruce F. Wollenberg. 1996) and IEEE 14 bus system. The test results are compared with GA and accuracy, convergence and efficiency of the proposed method are validated.

2. Problem Formulation

SSLS problem can be formulated as an optimization problem with the following objective function and constraints:

2.1 Objective function

The objective function (OBF) of the load shedding problem is to minimize the sum of curtailed load during generation outage conditions. It can be expressed mathematically as:

$$\min f(t) = \sum_{i=1}^{N_{bus}} (\alpha_i \cdot \Delta P_{di}^2 + \beta_i \cdot \Delta Q_{di}^2) \quad (1)$$

Where α_i and β_i are the weight factors for curtailed active and reactive power load of the i th bus and N_{bus} is the number of buses in the transmission system. ΔP_{di} and ΔQ_{di} are the curtailed active and reactive power load of the i th transmission system.

2.2 Constraints

The constraints can be listed as follows:

- Power flow balance equations:

$$P_{gi} - P_{di0} - \Delta P_{di} - V_i \sum_{j=1}^N V_j Y_{ij} \cos(\delta_i - \delta_j - \theta_{ij}) = 0 \quad (2)$$

$$Q_{gi} - Q_{di0} - \Delta Q_{di} - V_i \sum_{j=1}^N V_j Y_{ij} \sin(\delta_i - \delta_j - \theta_{ij}) = 0 \quad (3)$$

P_{gi} and Q_{gi} are active and reactive power generations at the i th bus. P_{di0} and Q_{di0} are initial active and reactive power load of the i th bus. V 's and δ 's, are system bus voltages magnitudes and phase angles. Y_{ij} and θ_{ij} are bus

admittance matrix elements.

- Maintaining the original load power factor:

To maintain the original load power factor ΔQ_{di} is selected as:

$$\Delta Q_{di} = \Delta P_{di} \left(\frac{\Delta Q_{di0}}{\Delta P_{di0}} \right) \quad (4)$$

- Generators active and reactive power limits:

$$P_{gi}^{\min} \leq P_{gi} \leq P_{gi}^{\max} \quad i=1 \dots NG \quad (5)$$

$$Q_{gi}^{\min} \leq Q_{gi} \leq Q_{gi}^{\max} \quad i=1 \dots NG \quad (6)$$

- Voltage range limits:

$$V_i^{\min} \leq V_i \leq V_i^{\max} \quad i=1 \dots N_{bus} \quad (7)$$

- Line loading limits:

$$|\delta_i - \delta_j| \leq \varepsilon_{ij} \quad i=1 \dots N_{bus}-1, j=1 \dots N_{bus} \quad (8)$$

Where δ_i and δ_j are the voltage angles at bus i and bus j , and ε_{ij} is the maximum voltage phase angle difference between buses i and j .

3. CPSO Algorithm

The ingenious formulation of PSO by Eberhart and Kennedy in 1995 was an inspiration for the simulation of social behavior of animals, such as bird flocking or fish schooling in optimization problems. Like GA, PSO begins with generating an initial random population matrix of solutions. The population matrix is called swarm and each row of the matrix is assigned as particle. Unlike GA, PSO has no evolution operators such as crossover or mutation and naturally is a continuous algorithm. Although binary versions of PSO are introduced, there convergence is weak to find optimal solution and revisions are needed to demonstrate the concepts of PSO to discrete state space. As mentioned before, PSO starts with a random generation of swarm matrix. Next, it searches the optimal solution in the search space by updating the swarm generation. Due to the nature of the problem, in a multi dimensional search space, each particle is defined by X_{id} and V_{id} which are the position and velocity of i th particle in d th dimension.

The PSO algorithm updates the velocity vector for each particle and then adds that velocity to the particle position or values. Velocity of a particle influenced by both the best local position associated with the lowest cost ever found by the particle (p_{id}^{best}) and the best global position associated with the lowest cost in the present population by other particles (g_{id}^{best}). Each particle updates its velocity and position based on its local position, the local best position and global best position. The best local position (p_{id}^{best}) is updated if a new best local solution with lower cost is found in the iterative process. Also, If the new best local solution has a cost less than the cost of the current global solution, then the best local position replaces the best global position. Therefore, the new velocity and position of particles can be determined as follows:

$$v_{id}^{t+1} = K. [\omega.v_{id}^t + C1.rand1.(p_{id}^{best} - x_{id}^t) + C2.rand2.(g_{id}^{best} - x_{id}^t)] \quad (9)$$

$$K = \frac{2}{2 - \Phi - \sqrt{\Phi^2 - 4\Phi}} \quad \text{where } \Phi = c_1 + c_2 \text{ and } \Phi > 4 \quad (10)$$

$$x_{id}^{t+1} = x_{id}^t + v_{id}^{t+1} \quad (11)$$

Where t is iteration number and constants c_1 , c_2 are the weighting factors of the stochastic acceleration terms,

