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Message from the Editor-in-Chief

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April 01, 2015
Prof. Dr. Aytekin ISMAN
Sakarya University

Dear Tojsat Readers,

Now, we are reading 5th volume of The Online Journal of Science and Technology. We finished the istec 2014 conference hold in Doha, Qatar. These papers receives interests from all over the areas of science and technology. The selected, peer-reviewed papers were accepted for publication apart from contributions from all over the World. The accepted and published papers are from forest ecosysytem to mechanical engineering.

Prof.Dr. Mustafa S. DUNDAR

Editor, TOJSAT

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A comparative study of Analytical Hierarchy Process and Ordinary Least Square methods for landslide susceptibility mapping using GIS technology

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Abstract: This work presents Analytical Hierarchy Process (AHP) method available in Geographic Information System (GIS) to identify and classify the Penang Island according to the grade of present or potential danger of land failure happening. Landslide susceptibility zonation map has been generated by considering seven factors. Sensitivity analysis was performed in detail by varying the contributing factors weights and their effects on defined landslide susceptible locations.
In other part of the analysis, ordinary least square (OLS) technique has been used to estimate weights of point parameters then its result compared with AHP technique result. Finally, the landslide susceptibility maps resulted from AHP and OLS method has been compared to the landslide inventory map containing 355 real occurred landslides in order to verify the practicality of susceptibility maps. The outcome was that the 75% of occurred land failures fit into the very high and high susceptibility class of AHP map (using seven parameters), while this is 73.8% in the case of AHP with point parameters (using four parameters), and 65.8% for the OLS map. As conclusion, the AHP method yields reasonable results which make it reliable and credible approach in comparison with OLS, especially in the case of using large number of landslide contributing factors.

Key Words: GIS (Geographic Information System), Landslide, Susceptibility, AHP (Analytical Hierarchy Process), OLS (Ordinary Least Square), Sensitivity Analysis

Introduction

Landslide hazard resulted in loss of lives and extensive property damages, is the main problem of many countries. Since Penang Island in Malaysia country is the area which frequently experiences heavy rainfall and subsequently much landslide harm, it has been selected as suitable region to study landslide susceptibility (S. Lee & Pradhan, 2006). Tropical rainfall as triggering factor plus uncontrolled urbanization and deforestation play an effective role to aggravate slope destabilization in this island. In order to forecast and specify the region where future land failure is likely to happen, it is necessary to mapping the landslide prone areas (Althuwaynee, Pradhan, & Lee, 2012). Reliable and accurate landslide susceptibility map can be helpful for land planners, decision makers, and risk assessment.
Over the last few decades, Geographic Information System (GIS) has become a compulsory tool in landslide hazard and risk assessment, thus many landslide susceptibility maps have been produced using different GIS-based methods including the analytical hierarchy process (AHP), frequency ratio, bivariate, multivariate, Logistics regression, fuzzy logic, and artificial neural network (Matori, Basith, & Harahap, 2011). Although, all techniques have advantages, incomplete knowledge applied through qualitative methods makes the expert decisions inaccurate or wrong, and imprecise or inaccurate data have the similar impact in the case of using quantitative approaches (Vahidnia, Alesheikh, Alimohammadi, & Hosseinali, 2010). Therefore, the results from the different mixture of qualitative and quantitative techniques, known as semi-quantitative approaches, which merge ranking and weighting, may be more credible (Ayalew & Yamagishi, 2005). The analytic hierarchy process (AHP) (Saaty, 1980), and analytic network process (ANP) (Saaty, 1999), weighted linear combination (WLC) (Ayalew, Yamagishi, & Ugawa, 2004), and fuzzy logic theory (Zadeh, 1965), are the examples of semi-quantitative techniques.
In this study the AHP and OLS methods have been chosen for making landslide susceptibility mapping. When AHP as popular and reliable method in landslide susceptibility mapping is integrated with GIS, it results in precise values for criteria. On the other hand, the ordinary least squares approach is considered as a basic prediction technique which is commonly used in various application fields. This method can be very quickly applied even to problems with hundreds of features and thousands of data points. However, linear models are not perfect since it is not reasonable to fit a simple line or planes to real world relationships. Although OLS has some weaknesses but it has been chosen for this research as a method to compare with AHP, because some distance factors have been discussed in this study are appropriate for OLS approach. Finally, it is noticeable that the quality and validity of landslide susceptibility zonation depend on the used methods and also the followed sampling strategies (Yilmaz, 2009). Thus, it is necessary to do comparative studies in order to find the best

method for landslide susceptibility zonation (LSZ) mapping (Tien Bui, Pradhan, Lofman, Revhaug, & Dick, 2012).
In summery the results of this study suggest that the AHP method is the reliable method that can be used for landslide susceptibility mapping. And also, using more number of landslide contributing parameters increases the validation and reliability of susceptibility map.

Study Area

Penang Island is located in the west coast of Peninsular Malaysia. This Island with the area of 293 Sq.km is the fourth-largest in the Malaysia country and the most populated as well. It is located almost between the latitude of 5º15´N to 5º30´N and longitudes 100º10´E to 100º21´E. The altitude changes from 0 to 817 meters above sea level and slope degree varies from 0º to 61.598º. The climate is tropical and the mean value of annual rainfall varies from 2400 to 2700 mm. There are three main lithological formations in the study area; alluvium, granite and micro-granite (Pradhan & Youssef, 2009). The terrain is mainly represented by coastal plains, hills and mountains with much developed lowland areas.

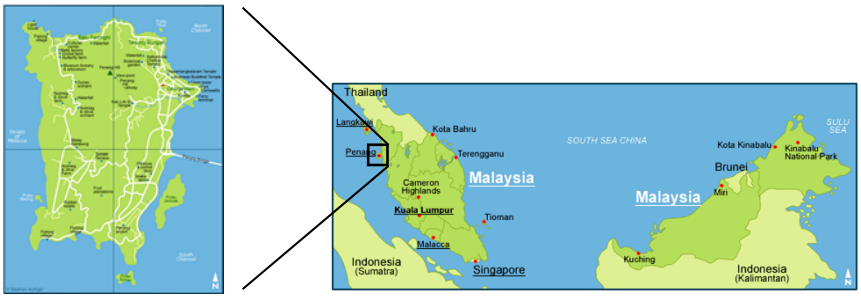


Figure 1: Malaysia, Penang Island Map

Materials and Method

Since 1970‟s, many researchers have applied GIS-based techniques to depict the spatial dispensation of landslide-prone areas. In general, all the models generated from all the methods rely on two assumptions: 1) future slope failures in a particular area will occur in the approximately same situation in which previous landslides have happened. 2) Casual factors that exist in GIS database can be utilized for evaluating the future landslides (Tangestani, 2009). Slope degree, distance to rivers, roads, and faults, lithology, land use/land cover, and precipitation are the causative factors considered in in this peoject based on availability, relevance, and scales.

Landslide causative factors

Slope

Since, the slope degree is straightly related to landslide, it is frequently applied in providing landslide susceptibility maps (Cevik & Topal, 2003; Dia, Lee, Li, & Xu, 2001; Lee, 2005; Yalcin, Reis, Aydinoglu, & Yomralioglu, 2011; Yalcin, 2008). Hence, the slope map of the study area was derived from digital elevation model (DEM) with a pixel size of 30 m by 30 m, and the terrain classified to five different zones according to the slope angle.

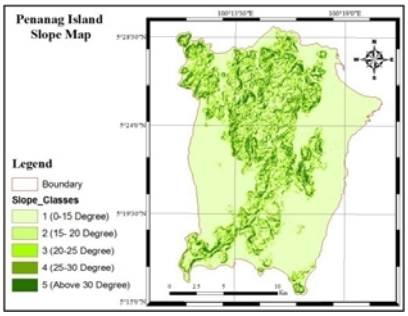


Figure 2: Penang Island Slope Map

Distance to Road

Constructing roads beside a slope results in some tensions, load decreasing on the slope heels, and landslide happening eventually (Ayalew & Yamagishi, 2005; Pachari, Gupta, Chander, 1998; Pourghasemi, Pradhan, & Gokceoglu, 2012). Therefore, the road proximity has been taken in account as a casual factor for landsliding. Road lines have been digitized from the hard copy of road network map that had been provided from Department of Survey and Mapping Malaysia (JUPEM), in the scale of 1:50,000. Then Euclidean Distance approach was applied to make different classes over the study area. The closest regions to the roads were classified to 5 zones based on the distance.

Distance to Rivers

Hydrological condition of the area or the saturation degree of the soil on slopes has been defined as a stability contributing parameter in landslide initiation in Penang Island. Water infiltration in soil, runoff, and groundwater flows were all happened under the hydrological circumstance (Thanh & De Smedt, 2011). Closeness of the slopes to river lines may affect its stability, because the proximity to rivers would activate the erosion process along the slope (Mancini, Ceppi, & Ritrovato, 2010). In this project five different zones have been buffered around river lines with 50 and 100 meters interval distance. The rivers map required for this part of the project had been provided from Department of Survey and Mapping Malaysia (JUPEM), in the scale of 1:50,000.

Lithology

Different lithological specifications of an area lead to different strength and penetrance of rocks. The soft copy of geological map in .pdf format and with the scale of 1:63,300, had been collected from Mineral and Geoscience Department of Malaysia. Then, it has been converted to IMAGINE Image format for further analysis in ArcGIS software. The lithology map was classified to three lithological units of Alluvium, Micro granite, and Granite.

Distance to Faults

The fractured rocks exist in faults form week zones that present favorable conditions for landslides. Landslides promotes in study area due to flow of water along fault planes and the erosion occurrence consequently. At first, the soft copy of geological map in .pdf format (scale 1:63,300) had been prepared from Mineral and Geoscience Department of Malaysia, and then converted to IMAGINE Image. The classified fault distance map has been extracted through Euclidean Distance method with 100 meter interval.

Land use/ Land cover

In this study the image of Penang Island has been downloaded from USGS website, clipped and prepared in ENVI 4.7 software and then classified to four classes of water bodies, clear land, vegetation, and urban area through Maximum Likelihood classification method. Finally converted to shapefile and exported to ArcGIS software.

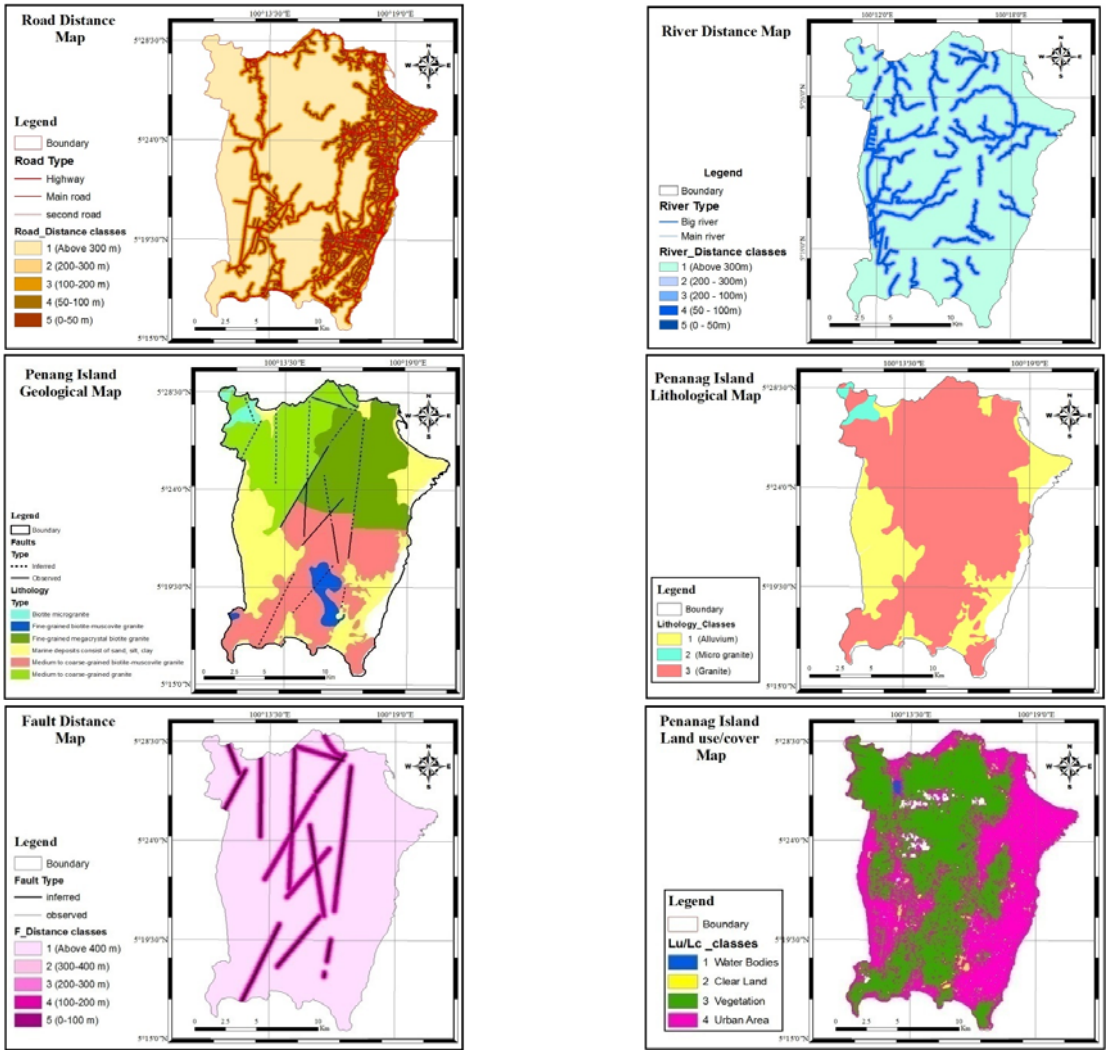


Figure 3: A) Road Distance Map, B) River Distance Map, C) Geological Map, D) Classified Lithological Map, E) Fault Distance Map, F) Land use/cover Map

Precipitation

Precipitation is initiation factor in landslide occurrence due to its major influence on runoff and pore water pressure. Total rainfall, short-term intensity, antecedent precipitation, and storm duration are the main rainfall measurements considered as effective factor in landslide initiation. Choosing from these factors for subsequent analyzing usually depends on rainfall records availability. In this study the average monthly rainfall data from three existing weather stations, was collected for the past ten years (2003 to 2012). The stations located in northwest, northeast, and southeast of Island have recorded the annual average rainfall of 2608 mm, 2677 mm, and 2381 mm respectively. An annual precipitation map of Penang Island was produced by Inverse Distance weighting (IDW) method over the three stations. This method is one of the spatial interpolation methods that are available in ArcGIS software spatial analyst tools.

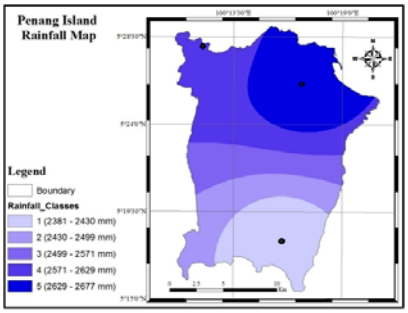


Figure 4: Rainfall Map of Penang Island

AHP analysis

AHP is widely applied in regional planning, resource allocation, routing modeling, suitability analysis, site selection, and landslide susceptibility analysis (Ayalew, Yamagishi, Marui, & Kanno, 2005). AHP uses pair-wise comparison to define weights or values for factors. Through pair-wise comparison each element compared to one another, and then the numerical weights are assigned to each factor due to their relative importance.
In this study the landslide causative parameters were put in sequence of importance. The relative importance of each parameter has been evaluated according to scientist researches especially for Penang Island (S. Lee & Pradhan, 2006; Oh & Pradhan, 2011; Pradhan, Lee, & Buchroithner, 2010). The following sequence indicates the priority of each parameter compare to others: Slope, Precipitation, Distance to roads, Distance to rivers, Land use/ Land cover, Lithology, Distance to faults. Then the preference matrix (Pair-wise comparison matrix) was created and AHP analysis was executed. Table 2 illustrates the weights calculated by AHP technique.

Sensitivity Analysis

Sensitivity analysis through simulation models helps researchers to specify the credibility of the result in cases where multi-criteria weights have been investigated (Abdullahi, Rodzi, & Pradhan, 2013; Chen, Yu, Shahbaz, & Xevi, 2009). It aims to identify the effects of changes in the inputs which are geographical data and the priorities on the outputs. If the changes do not result in significant effect on outputs, then the ranking is considered as robust and satisfactory. For this reason sensitivity analyses were performed to explore the response of the overall priority of landslide susceptible locations as alternatives to change in the relative synthesis value of each parameter. To perform sensitivity analysis three random points were chosen to act as alternatives.

Ordinary Least Square Technique

Ordinary least square method is used in order to investigate the relation of current landslides and defined criteria, such as high slope regions, areas with high road density, area with high river density and so on. By using this method the effect of various criteria on existing landslides were found, and the coefficients for each landslide occurrence parameter is shown in a table generated by OLS function (Table 2). These coefficients calculated by OLS, are based on the average distance between each happened landslides to parameters. For this reason, the point layers were created for landslide contributing factors. So, the land use/ land cover, lithology, and rainfall were eliminated, because point layers resulted from these factors were not reliable. Thus, the four independent factors used in OLS approach were slope, distance to road, river, and fault. The inventory map which had been produced by scientists through interpretation of aerial photographs, reports and field surveys, has been used for digitizing the location points of land failures occurred in Penang Island. Then the OLS measurements between existing landslides to road network density and rivers, high slope regions, and regions on faults were produced. Calculated coefficients of each parameter has been normalized and converted to Satty scale in order to apply in ArcGIS software (Table 2).

