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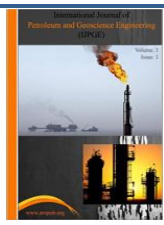

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Well Explorations Following Fuzzy Training Map

Zahid Hafeez Khokhar [a,*]

[a] Petroleum Engineering, MIACSIT, Faisalabad, Pakistan.

* Corresponding author. Tel.: +985144012861;
E-mail address: hafeezzahid@hotmail.com

Abstract

Keywords:

Fuzzy logic,
Training and Testing,
Well exploration,
Artificial intelligence,
Simulations.

In this piece, permeability data is available of a well which is trained under fuzzy rule based modelling. It seems that controlling the training is beyond and fuzzy made it plausible to map the new well. Machine and program respond well with each other although difficulties arise at memory adjustment and these were due to data clustering. Different number of epoch is tried with various types of functions and approaches drawing training and testing. It is an opinion to review various possibilities to customize the membership functions to set up procedures to send notifications to design new well explorations.

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1. Introduction

Computation of all sorts is heavily benefited by advancements in technology. It is all mathematics upon which calculations are being done. A technical computing environment is provided by Matlab which is flexible and simple. The fake relations of technologists and materials are simulated with rule base fuzzy interface to launch. A fuzzy universe of discourse of biosorption capacity histories with temperature and other parameters is constructed. Investigations of biosorption capacity histories with temperature and other parameters are done. Chain shuttling polymerization block formation is proposed to explore with fuzzy logic. [1]. A fuzzy logic rule base modelling is done for product quality enhancement. Experiment done at laboratory on experimental assembly constitutes of many operations, processes and equipments, industrial material fuzzy universe of discourse open up menu is presented. Recovery of production is very important to control quality. Calcium carbonate continuous carbon dioxide-jet controlled production experiments are done followed by fuzzy logic model to map the three variable temperature, time, reactants input space to conversion output space. Carbon capture and carbonate reservoirs may be explored accordingly. [2]. Choice modeling of styrene tertiary polymer under various monomer compositions considering first a fixed recipe is done. Experiments are done at laboratory and meanwhile with different aspects of experimentation, a production distribution of fiber, may be carbon, rubber, glass, or hard rubber or hard, tuff hard, rubber, glass or fiber, transparent, mercury alike and semi hard with some powder or paste, of organic compounds with few roly-poly is classified into bigger groups relating to temperature and time of process. Building of an input space of temperature and time with fixed recipe, that is out of questioning the checking of ingredients of recipe, and output space of product polymer organic compound material are done and mapped with rule establishments of input variables with output variable. The details of fuzzy work range editions and with using different membership functions are being in presentation. [3]. For above cases, data available and observations are handful enough to deduce information to establish rules for fuzzy logic operation and implementation is time saving and fast to draw experimentation procedures. In this work, data available is huge and is scattered and clustered. The case is of a well. Training ANFIS upon an old well to test a new well is placed here in this manuscript which may be extended and applied to many similar situations. Mature data from an old well is given to explore accordingly a new well by training the former to set out rules to form a model. Information deduction is assigned to fuzzy logic ANFIS which reacts fairly and the exercise of rules formation, rule addition, edition and range assigning are practically done by fuzzy logic predictions. Membership function is required to search out that which one is suitable. Epoch number depends upon machine and its memory adjustment. Minimum suitable number is assigned after many numerical run executions. Presence of negative data, an issue of data suppression, input values being outside of the specified input range, and number of data smaller than number of modified parameters are noticed, however, powerful machines and updated computing environment refined the work.

Table 1: ANFIS information.

Sr.	ANFIS	Number
1	Nodes	566
2	Linear parameters	276
3	Nonlinear parameters	506
4	Total parameters	782
5	Training data pairs	319

2. Procedure

A technical computing environment is provided by Matlab which is flexible. [4]. It has ANFIS which is used to interface input space to output space. It is used to train the data available and then testing is followed. Data is modeled by fuzzy interface techniques. There are two types of data: core and log. Core data consists of porosity and permeability along depth data whereas log data consists of well logs and marker data. Firstly data is refined into header text and numeric data with filtration of header to numeric data. Secondly, negative data is removed that is outlier and misplaced data points are tackled.

A mature permeability milli darcy data is available of a well which is trained under fuzzy rule based modeling using Matlab. Log data is received for measured depth and true vertical depth.

It is seen that controlling the training is beyond any discussions and fuzzy made it plausible to map the new well exclusively. Machine and program responded well with each other although difficulties aroused at memory level adjustment and due to data clustering. Different radii are checked from 0.1 to 0.9 for different values of epoch and numMF.

Plots are against depth. R=NaN, not a number, for all cases are due to clustering. Significance of membership function type is checked. Fuzzy trained data system is checked for new well. 'net' is trained system and 'sim' is used with it for new well data.

Sample check generated points are 477, 477 and must be same. Table I shows a tableau of ANFIS information with mfType gaussmf. Training and testing are done with facing following warning of number of data is smaller than number of modifiable parameters and warning of some input values are outside of the specified input range.

ANFIS training completes at designated epoch number epoch. Twenty three rules are established. In evalfis and in FLHW warnings of negative data ignored are seen. ANFIS execution is done by commands and Table II shows the data of training run execution sample for gaussian function. Result plots are directly stored to document file.

Table 2: ANFIS Training run execution sample.