which pull each particle toward p_{id}^{best} and g_{id}^{best} positions. $c1$, $c2$ are often set to 2.05 according to early experiences (Kennedy J & Eberhart R. 1995)(R. Eberhart. & Yuhui Shi. 2001) and $rand1$, $rand2$ are the random numbers selected between 0 and 1. Suitable selection of inertia weight, w , in (12) provides a balance between global and local explorations, thus, requiring less iteration on average to find a sufficiently optimal solution (Y. Shi. & R. Eberhart. 1998). As originally developed, w often decreases linearly from about 0.9 to 0.4 during the running process. In general, the inertia weight w is set according to the following equation:

$$\omega^{t+1} = \omega^{\max} - \frac{\omega^{\max} - \omega^{\min}}{t^{\max}} \times t \quad i=1 \dots Nbus \quad (12)$$

In equation (12), t^{\max} is the maximum number of iterations and t is current iteration number. Fig.1 depicts the basic idea of velocity and position updating in particle swarm optimizer graphically. In order to avoid divergence of the algorithm, the speed of each particle is limited as follows:

$$-v_{id}^{\max} \leq v_{id} \leq v_{id}^{\max} \quad i=1 \dots Nbus \quad (13)$$

Stopping criterion is defined if maximum iteration is achieved or maximum difference between best particle fitness function for specified number of generations is lower than a specified tolerance.

$$|f(g_t^{best}) - f(g_{t-q}^{best})| \leq \epsilon \quad i=1 \dots Nbus \quad (14)$$

Where ϵ is 10^{-5} and q is the specified number of generations.

4. Application of CPSO in the Proposed SSLS

In this section, the CPSO algorithm has been applied to the SSLS problem.

4.1 Initialization

Each particle of the swarm matrix is a real string indicates the amount of active power load shed from each transmission bus. The length of each particle is equal to the number of load buses in transmission system. Because each particle in the swarm matrix is a candidate solution, the initial swarm is generated randomly based on (15) to achieve a feasible solution.

$$\Delta P_{di}^{initial} = P_{di}^{\min} + rand.(P_{di}^{\max} - P_{di}^{\min}) \quad i=1 \dots Nbus \quad (15)$$

Where $\Delta P_{di}^{initial}$ is the initial active power load shed from i th particle in d th load bus. The initial reactive power load shed from i th particle in d th load bus is also generated based on (4).

The velocity of the particle indicates the change in the current position of the particle to its future position. Based on (13), the initial velocity of each particle is generated randomly. p_{id}^{best} and g_{id}^{best} are initialized with the current position of i th particle and the network data including network configuration, line impedances are read.

4.2 Fitness function calculation and constraint enforcement

Equality constraints are satisfying by the convergence of optimal power flow and inequality constraints are enforced by using penalty function approach (PFA) as below (Levitin, G. Kalyuzhny, A. Shenkman, A & Chertkov, M. 2000):

$$h(x_i) = \begin{cases} (x_i - x_i^{\max})^2 & \text{if } x_i > x_i^{\max} \\ (x_i - x_i^{\min})^2 & \text{if } x_i < x_i^{\min} \\ 0 & \text{if } x_i^{\min} \leq x_i \leq x_i^{\max} \end{cases} \quad i=1 \dots Nbus \quad (16)$$

Where $h(x_i)$ is a penalty function of a variable x_i and x_i^{\min} and x_i^{\max} are the lower and upper bounds of x_i . Thus, equation (1) is changed to generalized multi objective functions as below:

$$\min Ft = \sum_{i=1}^{Nbus} (\alpha_i \cdot \Delta P_{di}^2 + \beta_i \cdot \Delta Q_{di}^2) - ht(x_i) \quad i=1 \dots Nbus \quad (17)$$

Where $ht(x_i)$ is transmission system penalty factor.

The fitness of each particle is calculated by (17) and the new and best position of each particle and best position of this generation is found. So p_{id}^{best} and g_{id}^{best} are to be modified if better solutions have been explored.

4.3 Generating new population and particle movement

Based on equations (9) to (13) the velocity and position of each particle is updated and each particle is moved toward its new position. The procedure of sections 4.2 and 4.3 is repeated until the stopping criterion is satisfied. The last g_{id}^{best} is the solution of the problem.

5. Results and Discussion

In order to show the abilities of proposed algorithm, the 6 bus Wood & Wollenberg and IEEE 14 bus systems are studied. The optimization models are solved using well-known evolutionary method, GA, and CPSO. The parameters of lines and loads are presented in (M.A.Mostafa, M.E.El-Hawary, G.A.Mbamalu, M.M. Mansour, K.M.El-Nagar & A.N.El-Arabaty. 1997) and the CPSO algorithm parameters are $c1 = c2 = 2.05$, $\omega^{min} = 0.4$ and $\omega^{max} = 0.9$ and the number of particles are 20. The best solution determined by 50 times running of the algorithm.