Table 1: Aggregate pair-wise comparison

	Slope	Rainfall	D-Road	D-River	LU/LC	Litho	D-Fault	**Weight**
Slope	1	2	3	3.5	4	5	5	**0.3419**
Rainfall	0.5	1	2	2.5	3	4	4	**0.2254**
D-Road	0.3333	0.5	1	1.5	2	2.5	3	**0.1368**
D-River	0.2857	0.4	0.6667	1	2	3	3	**0.1204**
LU/LC	0.25	0.3333	0.5	0.5	1	1	1.5	**0.0689**
Litho	0.2	0.25	0.4	0.3333	1	1	1	**0.0555**
D-Fault	0.2	0.25	0.3333	0.3333	0.6667	1	1	**0.051**
CR	0.0146							

Table 2: Ordinary Least Square calculation

Parameters	Coefficients	Normalized Coef	Saaty's Scale
Distance to Slope	-0.018677	1	9
Distance to Road	-0.01182	0.632864	6
Distance to River	0.006463	0.3460406	3
Distance to Fault	-0.000838	0.0447074	1

Validation

Validation of landslide susceptibility maps was an absolutely essential component in this study. Without a validation, the maps are useless and have no value. For this reason, landslide inventory map which shows the previous landslide locations, were used to validate the landslide susceptibility maps. In order to verify the output maps, they were first converted to vector format then overlaid with the landslide inventory map by means of GIS software. From attribute table, the number of previous landslides that fell into each class of susceptibility was calculated easily. This procedure was done for three susceptibility maps generated in this research.

Result and Discussion

In first part of the research, AHP method was applied using seven factors. Figure 5 shows the output map. Sensitivity analysis was performed by Expert choice software. Figure 6A illustrates the numerical original condition of parameters and alternatives in Dynamic graph of Expert Choice software. Point 1 is 42.1% susceptible, point 2 is 30.7% and point 3 is 27.2% susceptible, with slope, rainfall, distance to road, distance to river, land use/cover, lithology, and distance to fault criteria priorities of 34.2% , 22.5% , 13.7%, 12%, 6.9%, 5.6%, and 5.1% respectively. As shown in figure 6 B, C, D, E, F, G, and H, the priority of each criterion is increased up to 50%; while susceptibility and priority of alternatives (locations) does not change significantly.

In another part of the research, the weights calculated by OLS approach for four factors were used to make landslide susceptibility map (Figure 7A). In order to do practical comparison between AHP and OLS, a landslide susceptibility map has been made by AHP with the same factors used in OLS approach (Figure 7B). According to the validation result summarized in table 4, 75% of occurred land failures fit into the very high and high susceptibility class of AHP map (using seven parameters), while this is 73.8% in the case of AHP with point parameters, and 65.8% for the OLS map. The weakness of OLS technique is that, only point parameters can be evaluated, because the evaluation of criteria by this technique is based on average distance of point parameters (as independent variable) to existing landslides (as dependent variable). However, the aim of performing this technique was to make challenge for AHP weighting technique with other approaches.

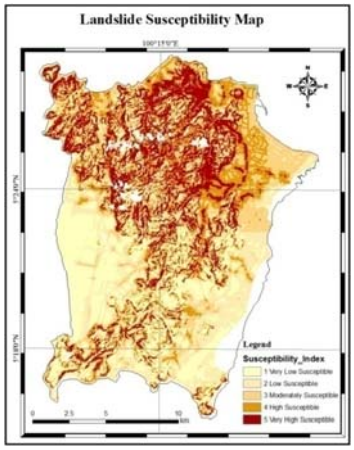
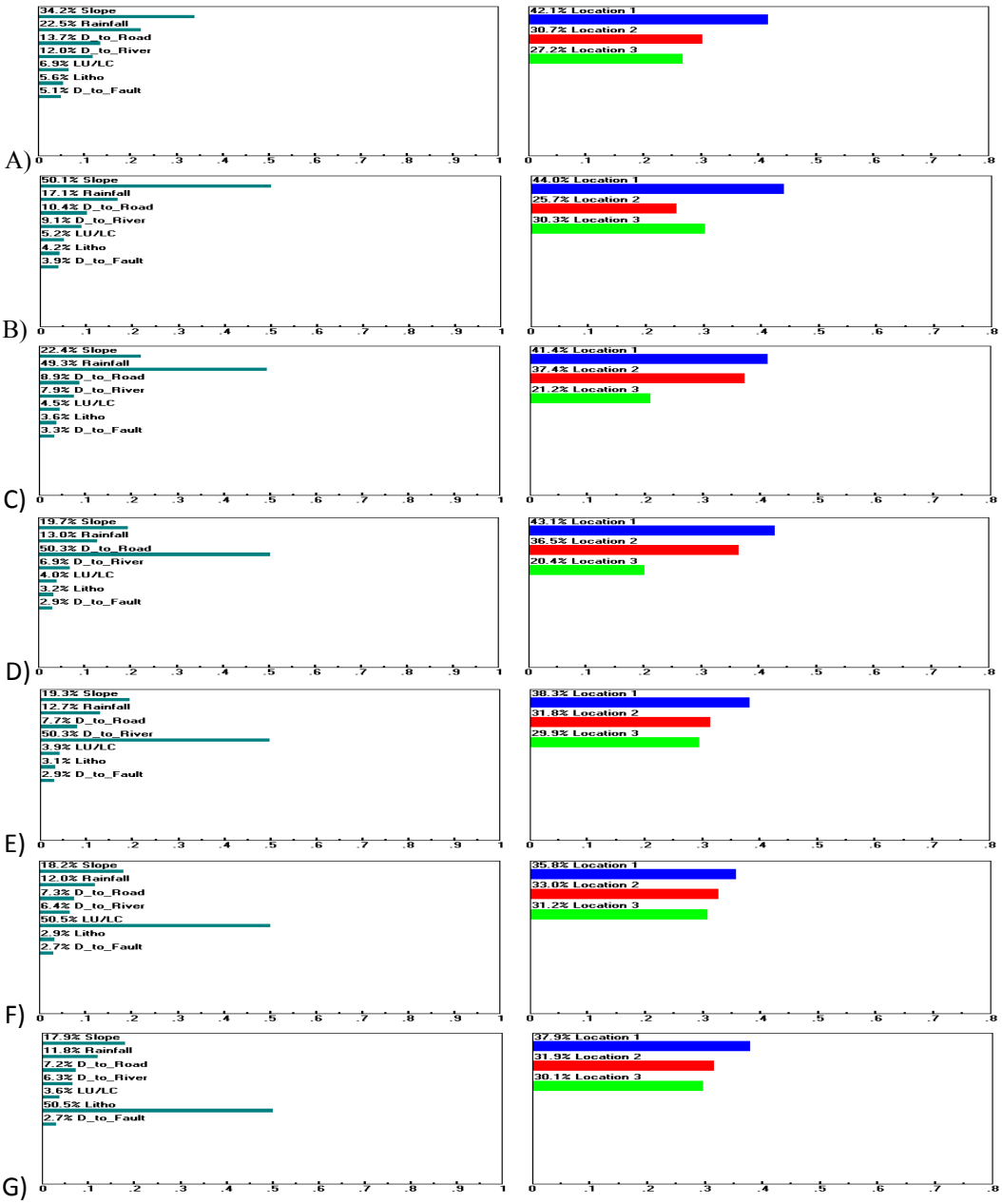


Figure 5: Landslide Susceptibility Map generated by AHP method



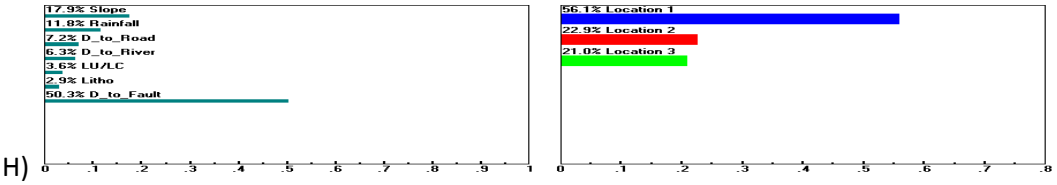


Figure 6: Numerical assessment of sensitivity analysis (Dynamic graph), A) Present condition

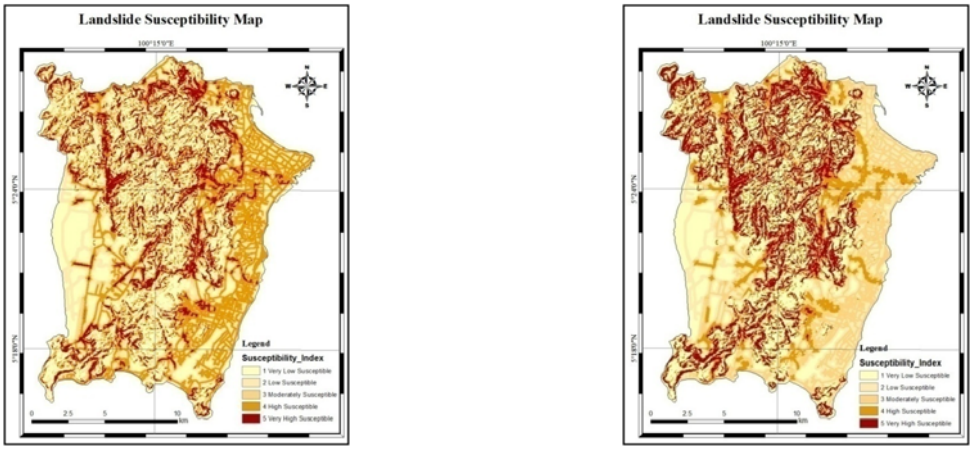


Figure 7: A) Landslide Susceptibility Map generated by OLS scales, B) Landslide Susceptibility Map resulted from AHP using four factors

Table 4: Comparison of different susceptibility map

	Past occurred landslides fall into Very High Susceptibility class		Past occurred landslides fall into High Susceptibility class		Past occurred landslides fall into Moderate Susceptibility class		Past occurred landslides fall into Low susceptibility class		Past occurred landslides fall into Very Low susceptible class	
	%	count	%	count	%	count	%	count	%	Count
AHP (seven parameters)	53.5%	187	21.5%	75	15.4%	54	6.8%	24	2.8%	10
AHP(point parameters)	52%	185	21.8%	77	6.9%	25	13.3%	47	6%	21
OLS	44.3%	157	21.5%	76	14.6%	52	13.6%	49	6%	21

Conclusion

As conclusion the AHP method is the reliable method that can be used for landslide susceptibility mapping. And also, using more number of parameters contributing in landslide happening, increase the validation and reliability of susceptibility map. For comparing the results from OLS and AHP using same parameters (four parameters), AHP shows the better result in very high susceptible class (52%) , but from low susceptible to moderate class, the number of landslide decreases from 21.8% to 9.6% which shows the invalid result. Actually this problem may be solved by considering more number of factors in landslide susceptibility analysis, like what has been done in the first part of the study applying AHP Using seven factors.

Sensitivity analysis was done to evaluate the overall priority of the parameters or objectives. Results of sensitivity analysis for first part of research were acceptable and showed that by changing the degree of preferences for each objective or factor, no significant changes has been occurred on alternatives.

Acknowledgement

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Copper-Zinc-Lead Alloys, Common Defects Through Production Stages and Remedy Methods

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Abstract: Two types of leaded brass alloys (CuZn40Pb2 and CuZn39Pb3) as extruded rods, which use to produce pressurized gas valves were produced by a vertical semi-continuous casting, hot extrusion, cold drawing, hot forging and machining processes. The effect of lead element on machinability of these alloys was explained. The common defects of the mentioned leaded brass rods, the causes and its remedies were explained. Many defects during productions stages of leaded brass rods were occurred, such as cavities, non-metallic contaminates, lead clustering, surface cracks and zinc segregation into foundry process. In addition, surface crack, hot tearing and back defect through hot extrusion, chevron and chemical composition cracks into cold drawing with hot bursts and lap during hot forging were appeared. The machining process and in-service processes were also involved some other defects. All these defects were occurred due to no care during manufacturing process stages and using improper technological parameters and bad casting product design. To remedying the above-mentioned defects, the proper and improving technological parameters with optimal product design must be used. The current technical review of all types of defects in leaded brass alloys, have been found that, these defects can be appear and increasing in sub-sequence applications and in-service stages.

Keywords: Leaded Brass, Casting, Extrusion, Hot forging, Processing Defects

Introduction

Copper and its alloys, such as bronze, brass, are the materials which are widely used in friction parts of machines, as bearing liners, bushings, etc. Properties such as high strength and ductility, fatigue strength, wear resistance, etc. are necessary for these materials. Obtaining such properties is possible by creating sub-microcrystalline and nanocrystalline structures in the materials (Sadykov, 1999).

Principle of brass bars manufacture from the viewpoint of forming lies in the following technological scheme. Melted brass is poured into billets of circular cross-section with diameter (D). Brass billets are hot extruded to the required cross-section of a circle, square, hexagon and profile. After removal of surface oxides the brass extruded rods are cold drawn (calibrated) to the required dimension (PERNIS, 2011).

There are two broad categories of brass rods, as far as their end-use and final product fabrication technique, the forging/stamping rods and the machining rods. Machinable brasses are produced by hot extrusion and drawing and serve as raw material for the production of various products ranging from decoration to mechanical and electrical engineering. The production of the final parts is realized by high-speed machining (turning) of feed stock material, for maximum productivity, using automatic and CNC machining centers. Lead precipitated in a fine and homogeneous distribution, serves as a chip-breaking constituent, minimizing the friction at the tool/work piece interface and impairing the chip ductility, increasing, therefore, the machinability of the material and extending the cutting tool life (Toulfatzis, 2011). Lead (Pb) content and Pb particle dispersion played an important role in the machining capability of the material. Pb remained insoluble to the α or β phase and it was distributed along the present (or former) grain boundaries. As the Pb particle distribution became finer (less than 5 μm) and more homogeneous, the chip-breaking action during cutting processes became stronger, and therefore the machinability was enhanced (Pantazopoulos, 2002).

Leaded brass rods are widely used in applications varying from decoration and architecture to electrical/electronic and structural systems. Such components, for example, screws, nuts, bolts, and fittings, are produced mainly by automatic turning operations (Pantazopoulos, 2008). The content varies Pb between 2.5 and 3.5 %, which allows for machining processes at high speed with good surface (Mannheim, 2009). The solubility of lead in copper alloys is very low and for that reason it is found in microstructure as dispersed globules all over the material. It acts as a lubricant decreasing the friction coefficient between the tool and the material, creating discontinuities that promote the chip fragmentation, reducing the cutting force and the tool wear rate (Vilarinho, 2005). Different alloying elements enhancing the machinability are usually added to brass. The most important element in this context is lead, improving the machinability with regard to excellent chip breakage, low tool wear and high applicable cutting parameters. These aspects can be explained by two basic phenomena. First of all, solubility of lead in brass is very low and lead segregates in the entire microstructure, particularly at the grain

boundaries. Hence, shear strength is significantly reduced, resulting in very good chip breakage. Secondly, lead exhibits a low melting temperature. During cutting, a thin, semi-fluid lead film reduces friction, cutting forces (Nobel,2014).

Materials and Methods

The methodology adopted to carry out this work involved wide studying of copper-zinc-lead alloys with two types (CuZn40Pb2 and CuZn39Pb3) as extruded rods which use to produce pressurized gas valves by hot forging, trimming and then machining process. The production sequences of leaded brass rods generally involves the manufacturing stages:- Vertical semi-continuous casting → Hot extrusion → Surface cleaning (pickling) → Cold drawing → Straightening → Stress relieving → Hot forging → Trimming & cleaning and Machining.

The study involved introduction about copper alloys especially leaded brass alloys and explain with discussion the common defects during production stages for two types of these alloys with its remedy methods. The study involved also some conclusions in finally.

The Common Defects of Leaded Brass Rods and It's Remedy

3.1 Foundry Process Defects

There are many types of defects appear into leaded brass billet casting such as:-

• **Surface defects: -** For certain products, such as those will have no machining after casting the surface finish is important and mould surface texture is reflected in that of the casting surface. For any blemishes or high and low spots will be carried over onto the product (Wilby, 2012). These defects can be avoided by adjust proper pouring temperature, repairing or replace the linear of casting mould and using oil lubricant for mould (Rajkolhe, 2014).

• **Zinc segregation: -** This can appear on the surface of billets in the case of insufficient the technological parameters and cooling of brass in chill-mould (PERNIS, 2011).

(Fig. 1) shows surface zinc segregates. These defects can be remedied by optimal casting parameters, repairing the cooling system of casting mould and adjusting the quality and cooling rate water.

• **Surface blackness cracks and lead clustering: -** The shortage and insufficient secondary cooling water lead to defects and surface cracks within the product. If the secondary cooling of the billet is not homogenous (non-uniform), this results the cracks, lead clustering and distortion of the billet (Hameed, 2014). **(Fig. 2)** shows lead clustering on brass rod surface. These defects can be avoided by controlling on technological casting parameters especially, cooling rate water and casting speed.

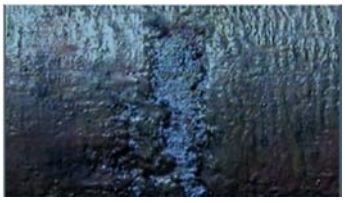

Fig. 1. Zinc segregates on brass CuZn40Pb2 billet (PERNIS, 2011).

Fig. 2. Lead clustering on leaded brass billet surface

•**Cavities and Porosity**: - These defects can be cause surface or internal cracks and/or voids that ultimately lead to failures during the metal forming operations. Careful selection of casting speed and cooling rate are viable techniques to control and minimize the solidification shrinkage and the associated porosity (Pantazopoulos, 2003). **(Fig. 3)** shows some porosity defects on section of leaded brass billet.

