LAMBDA-MAX CRITERIA WEIGHT DETERMINATION IN AN ADAPTIVE NEURO-FUZZY INFERENCE SYSTEM

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NOVEMBER 2012

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UNIVERSITI TEKNOLOGI MARA

PEMENANG Anugerah Kualiti Perdana Menteri 2008

Surat Kami : 600-RMI/ST/FRGS 5/3/Fst (79/2010)
Tarikh : 22 Mac 2010

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KELULUSAN SKIM GERAN PENYELIDIKAN FRGS FASA 01/2010

Tajuk Projek	:	Lamda-max Criteria Weight Determination in an Adaptive Neuro-Fuzzy Inference System
Kod Projek	:	600-RMI/ST/FRGS 5/3/Fst (79/2010)
Bidang	:	Teknologi Kejuruteraan
Tempoh	:	01 Mac 2010 – 29 Februari 2012 (24 bulan)
Jumlah Peruntukan	:	RM 52,000.00
Ketua Projek	:	Prof. Madya Dr. Rosma Mohd. Dom

Dengan hormatnya perkara di atas adalah dirujuk.

Sukacita dimaklumkan pihak Kementerian Pengajian Tinggi melalui surat JPT.S(BPKI) 2000/011/010 Jilid. 2 (19) telah meluluskan cadangan penyelidikan Prof/Prof. Madya/Dr./Tuan/Puan untuk di biayai di bawah Skim Geran Penyelidikan Fundamental (FRGS) Fasa 1/2010.

Bagi pihak Universiti kami mengucapkan tahniah kepada Prof/Prof. Madya/Dr./Tuan/Puan kerana kejayaan ini dan seterusnya diharapkan berjaya menyiapkan projek ini dengan cemerlang.

Untuk tujuan mengemaskini, pihak Prof/Prof. Madya/Dr./Tuan/Puan adalah di minta untuk menyusun perancangan semula bajet yang baru seperti yang diluluskan. Sila lihat lampiran bagi tatacara tambahan untuk pengurusan projek.

Sekian, harap maklum.

"SELAMAT MENJALANKAN PENYELIDIKAN DENGAN JAYANYA"

Yang benar

MUSTAFAR KAMAL HAMZAH
Ketua INFOREC
Merangkap Ketua Penyelidikan (Sains & Teknologi)

/RS...

5. Report

5.1 Proposed Executive Summary

Fuzzy inference is the process of formulating the mapping from a given input to an output using fuzzy logic. The primary mechanism for fuzzy inference engine involves a list of if- then statement called rules. A neuro-fuzzy system is a fuzzy system that uses learning algorithms derived from or inspired by neural network theory to determine its parameters (fuzzy sets and fuzzy rules) by processing data samples. In simple terms a neuro-fuzzy system is a combination of fuzzy logic and neural network in generating a model that produces required output (Oke S.A *et al.*, 2006). The existing method in determining the weights in the Adaptive Neuro-Fuzzy Inference System (ANFIS) is questionable since only simple multiplication (algebraic t-norm) is used. In fuzzy mathematics, criteria weights determination can be carried out using many available techniques such as the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), Analytic Hierarchy Process (AHP), Multi Attribute Utility Theory (MAUT), Multi Attribute Value Theory (MAVT) and the Fuzzy Preference Relation (FPR). There are three methods of calculating the fuzzy criteria weights using the Analytic Hierarchy Process (AHP) namely the Extend Analysis, Lambda-max and the Least Squares method. Each method has its own strengths and limitations. In this research we will use the Lamda-max method of the AHP to determine the criteria weights to replace the weights used in the existing ANFIS. Literatures have shown that the Extend Analysis method is not suitable when it involves extreme values (zero weights) and the Least Squares method requires an extensive amount of computing application. Thus the Lamda-max method is the most appropriate method to be used in this research. The first objective of this research is to improvise the existing ANFIS by applying the chosen criteria weight determination Lamda-max in developing the neuro-fuzzy system. The second objective is to assess the ability of the Modified ANFIS by comparing the performance of the Modified ANFIS with the Conventional ANFIS.In assessing the performance of Modified ANFIS we will use it to identify factors affecting the tensile strength of plastics. Currently experiments were carried out in the labs to help determine such contributing factors. The process can be very time consuming and costly. This research proposes a soft computing model specifically the Modified ANFIS model to help identify the contributing factors. The Modified ANFIS will be used to investigate the influence of fiber size, pH value, ash content, moisture content, pH value, density, melt flow rate and thermal transition on the tensile strength of plastics.

5.2 Enhanced Executive Summary

Accurate predictive modelling is highly essential and ANFIS has successfully been used as a forecasting tool in various fields. ANFIS is made up of a multilayer feed-forward network that comprises of two important elements in soft computing namely the neural network learning algorithm and fuzzy reasoning which provides smoothness in data processing. However, the weight determined by the first three layers of ANFIS causes inconsistencies in coefficient signs with underlying monotonic relations thus making it impossible to represent known monotonic relations. Hence the objective of this research is to find an alternative method among the AHP techniques in determining the weights to be supplied to the back-propagation layers of ANFIS. Lambda-Max technique has been identified to be the most suitable weight determination technique due to its simple calculation and precision of weights obtained. The newly developed Lambda-Max ANFIS is then used to predict the physical properties of degradable plastics using real life data obtained from the laboratory of the Malaysian Palm Oil Board (MPOB). Bootstrapping resampling technique was applied to the data and consistency control index measurement was carried out to ensure the suitability of the data prior to the model development. The system is capable to identify the most suitable input predictor sets based on the values of Root Mean Square Error (RMSE), R and R^2. The prediction accuracy of the Lambda-Max ANFIS is compared to the prediction accuracy of the conventional ANFIS. Both Lambda-Max ANFIS and conventional ANFIS were found to exhibit significantly similar high prediction accuracies. Predicted output of Lambda-Max ANFIS was also compared to the output of MPOB laboratories. The results show that Lambda-Max gives highly similar prediction output with the actual laboratory output. In addition to that, Lambda-Max ANFIS prediction outputs are highly consistent for any given input combination. Hence, the developed Lambda-Max ANFIS can be used for forecasting purposes with high prediction accuracy and the system can be used as an alternative to laboratory prediction on the physical properties of degradable plastics. Hence time and cost saving.