The contingency was simulated by disconnecting generator of bus 2 which leads to high unbalancing between power generated and load demand. To highlight the superiority of the proposed CPSO approach, simulation results have been compared with GA. Both algorithms use the same fitness function. The load shedding results are tabulated in Tables 1 and 2 for both test systems and both optimization methods. The total GA based load shedding is 26.9 MW (12.47%) for the 6 bus Wood & Wollenberg test system and 9.0305 MW (3.51%) for the IEEE 14 bus system while the total CPSO based load shedding is 26.0827 MW (12.42%) for the 6 bus Wood & Wollenberg test system and 2.8907 MW (1.12%) for the IEEE 14 bus system. It is clear that the CPSO method has the advantage of shedding fewer loads than GA in abnormal conditions for both systems.

Tables 3, 4 and 5 show the comparison of the active and reactive power generations and system losses under mentioned contingency condition for the 6 bus Wood & Wollenberg test system and IEEE 14 bus system.

Owing to the randomness in these methods, the algorithms are executed 50 times when applied to the test system. The best, worst and average objective functions found by these methods are tabulated in Table 6. These results show that the optimal SSLS solutions determined by the CPSO lead to load shedding less than that found by other methods, which confirms that the CPSO is well capable of determining the global or near-global optimum solution. Moreover, CPSO shows good consistency by keeping the difference between the best and worst solutions.

Figures 2 and 3 show convergence characteristic of SSLS problem for the 6 bus Wood & Wollenberg test system and IEEE 14 bus system by GA and CPSO. As it can be seen, these methods have rapid convergence characteristic. However, because the GA brings premature convergence, its total operating cost is larger than PSO. The quality of the solution, the convergence speed and simulation results show that PSO outperforms GA.

6. Conclusion

In this paper, an attempt was made to solve nonlinear optimization problem of SSLS. The steady state load shedding problem was formulated and constriction factor particle swarm optimization (CPSO) technique was used to solve it. The proposed technique was tested using the 6 bus Wood & Wollenberg test system and IEEE 14 bus system and compared with GA method. The simulation results obviously display a satisfactory performance by CPSO in comparison to GA, with respect to both the quality of its evolved solutions and the computational requirements.

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Table 1. Load demand after SSLS by GA and CPSO in 6 bus Wood & Wollenberg test system

| Bus | Original load demand | | Load demand after SSLS by GA | | Load demand after SSLS by CPSO | |
|-----|----------------------|------|---------------------------------|--------|-----------------------------------|---------|
| | MW | Mvar | MW | Mvar | MW | Mvar |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 70 | 70 | 66.101 | 66.101 | 65.8791 | 65.8791 |
| 5 | 70 | 70 | 62.661 | 62.661 | 63.1398 | 63.1398 |
| 6 | 70 | 70 | 55.048 | 55.048 | 54.8984 | 54.8984 |

Table 2. Load demand after SSLS by GA and CPSO in IEEE 14 bus system

| Bus | Original load demand | | Load demand after SSLS by GA | | Load demand after SSLS by CPSO | |
|-----|----------------------|------|---------------------------------|---------|-----------------------------------|--------|
| | MW | Mvar | MW | Mvar | MW | Mvar |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 21.7 | 12.7 | 21.162 | 12.385 | 21.7 | 12.7 |
| 3 | 94.2 | 19.0 | 93.773 | 18.914 | 94.2 | 19 |
| 4 | 47.8 | -3.9 | 46.205 | -3.7699 | 47.8 | -3.9 |
| 5 | 7.6 | 1.6 | 6.5127 | 1.3711 | 7.6 | 1.6 |
| 6 | 11.2 | 7.5 | 10.513 | 7.0398 | 11.2 | 7.5 |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | 29.5 | 16.6 | 28.616 | 16.102 | 29.5 | 16.6 |
| 10 | 9.0 | 5.8 | 8.0747 | 5.2037 | 6.8453 | 4.4114 |
| 11 | 3.5 | 1.8 | 1.6405 | 0.84371 | 3.5 | 1.8 |
| 12 | 6.1 | 1.6 | 5.4086 | 1.4187 | 6.1 | 1.6 |
| 13 | 13.5 | 5.8 | 12.863 | 5.5265 | 10.964 | 4.7105 |
| 14 | 13.1 | 8.5 | 13.401 | 4.4971 | 14.9 | 5 |

Table 3. Power generation after SSLS by GA and CPSO in 6 bus Wood & Wollenberg test system

| Bus | Original power generation | | Power generation after SSLS by GA | | Power generation after SSLS by CPSO | |
|-----|---------------------------|------|--------------------------------------|--------|--|----------|
| | MW | Mvar | MW | Mvar | MW | Mvar |
| 1 | 107.9 | 16 | 92.089 | 52.92 | 91.86538 | 53.04982 |
| 2 | 50 | 74.4 | 0 | 0 | 0 | 0 |
| 3 | 60 | 89.6 | 98.413 | 99.987 | 98.75387 | 99.99909 |