• **Non-metallic contamination: -** Slag or fragments of melting furnace refractory might be allowed to enter the melt charge during the pouring. Foreign attachments and extraneous materials get into billet where they become hard and follow into the extrusion process. The consequence of this is illustrated in **(Fig. 4)** (PERNIS, 2011). High, localized impurity levels may lead to cracks and discontinuities after extrusion and drawing. The necessary corrective action to avoid this set of defects is to establish the lowest possible impurity limits and to determine the chemical composition of the incoming raw material and/or the ingots from the casting process (Pantazopoulos, 2003). These defects can be remedied by pouring from the bottom of tundish and cleaning the molten metal from slag and dross (PERNIS, 2011).

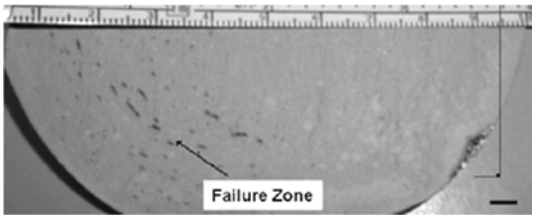

Fig. 3. Porosities and small cracks on brass billet (Mannheim, 2009).

Fig. 4. Surface crack on extruded brass bar (PERNIS, 2011).

3.2 Extrusion defects

There are many types of defects occurring through extrusion process, but the common defects are:-

• **Surface cracks: -** The cracks may be small fine or transversal cracking, surface defects of brass bars are influenced by improper geometry of extrusion equipment. **(Fig. 5)** shows transversally deformed brass CuZn40Pb2 bar. This deformation was caused by the geometry of extrusion die which was manufactured with slightly twisted positions. If extrusion tools (die, the holder of die) is not sufficiently preheated up to required temperature, it can lead to the occurrence of cracks at the beginning of the extrusion process (PERNIS, 2011). The most important of technological parameters of extrusion processes; such as extrusion ratio, extrusion speed (ram speed), the temperature of extrusion and suitable preheating of forming tools extrusion ratio and extrusion speed effected to appear some surface defects especially, when extrusion ratio increase and the temperature of extrusion tools decrease (PERNIS, 2011).

• **Hot tearing or hot cracking: -** Hot-shortness failures appear as surface cracks or delaminations along the length of the extrusion. Hot shortness results from overheating because the temperature of the extrusion is increased by billet container friction. This increase in temperature raises the metal temperature to the point where localized regions of segregation may melt or become hot short (Rajkolhe, 2014). Surface/subsurface cracking and tearing with intergranular form can be generated by longitudinal tensile stresses developed as the extruded rod passes through the die. The most common reason is a combination of high extrusion speed or pre-extrusion rod temperature, while similar phenomenon could have occurred at lower temperatures due to stick-slip processes at the die land (Pantazopoulos, 2008). **(Fig. 6)** shows hot tearing defect on face of section for extruded lead brass rod which produced by Al-Shaheed state company, Iraq\Anbar. Although hot tearing is most often considered as a phenomenon linked to the inadequate compensation of solidification shrinkage by melt flow in the presence of thermal stress, there are more factors that could be involved in the formation of cracks at super solidus temperature (Mannheim, 2009). The factors that affect the hot tearing defects are a very high extrusion temperature, low extrusion ratio and a very low extrusion ram speed. To avoid this effect and prevent hot tearing the temperature of billet could be lowered and the extrusion ram increased (Mannheim, 2009).

Fig. 5. Distortion of extruded hexagonal bar from brass CuZn40Pb2 (PERNIS, 2011).

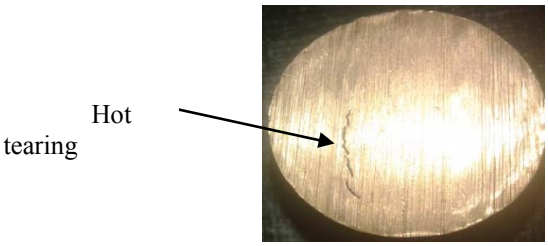

Fig. 6. Hot tearing in extruded brass rod

• **Back defect (internal piping): -** Which generally appears as a hole at the end of the extruded rod, results from a combination of the metal flow pattern and the introduction of surface oxides into the interior of the rod. Increased billet-container friction, an effect that frequently occurs in direct extrusion processes, gives rise to a non-uniform metal flow pattern, which is the main cause of the internal pipe formation (back defect) (Rajkolhe, 2014). In direct extrusion, if the extrusion ratio is too low, particularly with brass, the acceleration of the center of the billet can be so severe that cavities can occur toward the end of the section (**Fig. 7**), and due to the flow pattern of extrusion piping defects occurs (**Fig. 8)**. Their formation in the section can be prevented only by limiting the billet length and leaving a sufficiently long discard (Bauser, 2006). Removing a certain length form the end of the extruded rod can minimize the effects of this type of defect and the removing of the skin of the billet (scalping) during extrusion process also minimize this defect (Rajkolhe, 2014). In addition, the length of the billet is limited to reduce the risk of the piping defect. As a general rule the billet should not be longer than 2.5 to 3 times the diameter (Bauser, 2006).

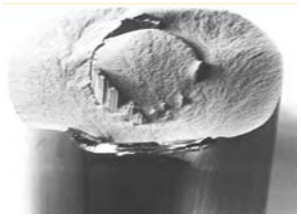

Fig. 7. Extrusion defect (piping) in leaded brass rod (Bauser, 2006).

Fig. 8. End cavities in section of leaded brass rod (Bauser, 2006).

3.3 Cold Drawing Defects:

The types of defects associated with cold drawing failure of leaded brass rods include the following:-

• **Chevron or internal cracking: -** Chevron crack is a result of excessive die-material friction and/or too large a reduction in area during drawing. Appropriate die lubrication and controlling the rod reduction to between 10 and 15% may eliminate this defect (Rajkolhe, 2014). **(Fig. 9)** shows style of chevron crack appears in drawing rod.

• **Chemical composition defects: -** Melting charge for melting and casting of brass CuZn40Pb2 billets is made from the company's own material which bought from external sources. The company's own material has the ensured chemical composition. However, this can not be said about the material bought from external sources, where is always the risk of unsuitable impurities. The most dangerous impurity is antimony. Some standards allow antimony as impurity up to 0, 02 wt. %. Technological problems appear with cold drawing of such bars. The consequences of antimony presence in brass CuZn40Pb2 bars are demonstrated in **(Fig. 10**). It is a circular bar which was cold drawn and contained 0,018 wt. % Sb (Rajkolhe, 2014).

Fig. 9. Chevron crack defects in drawn rod (NORASETHASOPON, 2011).

Fig. 10. Cracks on brass CuZn40Pb2 bar contains 0,018 wt. % of antimony (Rajkolhe, 2014).

3.4. Hot Forging Defects

The main types of hot forging/ stamping defects are:

• **Hot bursts:-**

• **Hot forging laps or discontinuities: -** The principal actions to minimize such these defects include (Rajkolhe, 2014):-

- First, and most importantly, review the processing stages and parameters with regard to the desired plastic deformation. These parameters include the alloy selected, the dimensions and geometry of the part produced, billet size, process temperature, strain rate, lubrication, die parameters, and other fabrication variables.
- Carefully adjust the preheating temperature. Excessive heating promotes hot tearing, and inadequate heating may lead to cracks due to insufficient ductility.
- Increase the alloy purity, and minimize alloy additions that may lead to hot shortness.
- Reduce friction through control of lubrication.
- Improve the die design to reduce sharp edges.

• **Surface cracking:** - Cause-Excessive working on the surface and too low temperature. Remedy by increase the work temperature (Rathi, 2014).

• **Cracking at the flash:** - This crack penetrates into the interior after flash is trimmed off. Cause due to very thin flash. Increasing flash thickness, relocating the flash to a less critical region of the forging, hot trimming and stress relieving (Rathi, 2014).

• **Cold shut (Fold):**- Two surfaces of metal fold against each other without welding completely. Cause due to sharp corner (less fillet), excessive chilling and high friction. Remedy by increase fillet radius on the die (Rathi, 2014).

3.5. Machining Defects:

When a good machining behaviour is required, lead is added (until 3%). The benefits conferred by the presence of lead has been appreciated for many years to facilitate chip fracture, reduce cutting forces, increase the machining rate and productivity, reduce tool wear and enhance surface finish (Garcia, 2010).

The chip shape obtained during machining is a very important factor of a material because it describes the possibility of using automatic machining processes. To do so it is necessary that the chip will be easy to remove and will not wind up on cutting tool what could influence the surface quality and tool life. To fulfill all these demands the chip has to be segmented. Lead is added to brasses and other copper alloys to force chip segmentation (Kondracki, 2003).

There are some defects and problems involved or appeared in machining process of leaded brass castings, such as hot crack propagation, lathe jaws marks and thin surface deflection of brass specimens as show in **(Fig. 11)** and **(Fig. 12)**.

Fig. 11. Hot crack propagation in machined leaded brass

Fig. 12. Jaws marking and cracks in lead brass

3.6. In-Service Defects

• **Environmentally induced failures: -** Such as fatigue, stress-corrosion cracking (SCC), and dezincification corrosion. These defects are generally a result of specific combinations of environmental and applied and/or residual stresses. To minimize the risk of SCC occurrence, a stress-relief annealing should be employed after the final manufacturing stage (Rajkolhe, 2014).
• **Cold-deformation failures or defects**: - Caused by the severe room temperature plastic deformation that may accompany component production. These failures are expected in cases where the alloy formability is exceeded during cold working. Better materials selection (chemical composition, temper) and process design are the main corrective actions to avoid such failures (Rajkolhe, 2014).
• **Hot-deformation failures or defects: -** These failures include hot bursts and laps, which can be prevented by limiting the intrinsic and extrinsic impurities and by careful control of process parameters (temperature, heating duration, billet dimensions, die design, and lubrication) (Rajkolhe, 2014).

Conclusions

• Several types of defects that occur in leaded brass rods during production process stages, especially through casting, hot extrusion, cold drawing and hot forging processes.
• Most of these defects occur due to improper technological parameters and product die designs adopted through the production processes.
• Some of these defects can be appear in last activities of production but, the causes of occurring are due to previous process.
• The proper and improving technological parameters can be used to remedy most of leaded brass rods defects.
In addition, quality control and quality assurance practices must be used.

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Durability of treated silty soil using lime and cement in road construction – a comparative study

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Abstract. The Treatment of soils using lime and cement is one of the appropriate techniques that provides solutions for poor geotechnical soils used in road construction, as subgrade layers. The present paper consists of a comparative study of bearing and sustainability of silty soils treated with lime and/or cement. The Tests carried out on samples of treated silty soil showed a great improvement in workability and bearing capacity compared to a natural one. It was also noticed that the soil that was treated with 5% of cement, and with 1% of lime and 4% of cement gives the highest values of CBR (Californian Bearing Ratio). However, the highest durability of the treated soil was obtained by mixed treatment (1% of lime and 4% of cement), which values the mixed treatment efficiency. It should also be noted that the proposed solution fits sustainable development well.

Keywords: sustainability; silty soil; treatment; lime; cement; environment; road infrastructure

1. Introduction

The depletion of natural resources in noble materials and the increase in the costs associated with the use of these materials requires the use of local materials in geotechnical works. However, the poor geotechnical properties of these materials cause difficulties for construction projects and therefore, they must be stabilized in order to improve their properties.

Soil treatment with a hydraulic binder is one of the appropriate techniques which consists in incorporating into the soil this filler material, optionally with water, and mixing them together to obtain a homogenous material with better properties compared to the natural soil. This technique uses chemical affinities of soil and binder in order to improve the physicochemical and mechanical soil properties. Several research studies have been performed on the stabilization of clay soils using various additives like cement, lime, fly ash and silica fume (Bell 1996, Boardman et al. 2001, Kalkan & Akbulut 2004, Al-Rawas 2005, Cuisinier et al. 2011, Harichan et al. 2011, Mahamedi and Khemissa 2013, Voottipruex and Jamsawang, 2014).

Soil treatment with hydraulic binders is a very interesting solution for improving poor soils to use them in subgrade layers, embankments, and even, in foundation layers, due to the technical, economic and environmental benefits of this solution (LCPC 2000). Fine soils like clays and silts have undesirable poor properties for the use in road construction. Indeed, these soils swell in the presence of water, shrink during dryness and abound under freezing effects, which make their use very subtle (Nelson and Miller 1992). The addition of a hydraulic binder such as lime significantly modifies these materials' behavior by improving their consistency and their bearing in the short and long terms.

This soil treatment process falls in the approach of sustainable development (Evangelos and Stavridakis 2006). Indeed, the execution of the treatment is a cold working, which significantly reduces pollution and the discharge of noxious fumes into the atmosphere (an energy saving and clean technique). In addition, this

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technique allows a significant overall energy saving by reducing materials to be transported, materials to be dumped and thus the decrease of indirect impacts, such as an inconvenience to road users and residents, and the reduction of the road network fatigue. The proposed technique represents an adequate solution for the preservation of natural resources, limiting nuisances caused by the transport of materials and reducing the cost of earthworks and the costs of landfill materials removed, which will certainly contribute to preserving the environment.

Durability that is defined as the ability of material to retain stability and integrity over years of exposure to destructive forces of weathering is one of most important factors of materials selection. However, poor soil does not sustain the effects of environmental factors, such as wetting-drying cycles, hence the interest of soil treatment (Al-Kiki et al. 2011, Estabragh and al. 2013). But treatment agents do not provide all the durability required in order to increase the life of road infrastructure; therefore in this comparative study, we tried to find out which mixture treatments that will ensure more durability; single or mixed ones.

This work presents the results of an experimental study carried out on a silty soil collected from a site located at 10 kms from Tiaret city (Algeria). It should be noted that this type of soil is found abundantly in the high plateaus of Algeria (Tellian Atlas in the north), which makes its use (valorization) very attractive in the field of road construction. This would be a good contribution towards sustainable development.

This paper aims at determining which mixture treatment will give the best durability of this silty soil in subgrade layers and embankments. We present, firstly, the identification tests of the studied soil, then the study of the influence of the treatment on the improving of the mechanical and physicochemical properties of the treated soil and, finally, the sustainability tests conducted on soil samples treated with various dosages of lime and/or cement.

2. Technical soil treatment

Soil improvement methods are one of the tools available for engineers to solve soil stability problems or soil deformations during project development. Many techniques have been developed by geotechnical engineers in the 20th century. They help to improve the soils' geotechnical characteristics and mechanical properties. Some of these are old, like soil treatment with lime or cement, while others are more recent, such as mixed treatment (Bell 1996, CRR 2004b, Estabragh et al. 2013). For two decades, they have witnessed considerable improvement and are now used in a very broad way in road projects.

2.1 Treatment with lime

The interactions of lime with the soil particles can be described by a series of complex physical and chemical processes that affect the mechanical behavior of soils. Generally, there are two effects during lime treatment (Bell 1993, Muntohar and Hantoro 2000, CRR 2004a). At first, there is a so-called short-term or immediate effect, which occurs in the following hours of the contact between the lime and the soil and leads to flocculation / agglomeration of the soil particles. This results in a change in the texture of the soil. In a second step, there is an effect, said to be long-term, in which pozzolanic reactions occur. These reactions, which take place in the presence of water, between the lime and compounds composed of silicon and / or aluminum, lead to the formation of pozzolanic compounds that develop through time.

2.2 Treatment with cement

The cement quickly hardens the soil irreversibility, but if there will be rupture of soil treated (mechanical action) there is no new cement reaction. Cement setting is faster than lime (which is still evolving after a year), but it is stopped by frost (Ghembaza et al. 2012).

There are several similarities between lime and cement as stabilizers (Bahar et al. 2004, Al-Rawas 2005), some distinctions must be identified before making a choice. These differences include the durability and permanence of the effects of treatment, initial resistance, the development of resistance as a function of time and curing time (Little et al. 2000). The treatment efficiency depends on the quantity of cement used and the type of soil (Evangelos and Stavridakis 2006). Studies have shown that clayey materials with low plasticity indexes are better suited to be stabilized with cement (Muhunthan and Sariosseiri 2008).

2.2 Combined treatment (lime-cement)

In the case of wet soil, lime is recommended and for low-clay, cement is recommended. For the combined treatment, lime is used firstly at low rates (0.5 to 2%) and thereafter, we add cement, because these binders have a complementary action (Morel, 1984).

The lime pretreatment, by its immediate action, brings the soil to an optimal state for its treatment with cement (DAAF 1994) which is due to a microstructural organization (Lemaire et al. 2013).

3. Materials

3.1 Soil

The soil used in this study is a silty soil obtained from a deposit called Sidi El-Abed which is situated to the east of Tiaret city (Algeria). Some of the soil index properties and chemical tests are presented in Table 1.

According to the road earthworks guide (LCPC 1992), the soil is classified as A1 class and subclass A1ts (low plastic silt).

3.2 Lime

The lime was brought from Saida factory (Algeria). The main physical and chemical properties of lime are presented in Table 2.

3.2 Cement

The cement was brought from Chlef factory (Algeria). It is a Portland cement class; CPJ-CEM II/ A 42,5. It consists principally of Clinker Portland (80 to 90%), pure calcareous (6 to 20 %) and secondary components (0 to 5% of calcium as a setting regulator). The main physical and chemical characteristics of cement are summarized in Table 3.

Table 1 Main physical and chemical properties of natural soil

Value of Dmax (mm)	Sieved over #80 sieve	Natural water content (wnat)	WOPM (%)	Plasticity Index Ip	VBS*	Carbonate rate
31,5	39 %	6,32 %	10.82	13,15	1,0 %	82 %

*VBS: Methylene blue value

Table 2 Main physical and chemical properties of lime

CaO (%)	MgO (%)	Fe_2O_3 (%)	Al_2O_3 (%)	SiO_2 (%)	SO_3 (%)	Na_2O (%)
> 73.3	<0.5	<2	<1.5	<2.5	<0.5	0.4-0.5
CO_2	$CaCO_3$	Specific Density (g/cm^3)	Over 90 µm (%)	Over 630 µm (%)	Insoluble material (%)	Apparent density (g/l)
<5	<10	2	<10	0	<1	600-900

Table 3 Main physical and chemical characteristics of cement

SO3 (%)	Cl (%)	Initial setting	Heat stability	Shrinkage at 28 days	Min Compressive strength	Max Compressive strength
≤ 2	≤ 0.08	> 60min	<7mm	<650µm/m	42,5 N/mm2	62,5 N/mm2

4. Methodology

4.1 Consistency and bearing tests performed on treated and natural soil

The soil studied was treated by adding of 3 and 5% of lime (S+3L and S+5L). The same percentages were applied to the soil treated with cement (S+3C and S+5C) in order to compare the results of binder effects. However, for the mixed treatment, the lime was added firstly at a percentage of 1% (pretreatment) and then 2 and 4% of cement was added to the soil (S+1L+2C and S+1L+4C).