Table 4. Power generation after SSLS by GA and CPSO in IEEE 14 bus system

| Bus | Original power generation | | Power generation after SSLS by GA | | Power generation after SSLS by CPSO | |
|-----|---------------------------|---------|-----------------------------------|----------|-------------------------------------|----------|
| | MW | Mvar | MW | Mvar | MW | Mvar |
| 1 | 194.3301 | 0 | 186.8132 | 10 | 186.8342 | 10 |
| 2 | 36.7192 | 23.6854 | 0 | 0 | 0 | 0 |
| 3 | 28.7429 | 24.1268 | 45.46868 | 30.89491 | 46.95906 | 31.51659 |
| 6 | 0 | 11.5459 | 2.210085 | 6.713896 | 4.266875 | 7.363999 |
| 8 | 8.4950 | 8.2730 | 20.82598 | 6.495298 | 23.39818 | 6.793911 |

Table 5. System losses after SSLS by GA and CPSO in 6 bus Wood & Wollenberg test system and IEEE 14 bus systems

| Test system | System losses after SSLS by GA | System losses after SSLS by PSO |
|-------------|--------------------------------|---------------------------------|
| | MW | MW |
| 6 bus | 6.692 | 6.7019 |
| 14 bus | 15.4605 | 16.9507 |

Table 6. Best, worst and average objective functions for GA and CPSO methods

| Optimization Method | objective functions for 6 bus Wood & Wollenberg test system | | | objective functions for IEEE 14 bus system | | |
|---------------------|---|--------|----------|--|-------|----------|
| | Best | Worst | Average | Best | Worst | Average |
| GA | 585.24 | 771.34 | 695.0457 | 15.16 | 99.86 | 47.88059 |
| CPSO | 584.2069 | 728.54 | 660.8489 | 14.188 | 91.26 | 44.11444 |

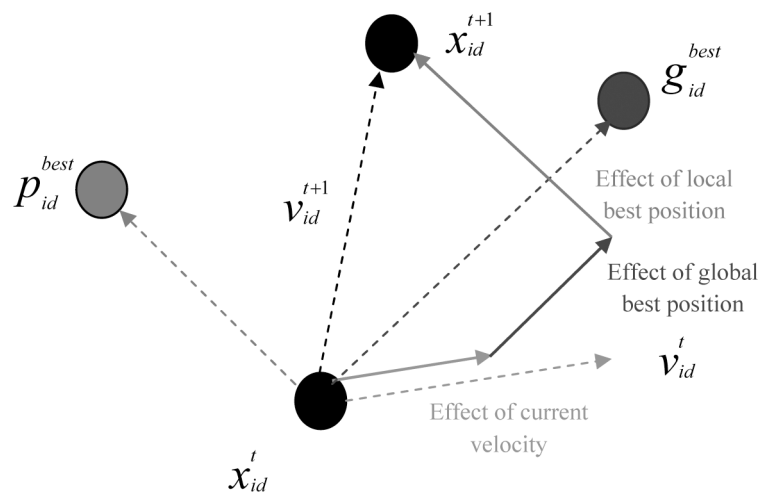


Figure 1. Modified velocity of each particle regarding to the personal initial velocity, the distance from personal best position and the distance from global best position.

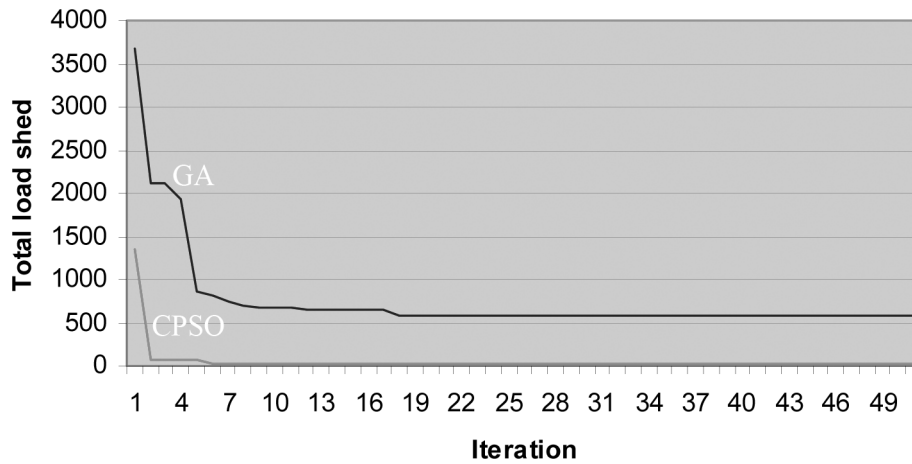


Figure 2. Convergence characteristic and solution quality of GA and CPSO method for 6 bus Wood & Wollenberg test system