The experiments were conducted to determine the Atterberg's limits, compaction characteristics and California Bearing Ratio (CBR). The tests were carried out according to European and French test standards (AFNOR 1993, 1999, 1997).

4.2 Durability tests performed on treated soil

The durability test is used to ensure the sustainability of the soil. The test is conducted according to an ASTM standard test method D 559-96 (ASTM 1996). The latter covers procedures for determining losses in the soil-binder, water content changes and volume changes (swelling and shrinkage) produced by repeated wetting and drying of soil-cement specimens.

These test methods are applied to soil treated with cement, but it can be generalized for other soil-binders, such as soil treated with lime.

Samples were prepared with varying binder contents. A set of two specimens were prepared for each mixture. These specimens were compacted at the optimum moisture content obtained from the Proctor compaction test. The test requires measurements and samples handling for each cycle of wetting and drying procedures over 24 days.

5. Results and discussion

The change in the plasticity index in terms of the percentage of lime and cement is shown in Fig. 1. It was noted that there is a decrease in the plasticity index when the binder content increases. Indeed, adding lime to the soil develops an agglomeration of fine clay particles into crumbly coarse ones (flocculation of clay) and therefore, a reduction in the plasticity index (Estabragh et al. 2013). The same tendency was observed when the cement was added into the soil, which is due to cementitious links between the calcium silicate and aluminate hydration products and the soil particles (Bahar et al. 2004, Estabragh et al. 2013, Phanikumar et al. 2014). It was found that mixed treatment significantly reduces the plasticity index compared to single treatment (with cement or lime). The same result was obtained by Khemissa and Mahamedi (2014) for expansive clay treated with 4% of lime and 8% of cement.

Adding binders to the soil renders it less sensitive to water and modifies its consistency and therefore, allows an improvement in the soil workability characteristics by the effect of cementing and pozzolanic reactions.

Fig. 2 shows compaction curves for various soil and mixtures obtained from the Proctor test. It can be observed that the addition of binders increases the optimum moisture content of the soil proportionally with the percentage of treating agent, because this latter needs a supplementary quantity of water. The optimum dry density for treated soil with a single binder is less than that for untreated soil. However, for the mixed treatment, the optimum dry density is greater than that for natural soil, which can be explained by the fact that the pretreatment limits the volume change of the soil.

For the soil treated with lime, the dry density increases with the increase in the percentage of lime, which can be justified by the fact that flocculated particles might be collapsed under compaction and therefore, causing an increase in dry density. However, for the soil treated with cement, the dry density decreases with the increase in the amount of cement.

California Bearing Ratio (CBR) results of soil and mixtures obtained with a high compaction effort are presented in Fig. 3. It was noted that the cement modification is more efficient than the lime modification in CBR results. The maximum CBR is obtained for the mixed treatment with 1% of lime and 4% of cement, which confirms the result obtained for the plasticity index (Khemissa and Mahamedi 2014).

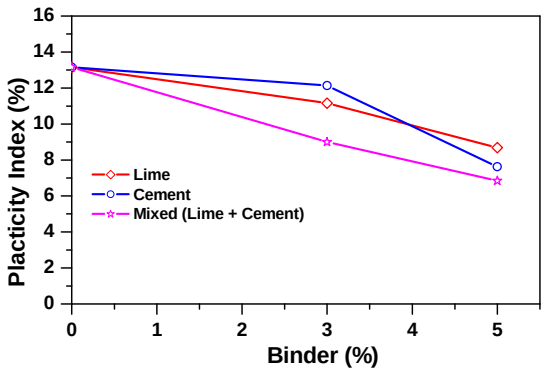

Fig. 1 Effect of treatment on plasticity index

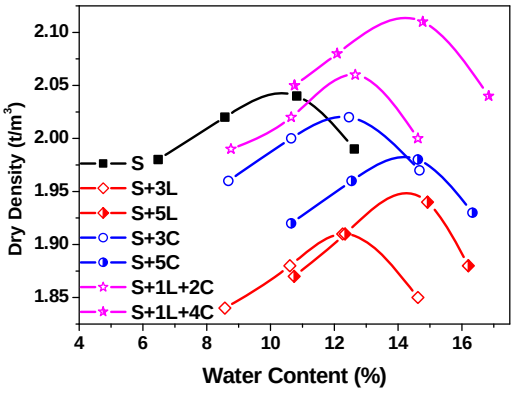

Fig. 2 Compaction curves of soil and mixtures

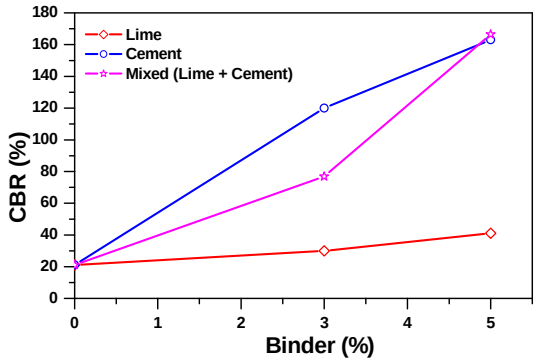

Fig. 3 CBR Results of mixtures

Fig. 4 shows the results of the durability test performed on various mixtures. It can be observed from the graph that the maximum percentage weight loss was obtained for soil treated with 3% of lime, which is about 30%, because lime has a limited effect to prevent shrinkage (Stoltz and al. 2012). The least weight loss was obtained for the mixed treatment with 1% of lime plus 4% of cement. It seems that soil treated with lime or with a small amount of cement presents no resistance for durability, as the percentage weight loss exceeds 10%. Such a threshold is fixed for silty soil by the Canadian Portland Association (Noor Megat 1994). Thus, the mixed treatment with 1% of lime and 4% of cement is the only mixture which satisfied the durability requirements. Nevertheless, the soil treated with 5% of cement presents a weight loss situated on the edge of the threshold, although the cement has a good reputation for having a good resistance against wet-dry cycling tests. Filippo and Puppala (2012) concluded in their study performed on the treatment of plastic clay with lime and cement that the combined treatment emerges as a strategy for improving the immediate performance of the treated soil. Furthermore, Nagaraj et al. (2014) found that the mixture with lime and cement offers a high strength in the long-term of compressed stabilized Earth Blocks (CSEBs). This confirms the effectiveness of the combined treatment. Indeed, the addition of lime at a rate of 1% may be a sufficient quantity to lead to an increase in the pH of the mixture and allows one to stimulate pozzolanic reactions by adding up to 4% of cement, which contributes to the strengthens of the treated soil by the self hydration of the cement.

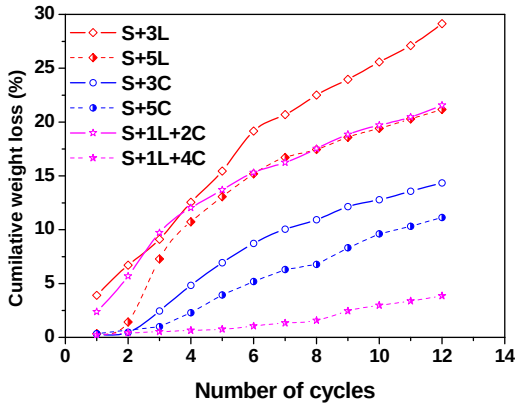

Fig. 4 Wetting and drying test on several mixtures

It can be concluded that the addition of lime or a small amount of cement slightly influenced durability resistance, while an additional amount of cement will lead to a significant decrease in weight loss and therefore, a good sustainable resistance of pavement layers prepared within the combined treatment of silty soil.

6. Conclusions

This paper aimed to study the durability of a silty soil treated with cement and lime for its valorization in embankments or subgrade layers using a technical process which fits sustainable development. Choosing this silty soil is justified by its processability, on the one hand, and its abundance, on the other.

It was found that the treatment of the soil with lime and/or cement significantly modifies the consistency of the soil and improves its workability characteristics. However, cement modification is more efficient than lime modification in improving CBR. It was also noted that the combined-agent treatment with 1% of lime and 4% of cement gave the greatest CBR.

Furthermore, it was concluded that to ensure durability of pavement layers performed with treated silty soil, it may be preferable to opt for a mixed treatment with lime at a low rate (around 1%) and cement at relatively higher rates (around 5%).

Acknowledgments

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Heart Attack Prediction System Based Neural Arbitration

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Abstract: Heart attack is an asymptomatic and epidemic medical condition that may suddenly occur and causes "death". Therefore, it is a life-threatening condition and it should be detected before it occurs. Heart attack is so far predicted using the conventional ways of doctor's examination and by performing some medical tests such as stress test, ECG, and heart CT-Scan etc. The coronary vessels constriction, the cholesterol levels in the arteries, and other attributes can be good indicators for making effective decisions. In this paper, a neural network based support decision system is developed for the prediction of heart attack. The proposed system uses 14 medical attributes, obtained from the Cleveland database such as sex, heart rate, and vessels narrowing etc. Two attributes have been emphasized in order to distinguish the heart attack from other heart diseases; the vessels constriction rate and the chest pain type. The testing results show high efficiency and capability for the designed system to predict heart attack and diagnose the three medical conditions: normal, abnormal, and imminent to heart attack.

Key words: Heart attack, asymptomatic, epidemic

Introduction

Heart is the basic part of the body. Heart-failure is a serious medical situation in which this vital organ doesn't operate properly. The malfunctioning of the heart may impact the whole body organs since it is affiliated with all the body parts through its arteries and veins. One of the most dangerous and insidious heart diseases is the heart attack. It can be delineated as a chest pain aligned with a constriction in the coronary vessels which is called atherosclerosis. The two main indicators for heart attack that/ have been focused on in this work are the type of chest pain and the coronary vessels clogging rate. The centre of disease control and protection (CDC) has estimated that about 720,000 Americans have a heart attack every year. 525,000 of these are a first heart attack and 190,000 happen in people who have already had a heart attack ("Every year about **720,000 Americans** have a heart attack", n.d.). Due to these dangerous upshots, there should be a way to predict a heart attack. The heart diseases can be diagnosed by their signs and symptoms. Heart attack is one of the riskiest heart diseases and it has the same signs and symptoms of other heart diseases, in addition to the plaques buildup in the coronary arteries which rupture inside of arteries, and the unstable angina which may be a warning sign for a heart attack.
Data mining is the automatic study (analysis) of stored data to elicit the results and find patterns beyond these data. Nowadays, various diagnostic and patient medical records devices which may store a huge amount of data are found (Nabeel Al-Milli, 2013). Therefore, these medical data that may indicate a heart attack must be stored and processed using data mining technique based neural network; in order to spring up a decision making system for the prediction of a heart attack.
The overall structural format of the paper is as follows. The first section is an introduction. The section 2 is a literature review which lists some studies related to the topic. The section 3 discusses the neural network and backpropagation algorithm. The section 4 discusses the data representation. The section 5 discusses the training and performance of the created neural network. Finally the section 6 is a conclusion of the whole work.

Literature Review

Nabeel Al-Milli (Nabeel Al-Milli, 2013) developed a heart disease prediction system using neural network. 14 parameters were used in this work with 4 output classes. The backpropagation algorithm was used for training the network and the experiments conducted in this work have shown the good performance of the proposed algorithm. Heart diseases dataset is analysed using Neural Network approach by Dr. K. Usha (K. Usha Rani, 2011). In this work a parallel approach is adopted in the training phase in order to increase the efficiency of the classification process.

Heart Disease Prediction system (HDPS) using neural network has been proposed by Chaitrali S. Dangare, Mrs. Sulabha S. Apte (Chaitrali S. Dangare, Sulabha S. Apte, 2012). The authors used 13 medical attributes such as sex, cholesterol level, and stress test in addition to two other attributes which are the smoking and the obesity in order to get a better accuracy. The HDPS system predicts the likelihood of patient getting a Heart disease. The accuracy of this designed system was nearly 100%.

Dilip Roy Chowdhury, Mridula Chatterjee R. K. Samanta (Dilip Roy Chowdhury, Mridula Chatterjee R.K. Samanta, 2011) applied an artificial neural network model for neonatal disease. The authors proposed a technique with a backpropgation algorithm for recognizing a pattern for the prediction of neonatal diseases. This proposed system was capable to predict and enhance the diagnosis accuracy of 75% of the neonatal diseases.

Artificial Neural Network (ANN)

Artificial neural network is a remodelling of the human brain information processing system. It is a multilayer system in which each layer is composed of multiple nodes which represent the neurons. Each node is connected to the others by means of edges represent the weights which are the information transmitted (Adnan Khashman, 2011). ANN is principally composed of multilayers: input layer, one or more hidden layer, and output layer. The input from the previous layer is multiplied by the adjusted weights. At each node or neuron the weighted inputs are added and then the combined inputs pass through a non-linear transfer function in order to produce the desired output (K. Anil Jain, Jianchang Mao and K.M. Mohiuddi, 1996). ANN is basically developed to solve data mining applications. It is an adaptive learning technique in which it has a different and specific learning methodology; the learning by examples. Therefore; some complex tasks can be handled using neural networks such as prediction, recognition, and classification (R. Rojas, 1996). Various learning and training algorithms can be used to train the network. One of the most public used algorithms is the backpropagation algorithm. In order to produce the desired output, the input weights should be adjusted and the correction-error should be reduced. The most popular used learning algorithm for updating the weights and correcting the learning error is the backpropagation algorithm. Backpropagation is a learning technique for the feedforward multilayer neural networks. It has two passes through the different layers; the forward pass and the backward pass. In the forward pass the weights are summed and then combined in the output layer. In the backward pass the weights are corrected. The actual output is subtracted from the desired one in order to produce the error. The error is then propagated back to all previous layers in order to update the weights and get the desired output (Nabeel Al-Milli, 2013).

Heart Attack Prediction System (HAPS) based neural network

In this paper, we develop a heart attack prediction system based neural network using backpropagation learning algorithm. 14 parameters are used as inputs for the network such as sex, heart rate, and cholesterol level. The main parameters that have been emphasized on to predict heart attack are the chest pain type and the coronary vessels constriction rate. The dataset is obtained from Cleveland database. It is a well-known database available on the internet (Bache, K. & Lichman, M., 2013). 300 records are taken. They are classified as 3 output classes: Normal, Abnormal, and imminent to heart attack. The 300 records are divided into 2 sets: 150 for training and 150 for testing. The training set is also divided into 3 sets: 50 for normal, 50 for abnormal and 50 for imminent to HA. The testing set is divided into 3 sets also: 50 for normal, 50 for abnormal and 50 for imminent to HA.

Data Representation

Most research papers related to heart diseases prediction used these 14 parameters according to their description provided by Cleveland database. Here, we use the 14 attributes; however, we focus on two main parameters in order to distinguish heart attack from other heart diseases. Table 1 illustrates the medical data used as inputs for the networks. Table 2 illustrates the output classes according to our proposed system.

Table 1: Cleveland Parameters (Bache, K. & Lichman, M., 2013).

Parameters	Description	Range
Age	Age in years	Continuous
Sex	1=male,0=female	1,0
cp	Value 1: typical angina Value 2: atypical angina Value 3: non-anginal pain Value 4: asymptomatic	1,2,3,4
trestbps	Resting blood pressure(in mm Hg)	Continuous
Chol	Serum cholesterol in mg/dl	Continuous
fbs	(Fasting blood sugar .120mg/dl) (1=true; 0=false)	0, 1
ECG	electrocardiography results Value 0: normal Value 1: having ST-T wave abnormality(T wave inversions and/or ST Elevation or depression of >0.05mV) Value 2: showing probable or definite left	0, 1, 2
Thalach	Maximum heart rate achieved	Continuous
Exang	Exercise induced angina (1:yes; 0:no)	0,1
Oldpeak	ST depression induced by exercise relative to rest	Continuous
Slope	The slope of the peak exercise ST segment Value 1: up sloping Value 2: flat Value 3: down sloping	0, 1, 2
Ca	Number of major vessels(0-3) colored by fluoroscopy	Continuous
Thal	Normal, fixed defect, reversible defect	3, 6, 7
Num	Number of major narrowed vessels: 0:<50% narrowing 1:>50% narrowing	0, 1

Table 2: Output Classes

Classes	Description
Class 1	Normal
Class 2	Abnormal
Class 3	Imminent to HA

Normal: all parameters are normal
Abnormal: all parameters are out of their normal ranges (abnormal) except the chest pain type and vessels constriction in which they don't indicate a heart attack
Imminent to HA: all parameters are not normal, as well as the chest pain type and the vessels constriction rate which indicate heart attack. For instance, for a case, the chest pain type is typical angina and the coronary vessels constriction rate is greater than 50%.

ANN Topology

The network was created on matlab software using the back propagation algorithm. The first step was to create a basic network and train it for simple operation such as 'AND" or 'OR' in order to reduce the mean sum error value to 0.01. All training is done using backpropagation with both adaptive learning rate and momentum; with the function 'traingdx' and with the transfer function 'logsig'. The network was fed with the normalized datasets for the three sets and their output targets respectively. Figure 2 illustrates a multilayer neural network with 14 neurons in the input layer, 5 neurons in the hidden layer, and 3 neurons in the output layer. We ran the experiments for 10000 iterations.
Table 3 represents 5 records data of the 14 attributes before normalization. Table 4 represents the same data after normalization.