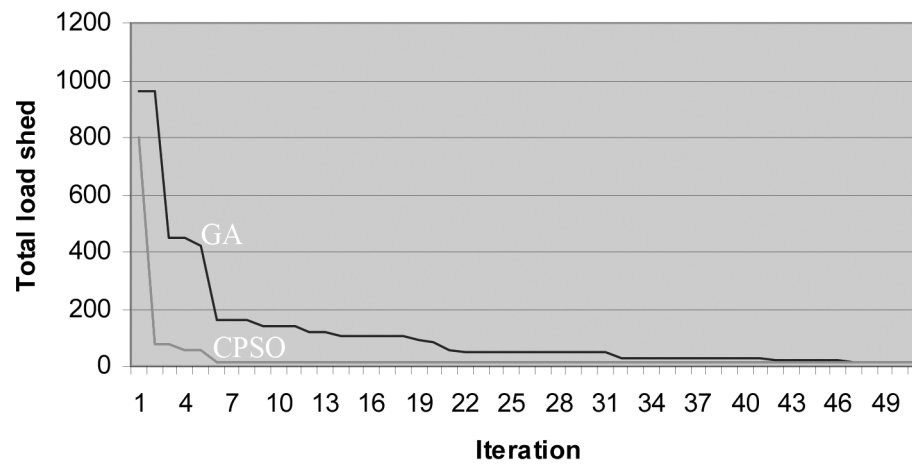


Figure 3. Convergence characteristic and solution quality of GA and CPSO method for IEEE 14 bus test system

An Integrated Inventory Model for Vendor and Buyer

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Abstract

An integrated inventory model for vendor and buyer is presented in this paper. Based on the integrated expected total relevant costs of both buyer and vendor, we obtain the optimal values of reorder point, order quantity, and number of shipments. Numerical example shows the model is effective, and it is also used to analyze the savings in joint total cost over individually derived policies.

Keywords: Inventory, Vendor, Buyer

1. Introduction

With the increased competition in today's global markets, companies are forced to closely work in partnership with their customers and suppliers. More and more individual businesses work together as a supply chain and no longer compete as solely independent entities (Min H et al.2002, Lambert DM et al.2000). With the growing focus on supply chain management, many companies are recognizing that inventories across the entire supply chain can be more efficiently managed through better coordination of the supply chain. The coordination of the supply chain is very important, otherwise if no such coordination exists, the vendor and the buyer will act independently to minimize their costs. If each stage of the supply chain only optimizes its local objective without considering the impact on the complete chain, lack of coordination results that total supply chain profits are less than what could be achieved through coordination (Stadtler H 2005, Goetschalckx M et al.2002). Each stage of the supply chain, in trying to optimize its local objective, takes actions that end up hurting the performance of the entire supply chain. A manager can use lot size-based quantity discounts, buyback contracts or quantity flexibility contracts and etc to achieve coordination.

This paper considers a supply chain consisting of one vendor and one buyer. The buyer orders lots to the vendor. The vendor produces the requested product in lots and ships each lot to the buyer in batches. In traditional inventory systems, the optimal ordering and shipment policies for vendor and buyer are managed independently. As a result, the lot size of purchaser may not result in an optimal policy for the vendor and vice versa. To overcome this disadvantage, researchers have studied the integrated inventory model of vendor and buyer, where the joint total relevant cost for the purchaser as well as the vendor has been optimized. On the other hand, it will be more effective to determine the ordering and shipment policies based on their integrated total cost function, rather than using the buyer's or the supplier's individual cost functions. The integrated inventory problem has received a lot of attention in recent years as it is one of the building blocks for the wider supply chain (Ben-Daya M et al.2008, Goyal Sk 1977, Hill RM 1999).

Although large number of researches extending different dimensions of the problems, however most of them are limited to deterministic conditions. In recent years, increasing attention is given to the development of non-deterministic integrated inventory models. In this paper, we develop an integrated inventory system consisting of a single vendor and single buyer, where the lot from the vendor is transferred to the buyer in equal-sized batches. The supply lead-time between vendor and buyer is considered to be stochastic. Moreover, the model is extended to the situation in which shortage is allowed.

This paper is organized as follows. In section 2, the notations and assumptions are introduced. In section 3, independent optimization models of buyer and vendor are given. Section 4 presents the integrated model and an algorithm is developed to find the optimal solution of the integrated model. A numerical example is showed in section 5.

2. Notations and Assumptions

2.1 notations

Q : buyer's order quantity;

D : demand per unit time;

h_v : inventory holding cost for the vendor per unit per unit time;

h_b : inventory holding cost for the buyer per unit per unit time;

r : buyer's reorder point;

A_1 : buyer's ordering cost;

A_2 : vendor's setup cost;

s : shortage cost for the buyer per unit per time;

n : number of shipments;

L : lead-time to replenish the buyer's order.

T : buyer's cycle time;

2.2 Assumptions

The demand rate is deterministic and constant. The supply chain is consisted of one vendor and one buyer. The vendor's production rate is infinite. The buyer orders a lot of size Q when the inventory reaches the reorder point r . Inventory is continuously reviewed. Shortages are allowed and completely backordered. Lead time to replenish the buyer's order is stochastic and follows a uniform distribution with parameters a and b .