Table 3: ANN Parameters Setting

Parameters	Value
Number of neurons in input layer	14
Number of neurons in output layer	3
Number of neurons in hidden layer	5
Iterations number	10000
Learning rate	0.001
Momentum rate	0.5
Error	0.001
Activation Function	Sigmoid

Table 3 shows all the parameters used when training the network. The network ran for 10000 iterations with a learning rate of 0.001, a momentum rate of 0.5 and a minimum error of 0.001 since it is a medical application.

Table 4: Normalized attribute values for 4 patients

Attributes	Patient 1	Patient 2	Patient 3	Patient 4
1	0.4308	0.446	0.492	0.523
2	1	1	0	0
3	0.5	0.5	0.5	0.5
4	0.4667	0.35	0.583	0.5
5	0.396	0.383	0.457	0.398
6	0	1	0	1
7	1	0	0	0
8	0.45	0.533	0.6	0.633
9	1	0	0	0
10	0.475	0.25	0.3	0.7
11	0.5	0	0.25	0.25
12	0	0	0	0
13	0.4286	0.857	0.428	0.428
14	0	0	0	0

Table 5: Attribute values for 4 patients before normalization

Attributes	Patient 1	Patient 2	Patient 3	Patient 4
1	28	29	32	34
2	1	1	0	0
3	2	2	2	2
4	130	140	105	130
5	132	135	198	161
6	0	0	0	0
7	2	0	0	0
8	185	170	165	190
9	0	0	0	0
10	1.3	0.5	0.2	0.8
11	1	1	1	2
12	0	0	0	0
13	3	3	3	6
14	0	0	0	0

Figure 1 illustrates the designed neural network architecture for our proposed system. (x1,…x14) represent the medical parameters which are the inputs of the network. The connections between the neurons called the weights. Each neuron in the input layer is connected to the succeeded neurons in the hidden layer. Moreover, each neuron in the hidden layer is connected to the three output neurons. Sigmoid function is used as a transfer function for the network.

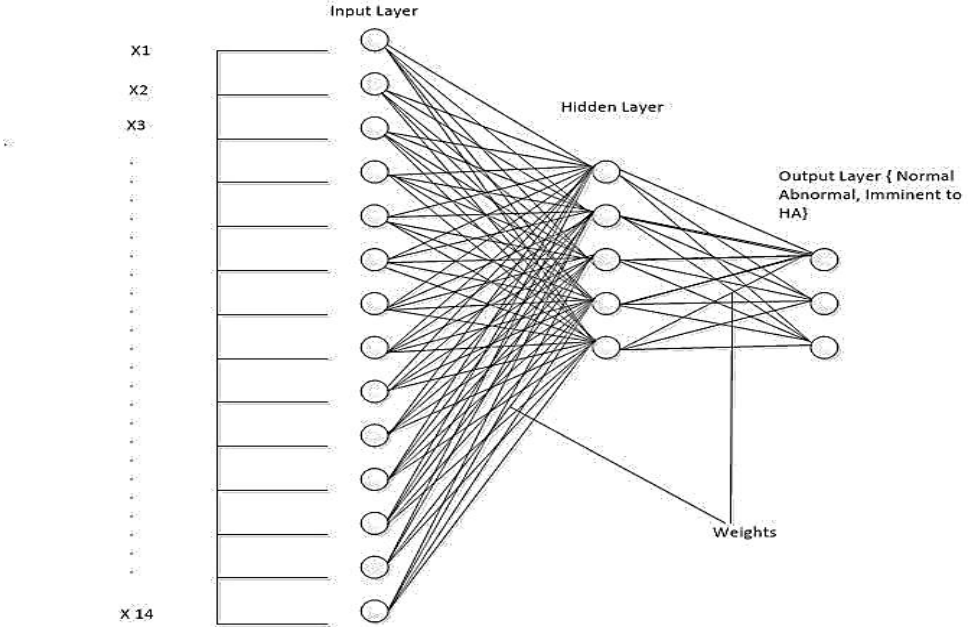

Figure 1: ANN Model

System Training

The network was trained on three different sets; first set is for the normal values and it contains 50 records, second set is for the abnormal values and it contains 50 records and the last set is for the imminent to HA values and it contains 50 records. The following is the training results of the three sets (learning curve).

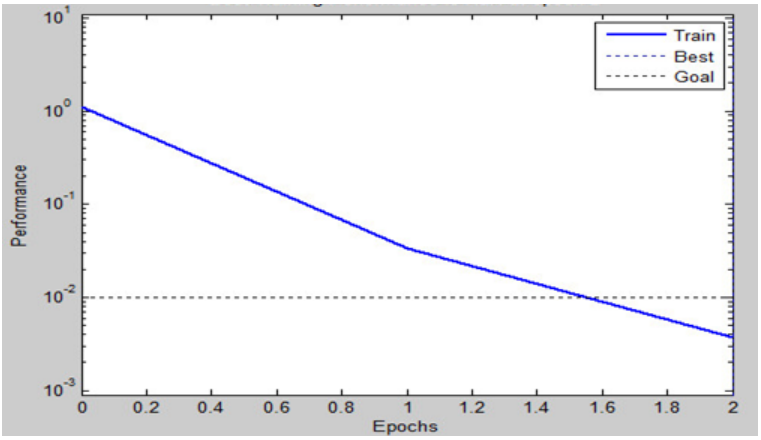

Figure 2: Variation of the MSE with the iteration number.

This curve below represents the regression plot of the desired output (dotted line) and the actual output. As the actual output is far from the target as the error is increased. In this figure, it is remarked that the target and the actual output are very close which means that the error is minimized and the network well trained (training ratio = 96%).

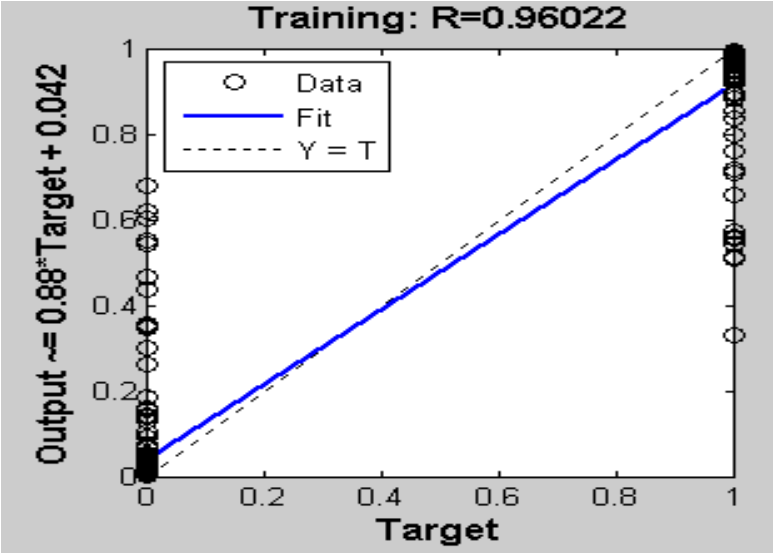

Figure 3: Actual versus target output

Network Performance

The network was tested on a dataset of 150 records; 50 for normal, 50 for abnormal and 50 for severe cases. Table 6 represents the results obtained from two runs for the three different classes (Normal, Abnormal and imminent to HA). This table below represents the number of records that were recognized by the network in the training and the testing phase. The number of recognized records was divided by the total number of records with respect to each case set (Normal, Abnormal, and imminent to HA). The result of this fraction is called the recognition rate.

Table 6: Recognition rate

	Runs	Classes	Training Sets (150)	Testing Sets (150)	Total
Recognition rate	1	Normal	99%	95%	97%
		Abnormal	96%	91%	94%
		Imminent to HA	97%	90%	93%
	2	Normal	94%	94%	94%
		Abnormal	97%	90%	95%
		Imminent to HA	97%	92%	93%
		All classes	96%	92%	94%

The total recognition rate for the training set is 96% and for the testing set is 92% which means that some records were not recognized correctly. The difference of training results of both runs is due to the changes in the set learning and momentum rate. As a result, the total recognition rate is 94% and it is a satisfying result for such medical application. Table 6 presents some recognized records of three different cases (Normal, Abnormal,

Imminent to HA) during the testing phase.

Conclusion

In this study, a heart attack prediction system based neural network was developed. Data mining technique was used to discover knowledge beyond a simple analysis of some medical data related to heart attack. The designed system was capable of diagnosing the three medical conditions: Normal, Abnormal and imminent to HA. The developed system used 14 medical parameters that may indicate heart attack if their values are out of normal ranges. The experimental results of the neural network were satisfactory for such prediction task and they can be furthermore improved.

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Mycorrhizal status of main spontaneous or introduced forest trees in El Tarf province (Algerian North-east)

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Abstract: In Algeria, often, serious imbalances of the forest ecosystems caused by the badly led exploitations, the repeated fires, the overgrazing involve the disappearance of the timbered state on vast territories. Within the framework of the plantation and restoration programs of these degraded forests, we plan to contribute to it by tests of controlled mycorrhization of forest tees in nursery. But to realize these tests, it is necessary to know beforehand the natural symbiotic status of the studied species.
We present there, the first stage of our work which consisted in establishing the mycorrhizal status of main spontaneous or introduced forest species into Algerian North-east. The study was carried out in El Tarf province and related to all the species of pine, oaks and other leafy trees existing in this area.
The results show that all the species observed have either ectomycorrhizas (ECM) or arbuscular endomycorrhizas (AM) or both at the same time. In addition, the introduced species of the *Acacia* or *Casuarina* genus carry AM and also nitrogen fixing nodules. It should be noted the remarkable diversity of ectomycorrhizal morphotypes associated to the pines and to the oaks and also that of the endomycorhizals fungi spores occur in the rhizosphere of other species.
Lastly, it is significant to note the omnipresence of *Cenococcum geophilum* mycorrhiza in all the stations and the majority of the ectomycorrhizal trees.

Keywords: ectomycorrhizas, arbuscular mycorrhizas, forest species, Algerian North-east

Introduction

In the Algerian North-East, the forest ecosystems play a socio-economic, ecological and entertaining role of first order (Messaoudène *et al.*, 1996). However, each year, the surface of these forests is reduced seriously because of many factors such as the long dry season, overgrazing, fires and overexploitation.
Today, the reconstitution of these forests proves to be of need consequently to increase the possibilities of trees to fight against the external agents proves more than necessary. In addition, it was established that the majority of the forest trees contract symbiotic associations with some fungi and bacteria of the soil which gives opportunity to the tree to resist the drastic effects of the climate, the lack of nutrients provided from the soil and the parasitic attacks (Dommergues *et al*., 1999; Smith and Read, 2008).

In this way, we foresee experiments of controlled mycorrhization in nurseries. But before, we think that the knowledge of the symbiotic status of the various species is an essential step. It is the subject of this present article. Our study proceeded in the El Tarf province (the extreme algerian North-east) and related to the trees or the shrubs of the forest ecosystems of plain, dune and mountain as well as the ripicolous ecosystems.

Materials and methods

-Presentation of the study zone and stations

The study zone is the area of Algeria limited by the Mediterranean Sea to north, the hills of the Tellian Atlas in the south and the west and by the Tunisian border in the east (Fig.1). It is characterized by an average rain fall of 910 mm/year and an average maximum temperature around 18°C. The coldest months are January and February whereas July and August are hottest. The dry season lasts nearly 4 months and the atmospheric humidity goes between 69 and 74%. According to the Emberger climagramm (1955), the area of El Tarf extends from the sub wet to wet bioclimatic stage of vegetation (de Belair, 1990) and stands on deposits and alluvia, numidians siliceous flyshs and dunes. In this area, altitude varies sea level up to 1202m.
The geological constitution of the basement gather only nummulitic grounds dating primarily from the tertiary sector and quaternary (Joleau, 1936).The most advanced soils are under the oaks and the pines, they are forest

brown soils. The hills are characterized by sandstones and Numidian clays, the depressions by alluvia and colluviums (Marre, 1992). The localization and the description of the study stations are presented in figure1 and table 1.

Fig. 1: ▽ Localization of sampling stations (scale : 1 /1000000)

Table 1: Localization and characteristics of the various sampling stations

Stations	Brief description of the station
S1	Maquis of kermes oak on littoral dune. Ben Mhidi county, 2 km after oued Mafragh, altitude: 20m
S2	Plantation of maritime pine, Righia, Berrihane county, alt.: 50m
S3	Forest of cork oak and ripisylvaie, Righia, Berrihane county, 18 km after the Righia village, in direction of El-Kala, alt.: 50m
S4	Forest of cork oak. El-Koursi county, in the West of the Mellah lake, alt.: 100m
S5	Degraded forest of cork oak. El Kala county, natural reserve of Braptia, full southern with Mellah lake, alt.: 87m
S6	Plantation of Eucalyptus and Acacia. El Kala county, alt.: 50m
S7	Mix introduced species Souarak county, arboretum of Tonga, alder grove, alt.: 50m
S8	Mixed forest of cork oak-zeen oak. Bougous county, 500m after the Bougous village, alt.: 260 m
S9	Forest of zeen oak, jebel Ghorra, Bougous county, 2 km after the Bougous village towards the Tunisian border, alt.: 850 m

-Estimate of the mycorrhizal colonization

For each station, we took root samples of ten individuals of each tree species present in the settlement. Part of the fine roots was observed directly with the dissecting microscope in order to seek the ectomycorrhizas (ECM), which made it possible to distinguish different morphotypes according Agerer (1987-1996) description. On the other part, the frequency of the arbuscular mycorrhizal (AM) colonization was evaluated by the method of Trouvelot *et al.* (1986) after staining with the acid fuschine or Chlorazol black according to the technique of Kormanik *et al* (1980). Lastly, the *Rhizobium* or *Frankia* infection was detected by the presence of nodules.

- Extraction of Glomalean fungi spores

This research was carried out on soil samples taken of from A*cacia decurrens* rhizosphere in mixture with *Eucalyptus camaldulensis* in the El kala station (S6). The arbuscular mycorrhizal fungi (AMF) spores or sporocarpes were extracted according to the wet sieving technique (Gerdeman, 1963).
Their identification was tried by means of Schenck & Perez (1986) key.

Results and discussion

The results show the existence of mutualist symbiosis in all the prospected species. Whatever were the species either main one (cork oak, zeen oak and maritime pine), the secondary species (alder , chestnut, merisier, laurel…) or the introduced species (eucalyptus, acacia, cypress...), they carry all either ECM or AM or both at the same time. We thus share the suggestion formulated by Trappe (1977) and then by Selosse and Le Tacon (1999) according to which the mycorrhizal state is a general state in the plant world.
Among the observed ectomycorrhizal morphotypes, *Cenococcum geophilum* mycorhiza (Fig. 2), easily recognizable, is in the majority and omnipresent as well at the oaks and the pines or other trees (chestnut, eucalyptus). *Cenococcum geophilum* is a fungus which has a great capacity to infect trees of different species and under varied ecological conditions (Le Tacon, 1997). When the water stress established (in summer), much of mycorrhizas is destroyed, those of *Cenococcum geophilum* are however more resistant (Garbaye & Guehl, 1997).

Its omnipresence at the majority of the studied forest species reveals difficult environmental conditions. Indeed, the Mediterranean forest constitutes an ecosystem submitted to strong edaphic, climatic and economic constraints which stimulates *Cenococcum geophilum* to be proliferating in this medium type.

According to Selosse and Le Tacon (1999), this species which is met in all the planet natural ecosystems with ectomycorrhizas, would contribute probably universally, to the survival of the forest trees with ectomycorrhizas during the water stress periods. Secondary species of the oak forest, spontaneous ones (wild cherry tree, bay-tree, alder, poplar…) or are introduced (hazel-tree, eucalyptus…) present an AM frequency infection ranging between 25 and 60% in the majority of the cases.
Acacia and *Casuarina*, although introduced species in Algeria present an additional infection respectively by *Rhizobium* and *Frankia*. The research of the Glomalean spores in the rhizosphere of *Acacia mearnsii* and *Eucalyptus camaldulensis* revealed a very significant morphotypic diversity (Fig. 3). The *Glomus* genus seems prevalent.

Table 2: Mycorrhizal status of main studied forest species (ECM: ectomycorrhiza, AM: arbuscular mycorrhiza, R: *Rhizobium* nodules, Fr.: *Frankia* actinorhizas)

Family	Plant Species and sampling stations (S)	Type of symbiosis and % of colonisation	Number of ECM morphotype
Pinaceae	*Pinus maritima* Lam S2	ECM (82,12)	10
	Pinus pinea L., S8	ECM (64,22)	4
	Pinus radiata L., S8	ECM (33,35)	2
Cupressaceae	*Juniperus oxycedrus* L., S6	MA (19,22)	-
	Cupressus sempervirens L., S6	ECM (58,64), MA (29,2)	3
Taxodiacea	*Taxodium disticum* L., S 8	MA (26,22)	-
Casuarinaceae	*Casuarina equisetifolia* Forst., S1	MA (58,02), F	-
	C. cunningamiana Miq.	MA (50,66), F	-
	C. obesa Miq.	MA (44,35), F	-
Fagaceae	*Quercus suber* L., S3, S4, S5, S6.	ECM (68,71), MA (09,00)	14
	Quercus faginea L., S4, S7,	ECM (62,32)	9
	Quercus coccifera L., S1	ECM (49,13)	2
	Castanea sativa L., S7	ECM (50,42), MA (41,15)	7
Betulaceae	*Alnus glutinosa* L.Gaertn, S2, S8	ECM (61,43), MA (25,52)	8
Salicaceae	*Populus alba* L., S5	ECM (28,40), MA (31,86)	4
	Salix pedicellata L., S5	MA (25,03)	-
	Salix babylonica L, S2, S8	MA (23,62)	-
Corylaceae	*Corylus avellana* L., S7	MA (29,24)	8
Juglandaceae	*Juglans regia* L., S8	MA (33,15)	-
Rosaceae	*Cerasus avium* L., S7	MA (44,09)	-
	Crataegus monogyna Jacq., S5	MA (38,64)	-
	Rubus ulmifolius L., S5,	MA (58,37)	-
Lauraceae	*Laurus nobilis* L., S5	MA(63,05)	-
Oleaceae	*Fraxinus oxyphylla* L., S8	MA (40,42)	-
	Olea europaea L., S1, S5	MA (51,56)	-
	Olea oleaster Link., S1, S5	MA (44,32)	-
	Phillyrea media L., S1, S5, ,S4	MA (65,62)	-
Anacardiaceae	*Pistacia lentiscus* L., S1, S5	MA (35,39)	-
Myrtaceae	*Myrtus communis* L., S3, S5	MA (63,54)	-
	Eucalyptus globulus Labill., S6, S8	ECM (36,80), MA (12,96)	3
	Eucalyptus camaldulensis Dehnh, S6	ECM (30,72), MA (15,06)	3
Fabaceae	*Ceratonia siliqua* L., S7	MA(35,44)	-
	Calycotome villosa Link. S5,	MA (60,00)	-
	Genista ferox L., S6	MA (30,39)	-
	Genista numidica L., S6	MA (29,35)	-
	Cytisus triflorus L'Herit., S6	MA (29,12)	-
	Acacia cyanophylla Benth., S8	MA (68,20), R	-
	Acacia mearnsii De Wild., S8	MA (72,75), R	-
	Acacia melanoxylon R., S8	MA (61,23), R	-
	Acacia retinoides Willd., S8	MA (42,26), R	-
	Retama monosperma subsp bovei Spach (Maire) S1	MA (08,77), R	-
Cistaceae	*Cistus monspelliensis* L.S2,S3,S5	ECM (09, 75), MA (18,77)	1
	Halimium halimifolium (L) Wilk	MA (42,42)	-

Figure 2: *Cenococcum geophylum* mycorrhiza colonizing the roots of *Quercus suber* (photo Adouane)

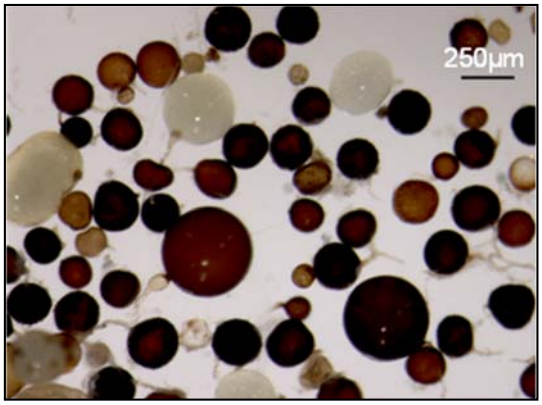

Figure 3:Various morphotypes of spores in the *Acacia mearnsii* rhizosphere (photo Meddad)

Conclusion

The results of this study allow us to give the following conclusions:
All the prospected trees present either an ECM or an AM colonization or both. Alder and filao carry actinorhizas, all Fabaceae are nodulated.
It is advisable to reinforce this study by identifying and by isolating the micro-organisms implicated in various symbiosis observed. These symbiotic microorganisms play certainly a significant role in the trees nutrition. But, do they act in an optimal way?

To make them profitable, intensifying the programs of biodiversity inventory of the whole knowledge is a requisite to any reliable biological or applied research, in order to select the most powerful strains by comparing them with known introduced strains. In this manner, the most performed strains will be selected. The exploitation of *Cenococcum geophilum* fungus would be also a significant way to explore.
To conclude, let us say simply that Algeria suffers from two flails, desertification and deforestation which dangerously accelerated after climatic changes and also under the effect of the intensive methods of exploitation and irrigation. Among the likely approaches susceptible to act against these two flails, one of most promising is that of to master the controlled mycorrhization in order to produce seedlings of good quality and to realize the successful afforestations.

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Performance Study of an Oil Palm Fresh Fruit Bunch Three Wheeler Evacuation Machine

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Abstract: A case study to determine performance of Three Wheeler evacuation machine was done at Felda Plantation. Using 20kg (average) of fresh fruit bunch (FFB), A machine was tested at different topography where the area are 0.7 hectares (terrace), 1.5 hectare flat area, 1.5 hectare mild undulating and 1.5 hectare heavy undulating. Method of optimum was used to determine performance three wheeler where the performance between 73% to 77% efficiency measured. From experiment also shows three wheeler can access all train in oil palm plantation.

Keyword: Oil Palm Fresh Fruit Bunch, evacuation, topography, three wheeler

Introduction

Oil palm area production of oil palm fresh fruit bunch (FFB) for last 5 year was increased to 5.05 million MT, as FFB improved to 19.59 MT per hectare (ha) from 19.12 MT per ha in 2012(Media released) . This data showed a good tool must have to harvest and evacuate oil palm FFB and loose fruit (LF). Tool in oil palm plantation was used to do a job for harvesting and evacuating include cutting and loading a FFB. Starting with the use of the sickle/chisel, cut the bunch will be identified after ripening. Sickle and chisel is a sharp instrument made of steel. Normally sickle and chisel will be affixed on the end of bamboo, round timber, steel and aluminium are also called pole. The length of the pole and timber depends on tree height and tree age. After FFB cut using the equipment will be transported by wheelbarrow or any powered machinery. In mechanization term, applied of machine or any tool in assist of work in field collection of oil palm plantation with indicator of production in tonne/day. In history of harvesting oil palm FFB, FFB and loose fruit will be loaded in wheelbarrow the number 2-4 of FFB, will be wheeled through the path of tree harvesting in the number of 10-15 trees up to the platform. From the platform of FFB will be sent to the factory for processing. Wheelbarrow that were originally made of wood and mounted of end a chassis with wheel. Wheel barrow is the easy way to evacuate the FFB because the maintenance is free and very cheap to buy but need a lot of labour to do work and low production of FFB. Ahmad Hitam (1999) study a system approach to mechanization in oil palm plantation. Figure 1 show a schematic diagram and connection from harvesting and mill. It show a related to FFB harvesting, pruning, evacuation and transportation of FFB to the mill. As for the evacuation of FFB and also mainline transport to mills, there have been tremendous improvements. Three wheeler is an important interface machine between harvester and in field collection to evacuate FFB to platform. This activity also to ensure FFB can send to mill in 24 hour to process and produce highly quality of crude palm oil.

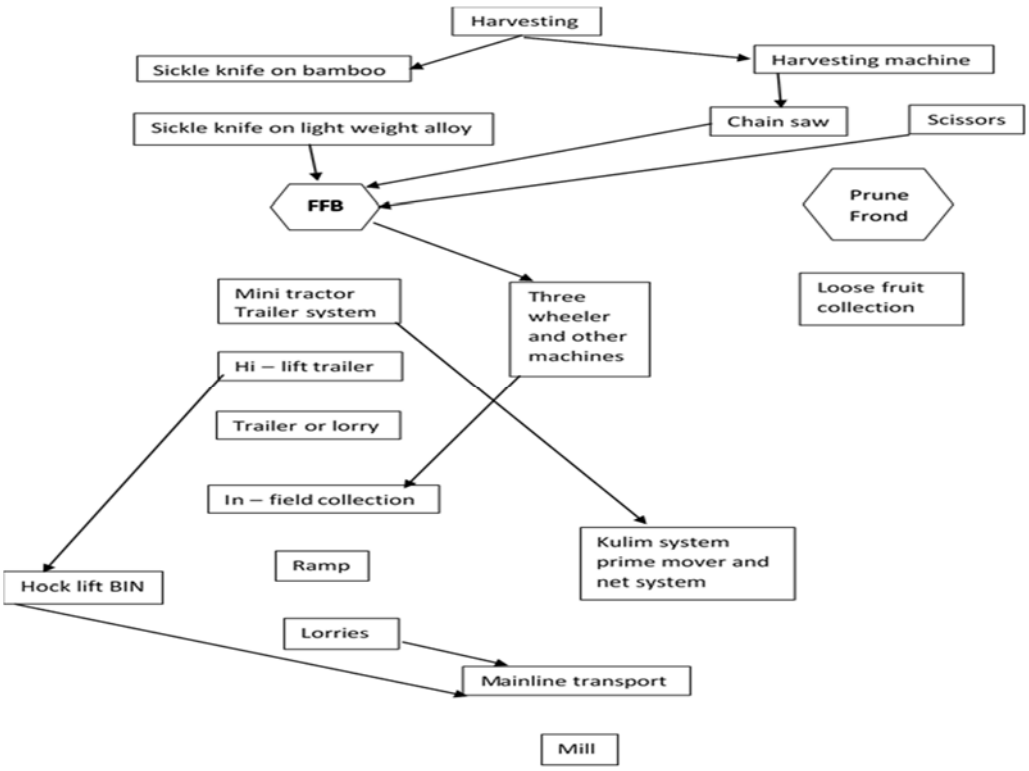


Figure 1: System approach to mechanization

In Malaysia, the demand for labour is a major issue, and now includes the use of mechanized equipment. If the matter is not resolved, FFB production will drop drastically and will give impact on the country's export commodities. Harvesting of FFB is presently an operation not amenable to mechanization, but infield fresh fruit bunch (FFB) collection especially on flat to undulating terrain has been mechanized with varying degree of success(Kamarudzaman Ali 1994), (Mohd Ali 1995) and (Cunnigham 1969). To overcome this problem, Azali Awaludin (2011) study the machinery used for the production of FFB were compared in terms of machinery, land use, the amount of labour used, the total production of FFB (MT) and the costs involved. Below in table 1 shows

Table 1: Mechanization comparison

Machine	First Capital (RM)	Maintenance (Monthly)(RM)	Usage of worker	Productivity (ton/hour)	Area Coverage (hectare)
Wheelbarrow	60 - 150	none	3	6t	6 -8h
Mini Tractor	60,000 -70,000	300 -500	3	30 -40t	10 -15h
Eco Rider	26,000	200	2	10 - 12 t	8 -10h
Buffalo	2,000	100	2	6t	6 -8h
Grabber	75,000	500 -1000	1	30 -40t	

This study focus to all machinery currently used in FELDA plantation, machinery application or farm mechanization in the production of FFB can accelerate when the harvesting work is done. Besides reducing of foreign labour, mechanization also reduce damage on FBB during transportation to the mill. FFB delivery to the mill will increase double if managed properly. Mechanization requires a large amount of capital, yet effective mechanization of returns to factors of work efficiency, quality of FFB produced, labour utilization and management of an effective oil palm plantations. While a recent study has been done on the three-wheeler to get

information related to the same information such as test equipment before. This testing purpose machinery to minimize costs, reduce labour and higher FFB productivity.

Problem statement of Oil Palm Fresh Fruit Bunch Evacuation

1. Requirements labour intensive to harvest. The ratio of workers to the acre is between 1:16 to 1: 18
2. Individual Task - harvester workers divided according to individual tasks ranging from 8-10 rows harvested per harvester. This causes the day to harvest a large area and difficult job of quality control that works with supervision.
3. Load BTS - Evacuate FFB from the base of the tree requires people or wheelbarrow. This work can reduce production of FFB because energy is used manually to evacuating FFB.
4. Loose collection -. To collect loose fruit for energy focusing to transport FFB bunches must be brought to the factory within 24 hours after harvest, resulting in a loose net seeds are not collected.
5. Acquisition costs - to bear the burden of additional costs of unskilled workers.

Material and Method

The methodology of evaluation includes 3 items are background of topography, the system works and test procedure. In Malaysia, Felda Global Ventures have 258,000 hectare of plantation area. Yong (2013), presented a data topography for Felda Global Venture Plantation Malaysia, there is 26% of area is Flat to gentle undulating (below 4° slope), moderately hilly is 49% (slope 5° -12°) and hilly is 25% (slope over 12°). Below in figure 2 shows a distribution of topography.

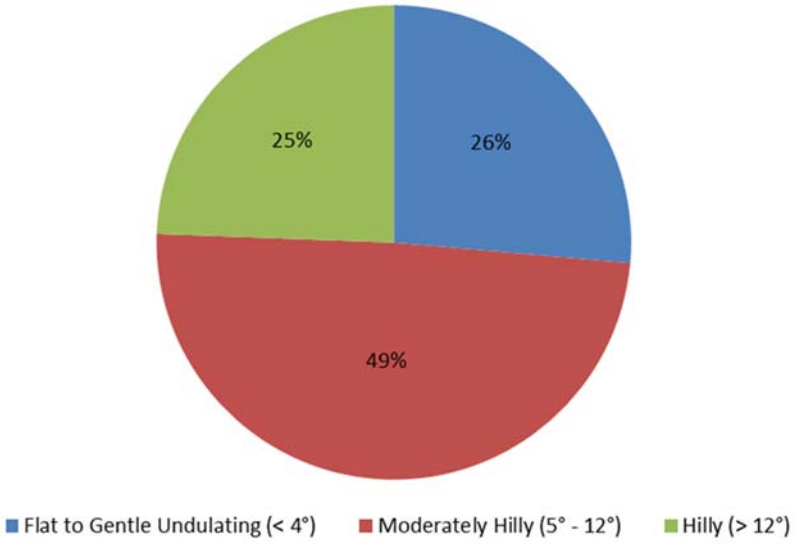


Figure 2: A distribution of topography for FGVPM

Based on above information, three wheeler evacuation machine evaluation will be focused to different train as mention in table 1.

Table 2: Information area of testing

Type of topography	Harvesting row	Area (hectare)	Slope (°)
Flat	7	1.5	0°
Undulating (mild)	7	1.5	5° - 8°
Undulating (heavy)	11	1.5	6° - 11°
Terrace	7	7	0°

In oil palm plantation, system of work implement to worker based on area coverage and job description. Works was divided based on area and total of labour. Ramesh Veloo (2010) proposed ratio 1 labour to 7 hectare for activities in plantation. To get same situation activities between actual working in plantation and this evaluation, 3 labour divided to do works as:-

1. Driver
2. Bunches loader
3. Loose fruit collector

Information of Three Wheeler

Figure 3: Three Wheeler Evacuation

Three wheeler was designed to suit with harvesting work. Equip with large bucket can contain 33 FFB at one time. Three wheeler evacuation machine also design with basic mechanical equipment and easy to drive and manoeuvre in harvesting path. Below in table 2 shows a specification of three wheeler evacuation machine.

Table 2: Information of Three wheeler evacuation machine

Description	Three wheeler machine
BODY AND CHASSIS	
Body Length (mm)	2510
Body width (mm)	1125
Body Width – tire to tire (mm)	1330
Carrier Type	Manual Tip - Off
Carrier Width (mm)	1120
Carrier Length (mm)	1295
Ground Clearance (mm)	Front – 290mm,Rear-325mm
Vehicle weight (kg)	415
ENGINE	
Engine	Yanmar Air – Cooled Engine
Hp	10hp
Model	L100N6 - MTMR
Fuel	Diesel
Fuel Consumption/Hour (estimated)	0.25lt/hour – 0.44lt/hour
Fuel Consumption / Day (estimated)	2.0lt – 3.5lt/day
Clutch Type	Tension Pulley

The evaluation was based on time recorded where time was recorded during FFB evacuation. A total of 200 bunches arrange at base of palm for topography of flat, mild undulating and heavy undulating. While the terrace area of 99 bunches are required. The three wheeler evacuation machine, will entered the harvesting path and 2 labour collecting FFB and loose fruit as normal/daily operation into the bucket of three wheeler. Time will recorded for this activity based on 2 repeated evacuation for each topography. Below in figure 4 shows a flow of three wheeler movement during evacuation and table 4 shows information area of testing.