3. Independent Optimization Models

When the vendor and buyer don't choose to cooperate, we give the buyer's and the vendor's optimal models and its solution respectively. Then we present the integrated inventory model and compare the independent optimal policies and the integrated policy.

3.1 buyer's optimization model

In order to get the optimal ordering policy of the buyer, we need to obtain the buyer expected total cost per unit time $C_b(r, Q)$. We assume that the orders do not cross in time and the order quantity received by the buyer is equal to or greater than the maximum demand during lead time. The lead time is assumed to be uniformly distributed, then

$$L \square U[a, b], \quad f(l) = \frac{1}{b-a}, \quad a \leq l \leq b.$$

During an order cycle, the buyer expected total cost is calculated by multiplying the inventory carried and shortages incurred during each cycle time and taking the expectation over the relevant limits for the lead time. then we obtain the expected total cost per unit time, dividing these costs by the length of the buyer order cycle, Q/D . When $r \leq Db$, there will be any shortages. But shortages will not occur if $r > Db$.

Thus, we obtain the following expected total cost per time for $r \leq Db$:

$$\begin{aligned} C_{b1}(r, Q) &= \frac{DA_1}{Q} + \frac{Dh_b}{Q} \int_a^{\frac{r}{D}} (r - \frac{Dl}{2}) \frac{l}{b-a} dl + \frac{rh_b}{Q} \int_a^b (Q - Dl) \frac{1}{b-a} dl \\ &\quad + \frac{h_b}{2Q} \int_a^b (Q - Dl)^2 \frac{1}{b-a} dl + \frac{r^2 h_b}{2Q} \int_{\frac{r}{D}}^b \frac{1}{b-a} dl + \frac{s}{2Q} \int_{\frac{r}{D}}^b (Dl - r)^2 \frac{1}{b-a} dl \\ &= \frac{DA_1}{Q} + h_b r + \frac{h_b(2r^3 - 3rD^2a^2 + D^3a^3)}{6DQ(b-a)} - \frac{h_b r D(b+a)}{2Q} + \frac{h_b(Q - Db - Da)}{2} \\ &\quad + \frac{h_b D^2(b^2 + ab + a^2)}{6Q} + \frac{h_b r^2(Db - r)}{2DQ(b-a)} + \frac{s(Db - r)^3}{6DQ(b-a)} \end{aligned}$$

We obtain the following expected total cost per time for $r > Db$:

$$\begin{aligned} C_{b2}(r, Q) &= \frac{DA_1}{Q} + \frac{Dh_b}{Q} \int_a^{\frac{r}{D}} (r - \frac{Dl}{2}) \frac{l}{b-a} dl + \frac{rh_b}{Q} \int_a^b (Q - Dl) \frac{1}{b-a} dl + \frac{h_b}{2Q} \int_a^b (Q - Dl)^2 \frac{1}{b-a} dl \\ &= \frac{DA_1}{Q} + h_b r - \frac{h_b D(b+a)}{2} + \frac{h_b Q}{2} \end{aligned}$$

Thus, the buyer expected total cost per time unit is

$$C_b(r, Q) = \min\{C_{b1}(r, Q), C_{b2}(r, Q)\}.$$

Theorem $C_{b1}(r, Q), C_{b2}(r, Q)$ are convex.

Proof for the case $r \leq Db$, we obtain the Hessian matrixes H of $C_{b1}(r, Q)$ as follows

$$H = \begin{pmatrix} \frac{(h_b + s)(Db - r)}{DQ(b - a)} & \frac{6D^2 A_1(b - a) + (h_b + s)(Db - r)^3}{3DQ^3(b - a)} \\ \frac{6D^2 A_1(b - a) + (h_b + s)(Db - r)^3}{3DQ^3(b - a)} & \frac{(h_b + s)(Db - r)^2}{2DQ^2(b - a)} \end{pmatrix}$$

Hessian determinants can be obtained as follows $|H_1| \geq 0, |H| \geq 0$.

Therefore the Hessian matrix is positive and $C_{b1}(r, Q)$ is convex. By the same method, we prove $C_{b2}(r, Q)$ is also convex.

The proof is completed.

Since the buyer expected total cost per time unit is convex, the local optimum solution is global optimum solution. Therefore we use a numerical procedure to find the optimal values of the nonlinear programming problems.

3.2 vendor's optimization model

When the purchaser order quantity Q is adopted, the orders are received by the vendor at intervals T . Then the vendor expected total cost per time is

$$C_v(n) = \frac{DA_2}{nQ} + \frac{(n-1)Qh_v}{2}$$

We can easily prove the is convex and obtain the following optimality conditions on n^*

$$n^*(n^* - 1) \leq \frac{2DA_2}{h_v Q} \leq n^*(n^* + 1)$$

When the vendor and buyer are free to choose their own ordering policy $n, (r, Q)$, the individually derived expected total cost $TC(Q, r, n) = C_b(r, Q) + C_v(n)$ is equal to the summation of buyer's and vendor's sub-optimal expected costs.