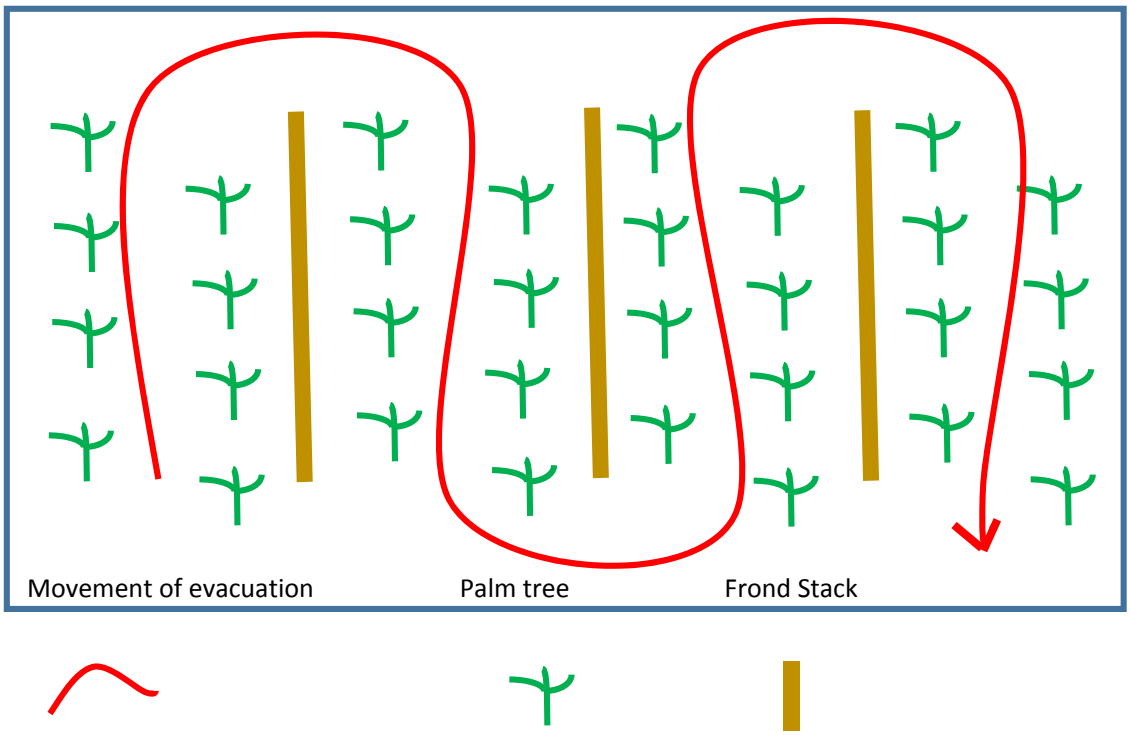


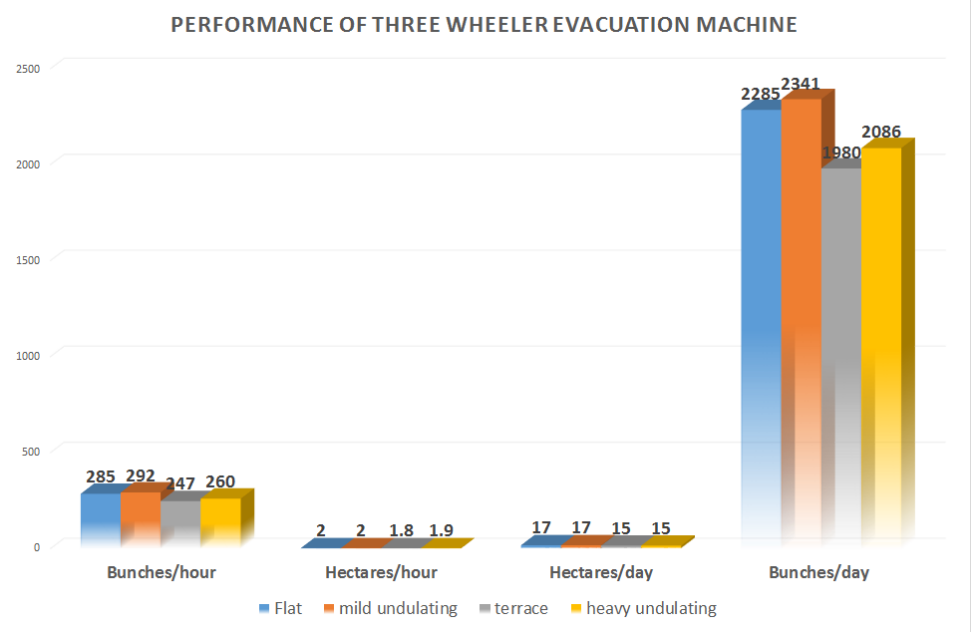
Figure 4: Movement of evacuation

Table 4: Information of topography, area and number of FFB

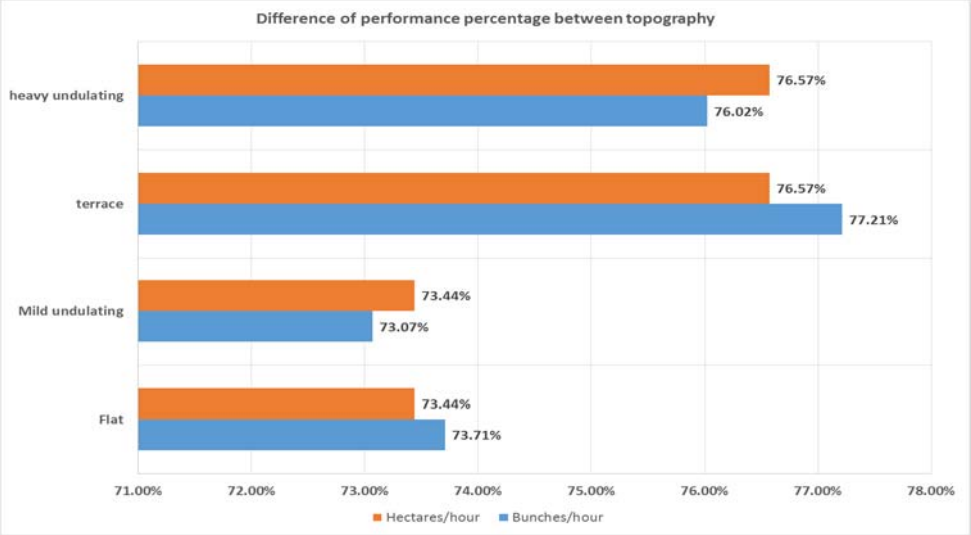
Topography	Area (Ha)	No of FFB
Flat	1.5	200
Mild Undulating	1.5	200
Heavy Undulating	1.5	200
Terrace	0.7	99

Result

From results, this machine can evacuating 1980 to 2341 bunches of FFB per day or the equivalent of 39.6 tons to 46.8 tons per day with the use of 0.5 liter of diesel to 1 liter. The average number of tons per worker per day was 14.4 tonnes per hectare while the employee is 5.42 hectares per day. This machine also can operating in all topography testing. Below in graph 1 and graph 2 shows the performance result of three wheeler during the experiment.



Graph 1: Performance of three wheeler evacuation machine



Graph 2: Different of performance between topography

Discussion

Abdul Rahim Shuib (2010) claimed their FFB collection and evacuation machine productivity was found between 2.4 tonnes to 3.6 tonnes per hour. This FFB production are same (three wheeler) but this machine have no traction problem on shallow peat. Using Halftrack, this machine can carried weight about 500kg of FFB and using 18 hp diesel engine. Compared to three wheeler FFB evacuation machine, this three wheeler can carried load about 750 kg and using 10 hp engine more than 50% performance with halftrack machine. Abdul Rahim Shuib (2010) also promote evacuation machine named 'Grabbie' which specially designed grapple attached to chassis. The machine requires a team of eight FFB harvester and one machine operator. With production of FFB 18 -25 tonne per day and coverage an area of 25 hectare but not same with three wheeler because three wheeler can produce more FFB with same labour uses. Below in figures 3 shows halftrack and 'Grabbies'.

Figure 3 and **figure 4**: Halftrack and Grabbies

From topography testing, three wheeler can enter all the topography with evacuating include terraced areas. Three wheeler has a chassis width is 1330 mm. With a minimum capacity of 33 bunches FFB, three wheeler can easily move between harvesting path. Below shows factor influencing during experiment:-

- **Labour**
  FFB evacuating job and collect loose fruits into the bucket machinery using manpower, total use of labour energy will increased and lead to worker fatigue.
- **Weather**
  During the experiment period, the rain dampened the ground in the harvesting path. This will cause the surface to become slippery and affect the amount of time recorded.
- **The degree of slope**
  Degree slope measured is in the range of 5 ° to 11 ° resistance to evacuation equipment in the FFB issue of harvesting path. Three wheeler evacuation have a special specification for climbing hills called 'differential gear lock "which can grip the surface better.
- **Loose fruit**
  Loose fruit collecting will influencing a lot of time recorded. This is because the FFB dropped at ground trash loose fruit because of the impact. It takes 1 minute to 2.5 minutes to collect loose fruit.

Conclusion

The factor of time is the most frequently used operations in the optimization method to obtain the efficiency of a machine. This method is based on time parameter changes, while keeping the others parameter at a constant level. Experiment show, three wheeler evacuation machine perform FFB evacuate work better than mini tractor because an efficiency show machine 70% and above. From topographic testing result, three wheeler evacuation machine can access all terrain of topography where this machine easily manoeuvre between harvesting path and terrace area. All result shows, three wheeler evacuation machine can help yield FFB increase and increase an oil extraction rate at mill.

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Probability density function estimation using Multi-layer perceptron

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Abstract : The problem of estimating a probability density function (pdf) can easily be encountered in many areas of experimental physics (high energy, spectroscopy, etc.) and other fields. The standard procedure is to bin the space and approximate the pdf by the ratio between the number of events falling inside each bin over the total and normalized to the bin volume. In this paper we estimate the univariate pdf using an MLP (Multi-Layer Perceptron) where the inputs are based on the exponential model. The proposed method is very effective and estimated densities are too close to some theoretical pdfs. Our method has been integrated in the famous steepest descent algorithm for marginal score functions estimation where two linearly mixed sources were successfully separated.

Key words: Probability density estimation, Neural networks, Multilayer perceptron, BSS, Score function.

Introduction

The probability density function (pdf) is a central concept in statistical data analysis, and the most popular instruments for pdf estimation are: histograms and kernel density estimation. More information about pdf estimation can be found in (Silverman, 1986). The reader can also be referred to (Vogt, 2007) for some basic analysis techniques.
In the following we give a short introduction to some density estimation methods.

Histograms:

It is the oldest and most widely used density estimator. The data range is divided into a set of successive and non-overlapping intervals (bins). The bins of the histogram are defined as the intervals [$x_0 + mh$, $x_0 + (m+1)h$] for m positive and negative integers, x_0 is the origin and h is the bin width. For a set of n observed data points supposed to be a sample of an unknown density function p_X , The histogram is defined by:

$$\hat{p}_X(x) = \frac{number\ of\ observations\ in\ the\ same\ bin\ as\ x}{nh} \qquad (1)$$

The histogram can be generalized by allowing the bin widths to vary. Then the estimate becomes:

$$\hat{p}_X(x) = \frac{number\ of\ observations\ \ in\ the\ same\ bin\ as\ x}{n(width\ of\ bin\ containing\ x)} \qquad (2)$$

However, there are some drawbacks in using histograms:

-The histogram is not continuous so trouble arises when derivatives are required (score functions in blind source separation)
-Choice of origin may have an effect in the interpretation
-Representing multivariate data by histogram is difficult

The naive estimator:

The pdf can be defined as a probability density as:

$$p_X(x) = \lim_{h \to 0} P(x - h \leq X \leq x + h) \qquad (3)$$

Thus,

$$\hat{p}_X(x) = \frac{number\ of\ observations\ falling\ into\ [x-h,x+h]}{2hn} \quad (4)$$

By this way, $\hat{p}_X(x)$ does no longer depend on the origin of the chosen data range discretisation.
The naïve estimator can be defined clearly by a weight function as follows:

$$\hat{p}_X(x) = \frac{1}{nh}\sum_{i=1}^{n} \omega\left(\frac{x-x_i}{h}\right) \quad (5)$$

Where

$$\omega(x) = \begin{cases} \frac{1}{2} & if \quad -1 < x < 1 \\ 0 & if \quad otherwise \end{cases} \quad (6)$$

This means that rectangular boxes of width 2h and height $\frac{1}{2hn}$ are placed around each datum and then summed up to get the estimate $\hat{p}_X(x)$.
But this estimator also has got some drawbacks:

$\hat{p}_X$ is not continuous but has jumps at the points $x_i \pm h$ and has zero derivative everywhere else

The kernel estimator:

This estimator is obtained by replacing the weight function in the expression of the naïve estimator by a kernel function $K(x)$ which satisfies:

$$\int_{-\infty}^{+\infty} K(x)\,dx = 1$$

Then the kernel estimator is given by

$$\hat{p}_X(x) = \frac{1}{nh}\sum_{i=1}^{n} K\left(\frac{x-x_i}{h}\right) \quad (7)$$

Here h is the smoothing parameter. It controls the trade-off between the statistical significance of the pdf estimate and its effective resolution.

Traditionally and statistically, the pdf is constructed by locating a Gaussian kernel at each observed datum, e.g., the fixed-width kernel density estimator (FKDE) and the adaptive kernel density estimator (AKDE). Although the FKDE, which constructs a density by placing fixed width kernels at all of the observed data, is widely used for nonparametric density estimation, this method normally suffers from several practical drawbacks (Silverman, 1986).

Neural networks for pdf estimation

To overcome the problem of high cost in computation and memory storage of the kernel estimator, a clustered radial basis function (RBF) based kernel density estimator, named RBF network, can be used (Hwang, Lay and Lippman,1993, Popat and Picard, 1993; Popat and Picard, 1994). The RBF network uses a reduced number of radial basis kernels, with each kernel being representative of a cluster of training data, to approximate the unknown density function. This method is often referred as mixture (Gaussian) modeling (Rabiner, 1989). These networks are also widely used in regression and classification applications (Moody & Darken, 1989).

The use of feedforward neural networks (Svozil, Kvasnicka & Pospichal, 1997) with sigmoid hidden units called multilayer percceptrons (MLPs) for pdf estimation was proposed in (Modha & Fainman, 1994), where the training approach based on the minimization of the negative log-likelihood is described. However, the pdf approximation capabilities of general multilayer feedforward neural networks have been established by White (1992).

It is well known that the gaussian mixture approach encounters difficulties in approximating the uniform distribution. This is not the case for the MLP model. Likas (2001) have presented an approach of pdf estimation based on the use of feedforward multilayer neural networks with sigmoid hidden units. The method is based on numerical integration technique.

In this paper we estimate the univariate pdf using an MLP (Multi-Layer Perceptron) where the inputs are based on the exponential model. The proposed method is very effective compared to some theoretical pdfs.

Problem formulation

For problems defined in $\mathcal{R}^p$, the network architecture (Fig.1) consisted of p input units, one hidden layer with H hidden units having the logistic activation function and of one output unit with exponential activation function (Modha & Fainman, 1994) :

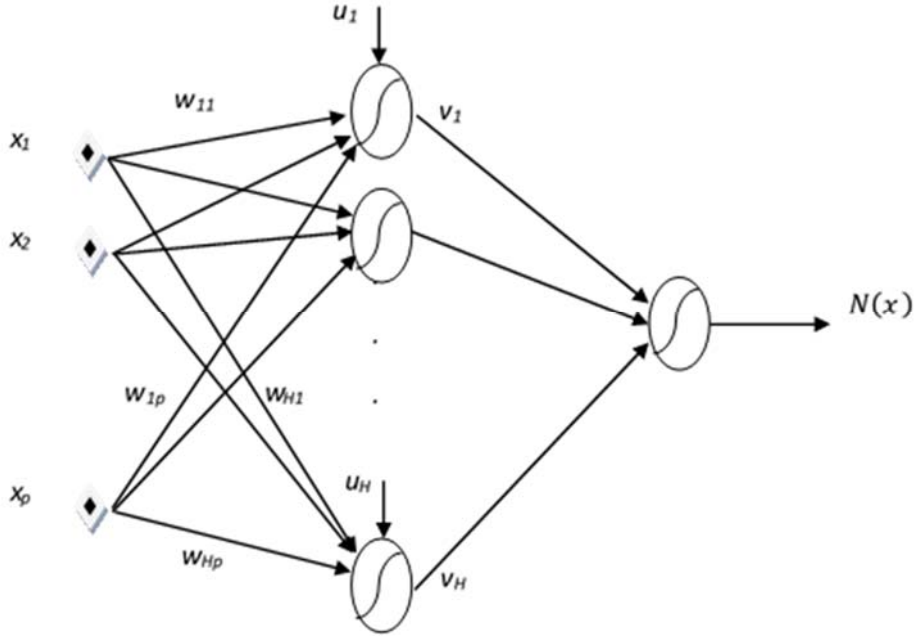


Figure 1: Basic MLP approach to pdf estimation

Let $x(k) \in \mathcal{R}^p$, $(k = 1, \dots, n)$ be a set of n data points drawn independently according to an unknown density $f(x)$ that we want to approximate, and let's define the model of pdf with parameter $\boldsymbol{\theta}$ by the function

$$p_N(\boldsymbol{x}, \boldsymbol{\theta}) = \frac{N(\boldsymbol{x}, \boldsymbol{\theta})}{\int_{\mathcal{R}^p} N(\boldsymbol{y}, \boldsymbol{\theta}) d\boldsymbol{y}} \tag{8}$$

In the paper of Modha & Fainman (1994), the parameter vector $\boldsymbol{\theta}$ is adjusted by minimizing the function:

$$\mathcal{L}(\boldsymbol{\theta}) = -\sum_{k=1}^{n} ln\{p_N(\boldsymbol{x}(k), \boldsymbol{\theta})\} \tag{9}$$

Replacing $p_N(\boldsymbol{x}, \boldsymbol{\theta})$ in (9) by its expression (8) we obtain:

$$\begin{aligned} \mathcal{L}(\boldsymbol{\theta}) &= -\sum_{k=1}^{n} ln\{N(\boldsymbol{x}(k), \boldsymbol{\theta})\} + n\, ln\left\{\int_{\mathcal{R}^p} N(\boldsymbol{x}, \boldsymbol{\theta}) d\boldsymbol{x}\right\} \\ &= -\sum_{k=1}^{n} ln\{N(\boldsymbol{x}(k), \boldsymbol{\theta})\} + n\, ln(I_{\boldsymbol{\theta}}) \end{aligned} \tag{10}$$

With

$$I_{\boldsymbol{\theta}} = \int_{\mathcal{R}^p} N(\boldsymbol{x}, \boldsymbol{\theta}) d\boldsymbol{x} \tag{11}$$

The key idea in the algorithm of . Likas (2001), is the numerical integration technique used to compute (11).

Our work consists of estimating the monovariate pdf modeled by an exponential law. Hence, the equation (8) becomes:

$$p_d(x,\delta) = \frac{N_e(x,\delta)}{\int_a^b N_e(y,\delta)dy} = \frac{exp(\delta_1 x + \cdots + \delta_d x^d)}{\int_a^b exp(\delta_1 y + \cdots + \delta_d y^d)dy} \quad (12)$$

Where

$[a,b] = [\min x, \max x]$, d is the model order ($d = 1, 2, \ldots$)

$(\delta_i, i = 1, \ldots, d)$ are the model parameters.