4. Integrated Vendor-Buyer Optimization Model

Suppose that the vendor and buyer decide to cooperate and follow the jointly optimal policy. Then the joint expected total cost of the buyer and the vendor per time unit for $r \leq Db$ is

$$JC_1(Q, r, n) = \frac{D(nA_1 + A_2)}{nQ} + \frac{Q(h_b + (n-1)h_v)}{2} + h_b r + \frac{h_b(2r^3 - 3rD^2a^2 + D^3a^3)}{6DQ(b-a)} \\ - \frac{h_b D(b+a)(r+Q)}{2Q} + \frac{h_b D^2(b^2 + ab + a^2)}{6Q} + \frac{h_b r^2(Db-r)}{2DQ(b-a)} + \frac{s(Db-r)^3}{6DQ(b-a)}.$$

We obtain the following expressions for $r > Db$:

$$JC_2(Q, r, n) = \frac{D(nA_1 + A_2)}{nQ} + \frac{Q(h_b + (n-1)h_v)}{2} + h_b r - \frac{h_b D(b+a)}{2}.$$

Then we can obtain the joint expected total cost per time

$$JC(Q, r, n) = \min\{JC_1(Q, r, n), JC_2(Q, r, n)\}.$$

We can easily prove that $JC_1(Q, r, n)$ and $JC_2(Q, r, n)$ are convex. The optimal solution of the nonlinear programming can be gotten using LINGO 9.0.

5. Numerical Experiments

We consider an example with the following data: $D = 1000 / \text{year}$, $A_1 = \$25 / \text{order}$, $A_2 = \$400 / \text{setup}$, $h_b = \$10 / \text{unit} / \text{year}$, $h_v = \$8 / \text{unit} / \text{year}$, $s = \$30 / \text{unit} / \text{year}$, $a = 0$, $b = 35$. For the independent optimization model, the optimal values of r, Q, n and expected total cost per time are 27.7, 97.0, 3 and 2918.1. The corresponding values for the integrated optimization model are 0, 311.9, 1 and 2639.2, the total saving cost is 9.56% and it should be shared by the vendor and the buyer in some equitable manner.

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Network Security Policy

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Abstract

The development of the Internet makes the rapid economy development of the whole society. Many enterprises form their own networks and connect to the Internet, in order to fully realize the sharing and use of data resources. With the development of the network, network security has become a growing concern in all sectors. This paper discusses the status of network security and several major network security technologies, and proposes several measures to realize the network security.

Keywords: Network security, Firewall, Encryption, Intrusion detection

1. Network and its status

1.1 The concept of networks and network security

The computer security is defined as "the establishment of a data processing system and the technical and management security to protect the computer hardware, software, data is not damaged, changed and disclosure due to accidental or malicious reasons." by International Standards Organization (ISO). The definition of computer security includes physical security and logical security. The logical security can be understood as information security, referring to the protection of the integrity, availability and reliability of the information. The network security is the meaning of information security, extended, or network security is the integrity of network information, availability, confidentiality and reliability of protection.

1.2 The necessity to realize the network security

As the development of the Internet, the world economy is rapidly integrating. Computer network are growing popular in all areas of economic and life, and the whole society is increasingly dependent on the network. Many enterprises, the education sectors, government departments and so form their own networks and connect to the Internet, in order to fully realize the sharing and use of data resources. However, with the rapid development of the network, a variety of issues are also produced, especially security issues. To understand the threats to the network to prevent and eliminate it, has become one of the most important things of the network development. Security is the Guarantee of the network's survival, and only security is guaranteed, the network can be more fully realized the value of application.

2. The main technology to realize the network security

The Network security involved a very wide scope with the development of the use of the network.

2.1 Firewall Technology

As the first barrier between internal network and external public network, the firewall is the first one of the products to pay attention to by people.

The firewall is a combination of computer hardware and software. The firewall can be established a security gateway between the Internet and the internal networks to prevent users outside to illegally enter the internal network accessing to internal network resources thereby protecting the internal network from the invasion of illegal users.

According to the technology used in different firewall, we can divide them into three basic types: packet filter-based, agent-based and monitoring-type.

2.1.1 Packet filter-based type

Packet filter-based types are primary products and its technology is based on sub-transmission technology of the network. Network data is packaged as a unit for transmission and the data divided into packets for a certain size. Each packet contains specific information, such as the source address, destination address of the data, source port and destination port of TCP / UDP and so on. The firewall determines if the "package" is from the trusted secure site by reading the address information of the data packets. The firewall will be shut out of these packets, once the packets are from the dangerous site. System administrators can also formulate the flexibility rules according

to the actual situation.

The advantage of packet filtering technology is simple and practical. It can be realized with the lower cost and simple environment.