This model has the following advantage:

- Most common densities (normal, uniform, exponential …etc.) are well fitted by the exponential densities (Ould Mohamed, 2012, p.54)

In Fig. 2, inputs in Fig. 1 are changed according to the model order so that the MLP architecture becomes:

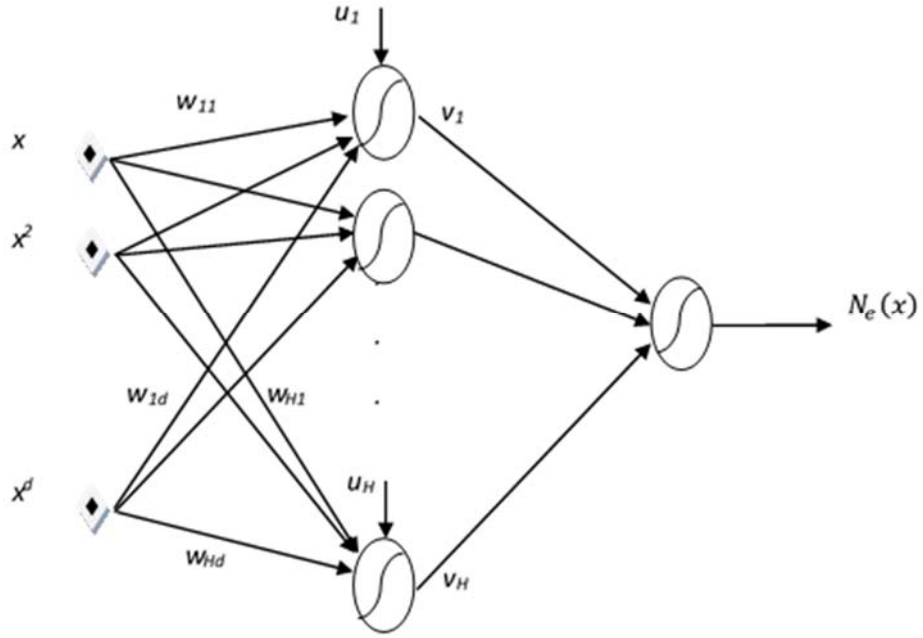


Figure 2: MLP architecture for exponential pdf modeling and estimation

A supervised training of the MLP is performed by constructing a training set using some non-parametric technique for pdf estimation. This means that, for the training set x_k, we have selected the histogram estimation method.

Application to blind source separation

Blind signal separation (BSS) and independent component analysis (ICA) are emerging techniques of array processing and data analysis that aim to recover unobserved signals or "sources" from observed mixtures (typically, the output of an array of sensors), exploiting only the assumption of mutual independence between the signals, more details can be found in (Hyvärinen, Karhunen and Oja, 2001; Jutten and Comon, 2007).

In instantaneous case, BSS becomes the problem of identifying the probability distribution of a vector $\boldsymbol{x} = \boldsymbol{As}$, given a sample distribution. In this perspective, the statistical model has two components: the mixing matrix $\boldsymbol{A}$ and the probability distribution of the source vector. the main idea is to find a matrix $\boldsymbol{B}$ (separating matrix) such that the components of the vector $\boldsymbol{y} = \boldsymbol{Bx}$ are mutually statistically independent.

Mutual information, $I(.)$, is a measuring criterion for designing a system which generates independent outputs.

If, $\boldsymbol{x} = \boldsymbol{As}$, where

$\boldsymbol{s} = (s_1, s_2, \ldots, s_p)^T$, source signals , $\boldsymbol{x} = (x_1, x_2, \ldots, x_p)^T$, observed signals

and

$\boldsymbol{A} = [a_{ij}]$, mixing matrix

Then

$\boldsymbol{B}$ is estimated by minimizing the mutual information $I(\mathbf{y})$ of $\boldsymbol{y} = \boldsymbol{Bx}$

$$I(\mathbf{y}) = \int_y p_{\mathbf{y}}(\mathbf{y}) ln\left\{\frac{p_{\mathbf{y}}(\mathbf{y})}{\prod_{i=1}^{p} p_{y_i}(y_i)}\right\} d\mathbf{y} \quad (13)$$

Where,

$p_{\mathbf{y}}(\mathbf{y})$ is the joint pdf of vector $\mathbf{y}$, $p_{y_i}(y_i)$ is the marginal pdf of y_i

It is well-known that $I(y)$ is always non-negative and vanishes if and only if the y_i's are independent. Consequently, the parameters of the separating system can be calculated based on minimization of the mutual information of the outputs. It is very helpful to know an expression for the gradient of the mutual information. However, the gradient of the mutual information, $\frac{\partial I(\mathbf{y})}{\partial \boldsymbol{B}}$, can be expressed (Taleb and Jutten, 1999) by the following expression:

$$\frac{\partial I(\mathbf{y})}{\partial \boldsymbol{B}} = E\{\psi_{\mathbf{y}}(\mathbf{y})\boldsymbol{x}^T\} - \boldsymbol{B}^{-T} \quad (14)$$

where

$\psi_{\mathbf{y}}(\mathbf{y}) = \left(\psi_{y_1}(y_1), \ldots, \psi_{y_p}(y_p)\right)^T$ is the marginal score functions vector

and

$$\psi_{x_i}(x_i) \triangleq -\frac{d\, ln\left(p_{x_i}(x_i)\right)}{d\, x_i} = -\frac{\dot{p}_{x_i}(x_i)}{p_{x_i}(x_i)} \quad (15)$$

Then the steepest descent algorithm is applied on the parameter vector to search the minimum of $I(\mathbf{y})$:

$$\boldsymbol{B} \leftarrow \boldsymbol{B} - \mu \frac{\partial I(\mathbf{y})}{\partial \boldsymbol{B}} \quad (16)$$

μ is the step-size (positive constant)

We can see that in calculating $\frac{\partial I(\mathbf{y})}{\partial B}$, the pdf's of the components of $\mathbf{y}$ must be estimated, and the algorithm can be summarized in Fig. 3, where $\boldsymbol{I}_p$ denotes the identity matrix

Simulation results

In this step we have conducted experiments with data drawn independently from known distributions, which in turn we tried to approximate with the proposed approach. MLP training in the likelihood minimization was performed using gradient descent algorithm.

In all problems we have considered a training set with $n = 2000$ data points drawn independently from the corresponding pdf to be approximated.

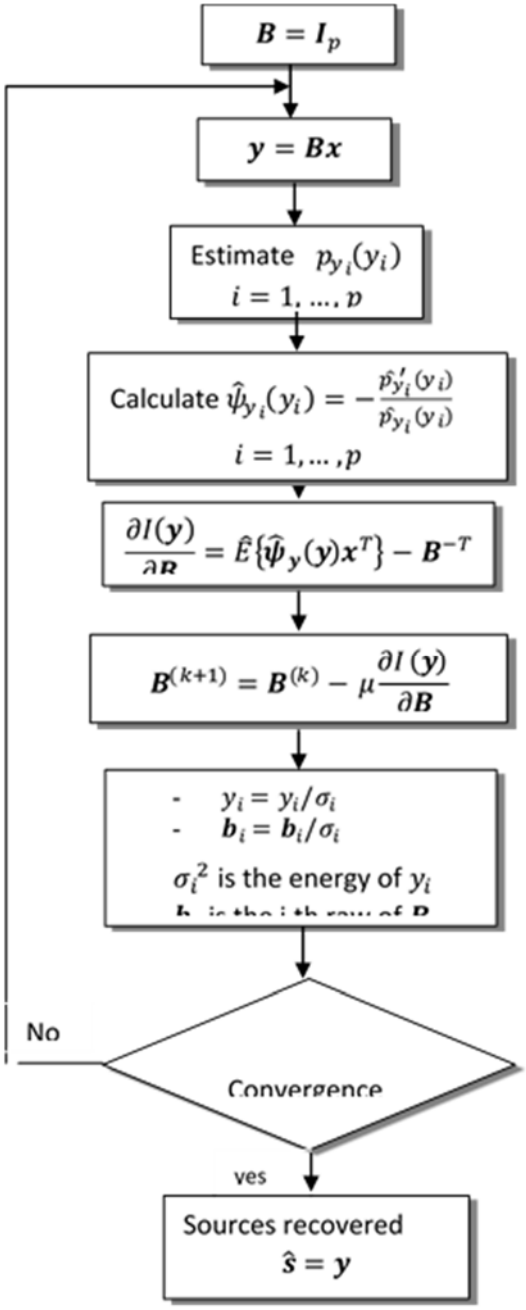
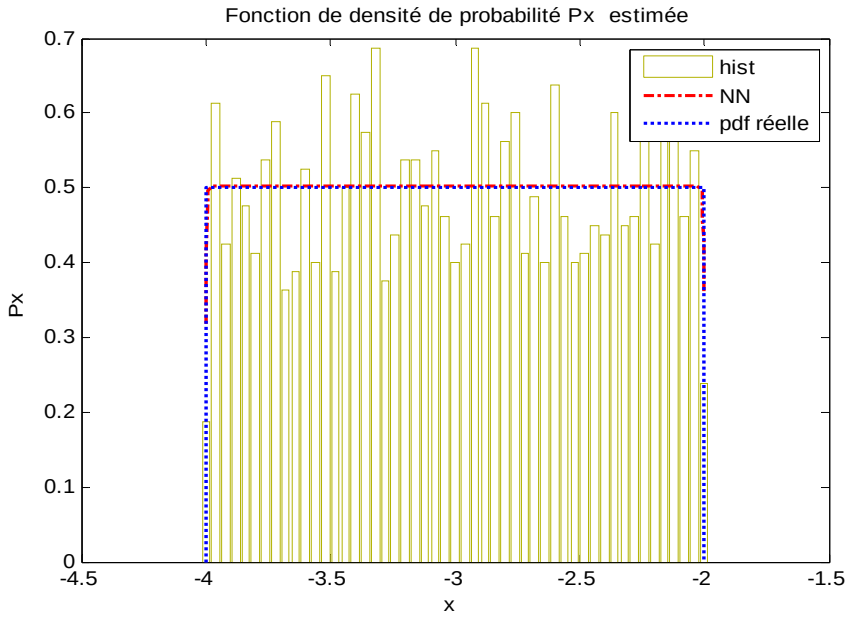


Figure 3: Steepest descent and neural pdf estimation for blind source estimation - linear instantaneous mixtures

Example 1

In this example we have generated samples using two simple distributions: Gaussian ($N(5,1)$) and uniform in the interval [-4,-2] ($U[-4,-2]$).
Fig. 4 illustrates the process of fitting the histograms of the two pdfs, and we can easily observe that the estimated pdfs coincide with the true ones.



(a)

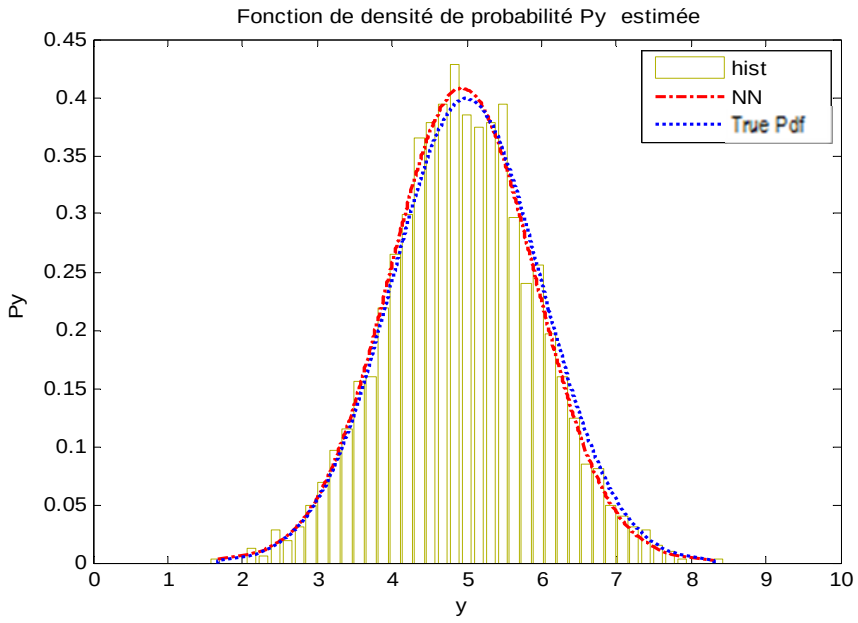


Figure 4: Estimated Pdfs, (a) uniform pdf , (b) Gaussian pdf – (*d*=2 and *H*=2)

Example 2

In this example, the unknown pdf, $g(x)$, was a mixture of the two pdfs used in the last example:

$$g(x) = 0.25\,U[-2,-1] + 0.25\,N(-7,0.25) + 0.25\,U[1,2] + 0.25\,N(7,0.25) \quad (17)$$

Fig. 5 is another illustration of the effectiveness of our method. It is also clear that the estimated pdf is very close to the true pdf and is a smooth function unlike the histogram estimator.

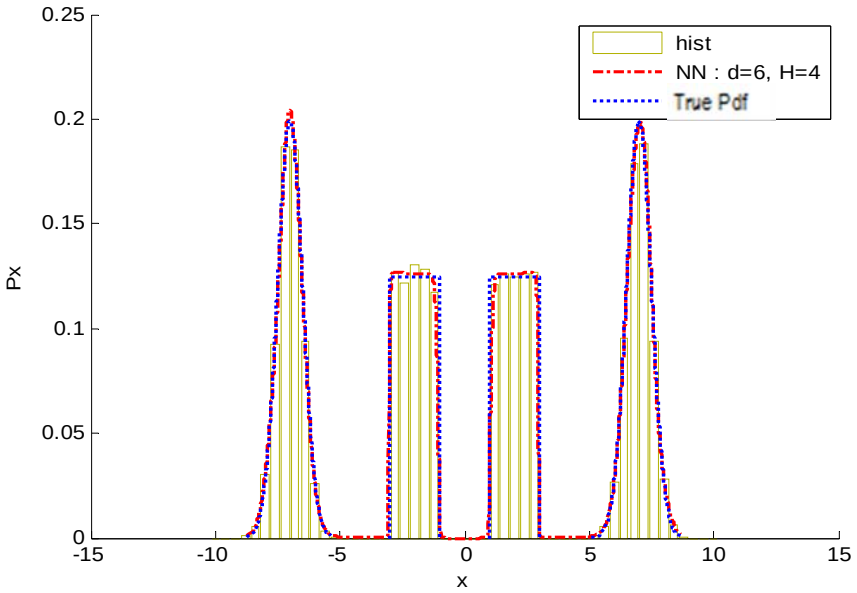


Figure 5: Estimated pdf (mixture of two pdfs) for two architectures of the MLP: (d=2,H=2) and (d=1,H=4)

Example 3

As sited in section (2.2), estimating pdf's in blind source separation is an essential step, and in some cases without this step, separation of the sources is impossible.

In this example, we apply our neural pdf estimation method to separate two linearly mixed independent sources.

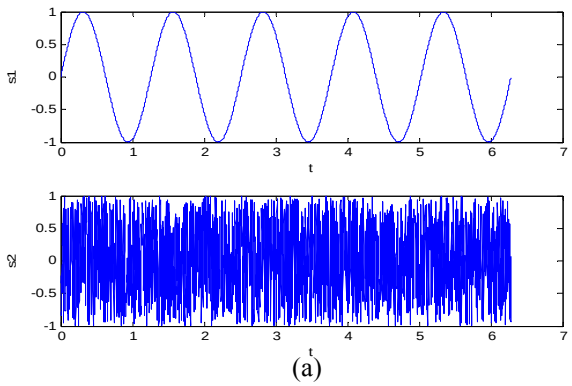
The independent sources are sine wave and uniformly distributed white noise in the interval [-1, 1]. These signals are linearly mixed with the mixture matrix

$$\boldsymbol{A} = \begin{bmatrix} -2.29 & 0.49 \\ 1.84 & 0.41 \end{bmatrix}$$

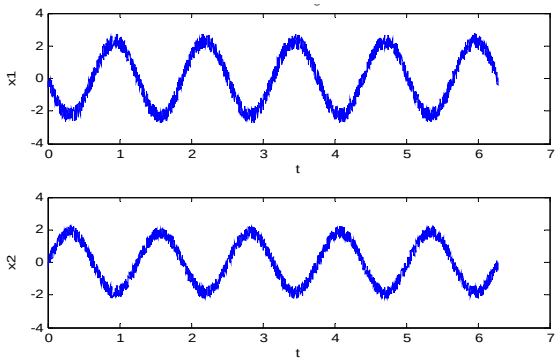
Fig. 6 shows the two sources and their mixtures.

Algorithm of Fig. 3 is used to separate the sources where marginal score functions are calculated from the estimated marginal pdf's and an MLP of two elements in the hidden layer ($H=2$, $d=2$) was used.

Outputs of the algorithm are shown in Fig. 7 and are good estimations of the source signals.



(a)



(b)

Figure 6: (a) Sources , (b) Mixture Signals

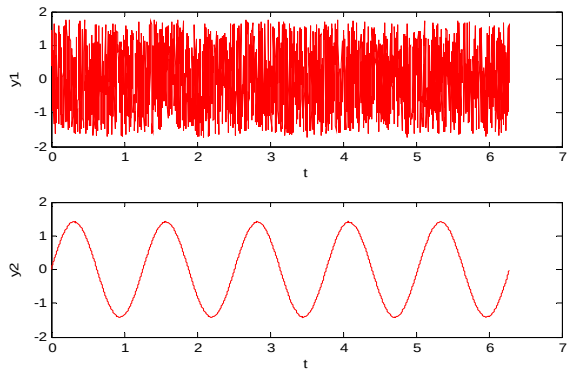


Figure 7: Estimated Sources (*d*=2, *H*=2, for pdf estimation)

Conclusions

As we mentioned before, this is a very important result about evaluation of the effectiveness of MLP in estimating probability density functions. We have modeled the data by exponential density law because most common densities (normal, uniform, exponential …etc.) are well fitted by the exponential densities (Ould Mohamed, 2012, p.54). We found that this method for one-dimensional problems has superior estimation capability compared to the widely used histogram approach. Our method has been integrated in the famous steepest descent algorithm for marginal score functions estimation where two linearly mixed sources were successfully separated.

Future research may focus on using our method to estimate the pdf for higher dimensions, and its application in separating nonlinear mixtures.

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