However, the defect of packet filtering technology is obvious, which is wholly based on network layer security technology and only judge by the source of the data packet, destination of the data, port and other network information. It can not recognize the malicious invasion based on application layer, such as the malicious Java applet and the e-mail with the virus. Experienced hackers can easily forge IP addresses, fooling the packet filtering firewall.

2.1.2 Agent-based type

Agent-based firewall can also be called an agent server, which is more secure than packet filtering products, and has begun develop to the application layer. Agent server completely blocked the exchange of data between the client and server. From the client point of view, the agent server is equivalent to a real server. From the server point of view, the agent server is a real client. When clients need to use data on the server, the data request is firstly transferred to the agent server, then agent server request data to the server, then the data is transferred to the client by agent sever. As the external system and internal server has no direct data channels, it would be difficult that external malicious damage to the internal network.

Agent firewall has the advantage of higher security and can scan application layer to effectively detect and deal with the application layer-based intrusion and viruses. The drawback is that the system's overall performance has a greater impact and agent server must be set up one by one for all application types, which increases the complexity of the system management.

In fact, as the main trend of the current firewall products, most of the agent server (also named application gateway) integrated packet filtering. The mixture application of these two technologies is clearly greater than the one.

2.1.3 Monitoring type

Monitoring firewall is the new generation of products, the technology of which has gone beyond the actual definition of the original firewall. The types of firewalls can take the initiative and real-time monitoring for each layer of data. Monitoring firewall can effectively determine the illegal intrusion of levels, in an analysis of these data.

At the same time, the firewalls are generally detectors, which are placed in a variety of application server and other network nodes. It can detect attacks not only from outside the network, but also from the inside vandalism. According to authoritative statistics, a substantial proportion of attacks come from the inside network system. Therefore, the monitoring firewall is not only beyond the traditional definition of firewall, but also exceed the previous two generations in security.

2.2 Data Encryption

Computer network security mainly includes system security and data security. The system security generally use firewall technology, virus killing and other measures. And data security generally uses encryption technology. Encryption is a way confusing the information, so that unauthorized people can not understand it. There are two types of encryption, that is the private key encryption and public key encryption.

2.2.1 Private key encryption

Private key encryption uses a key to encrypt data, and the other receiving the data use the same key to decrypt. The advantage of this encryption method is very fast and very easy to achieve in hardware and software. But its main weakness is that, once the key disclosure, the information security is directly impact on.

2.2.2 Public key encryption

Private key encryption using the same key to encrypt and decrypt, and public key cryptography uses two keys, one of which is for the encryption, the other is for the decryption. The disadvantage of public key encryption system is slow, but if we combine the two, we can get a more complex system.

2.3 Intrusion Detection System

Intrusion detection technology is a research focus in network security and it is a proactive security technology. It provides real-time protection for internal intrusion, external intrusion and misuse operation to block invasion before the danger in the network. With the development of times the intrusion detection technology will develop to three directions, which are distributed intrusion detection, intelligent intrusion detection and comprehensive

security defense program.

Intrusion detection system (referred to as IDS) is the combination of software and hardware. Its main function is to collect and analysis information from the network or system to find if there is violating security policy behavior or attacking behavior. So that security administrators can promptly deal with the invasion to minimize the damage.

2.4 Virtual private network (VPN) technology

The full name of VPN in English is "Virtual Private Network". It is virtual dedicated or private network built on the public communications infrastructure and can be considered as a separate network from the public network. It can build a proprietary line through special encrypted communication protocol in two or many enterprises, which lie in the different places in the Internet. It is like a line set up the same, but it is not real physical lines.

VPN use four technologies to protect the safety. That is tunneling, encryption & Decryption technology, key management and authentication technology. Several popular technologies of tunneling are PPTP, L2TP and IPSec.

3. Network security strategy

3.1 The concept of networks and network security

Network security is a systematic project, a social engineering. Network security measures are available from the following four aspects.

From a technical point of view, first of all, network managers must have the right mental preparation. The feature of network decides that network security is a constantly changing and updating field. The rapid development of network technology also means that network security is a "protracted war". Second, it is necessary to strengthen the technical level of network management to establish high-quality personnel. Currently in China, the scarce of talent is prominent problems, especially top-notch talent.

From the management to see, examining the safety of an internal network not only depends on its technical means, but more importantly, depends on the comprehensive measures taken for the network. This is mainly focuses management and safety is from management. Even the best technology, equipment, and no high-quality management, efficiency will be very low.

From the perspective of organizational systems and responsibilities, we should establish network security organization system as quickly as possible, clear responsibility at all levels within the organization, dedicate to safety oversight processes, such as logging and monitoring statistics, establish a scientific organization and management system, and so on.

Finally, strengthen network legislation as soon as. At the same time, we also continuously improve the moral standards of a vast of network users; enhance the safety awareness of each network user. We can fundamentally solve network security problems only in this way.

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