Epoch	Designated Epoch Number	Logic	[0,1]	Parameter	Training
1	5	1<5	0	17.594	Start, on
2	5	2<5	0	13.7744	on
3	5	3<5	0	10.9947	on
4	5	4<5	0	8.19191	on
5	5	5=5	1	12.8378	Completed

3. Results

Present fuzzy logic prediction work, for different values, wholly observed for different functions is well trained from the best function. Firstly membership function gaussmf is tried for training and testing data and parameters are modified during training as shown in Figure 1 and Figure 2 respectively. Prediction using fuzzy logic is shown. K is permeability and MD is measured depth. K_core and k_pred are core permeability point and predicted permeability point respectively. Warning is appeared of number of data smaller than number of modified parameters that is more number of data is needed or reduction in modified is required. Some input values are outside of the specified input range during training. The values are fixed to nearest bound. Negative data ignore message is appeared which is an issue of data suppression. Then other membership functions trimf, name of triangular membership function, is tried for varying radii. Training and testing are shown in following figures for similar epoch number and numMF. In further figures with trimf training and testing are shown. With trimf, radii is checked from 0.1 to 0.9, and training and testing are done for radii 0.9, 0.5 and 0.1. Negative data values are always ignored. Overall the testing is curlier than the training and it reduces as the radii increased from 0.1 to 0.9. Three selected radii are shown for training and testing. Figure 3 shows training predictions using fuzzy logic with trimf for radii 0.9. Trimf function is a collection of three points forming a triangle. Figure 4 shows the testing fuzzy logic prediction for the same getting an m = 0.00; b = -18853.01 and r = NaN.

Figure 5 shows training predictions using fuzzy logic with membership function type trimf at radii 0.5. Testing predictions are shown in Figure 6 using fuzzy logic getting an m = 0.00, b = 2.13, r =

NaN. Average is plotted with depth and circle shows core values whereas line shows predictions. Many core points are away from prediction line. For radii 0.9 it is too unlike predictions therefore, reduced radii is checked and predictions using fuzzy logic with radii 0.1 are shown in Figure 7 with membership function type trimf, getting m = 0.00, b = 47.87, r = NaN for similar epoch and numMFs in Figure 8 for testing prediction using fuzzy logic. Average is plotted with depth and circle shows core values whereas line shows predictions. Much core points are on prediction line. Although the execution is fine yet some warning message of number of data is smaller than number of modifiable parameters, some input values are outside of the specified input range, and Negative data ignored are arrived. Using different approaches with radial basis functions further investigations may be done and the explored results of training and testing may be shown more concisely. Table III shows the summary of radii for gauusian and trimf. For smaller radii execution time is larger as compared to bigger values of radii so the machine memory and computation power become important factors during the execution runs. Time of initial preparations of run and time of final saving and analyzing of results are addition to time of execution run. For different approaches using radial basis functions types newrb: designs a radial basis network, newrbe: designs an exact radial basis network, newpnn: designs a generalized regression neural network, newgrnn: designs a probabilistic neural network may be tested in similar fashion.

Table 3: For different types of functions, TRIMF, For Radii 0.1-0.9.

Sr	**Membership function Type**	**Design**	**Radii**	**Bias**
1	gaussmf	Gaussian distribution curve	0.9	-18853.01
2	trimf	Triangular membership function	0.9	-18853.01
3	trimf	Triangular membership function	0.1	47.87
4	trimf	Triangular membership function	0.5	2.13

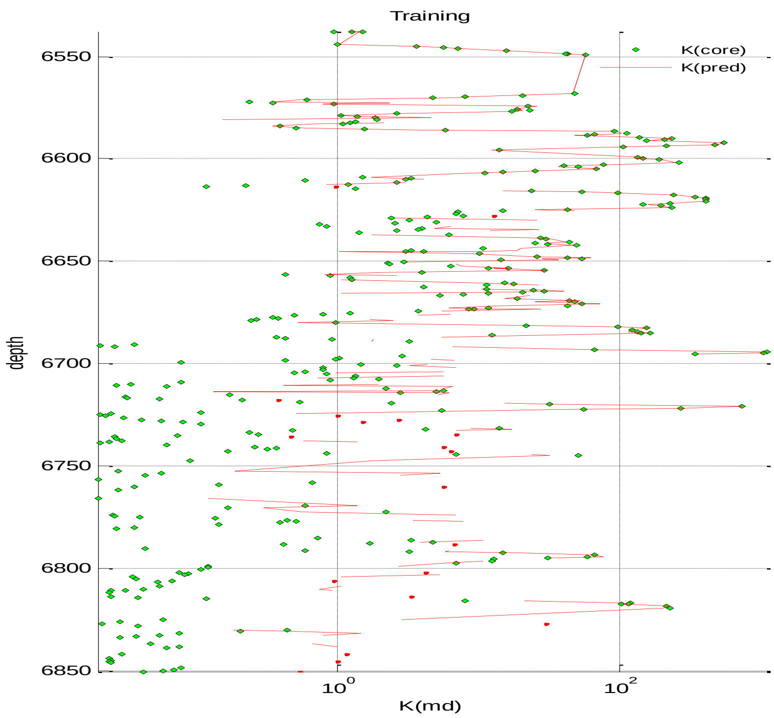

Fig. 1: For training Predictions using Fuzzy Logic epoch_n_2, numMFs_5, mfType = gaussmf, m = 0.00 ; b = -18853.01 ; r = NaN.

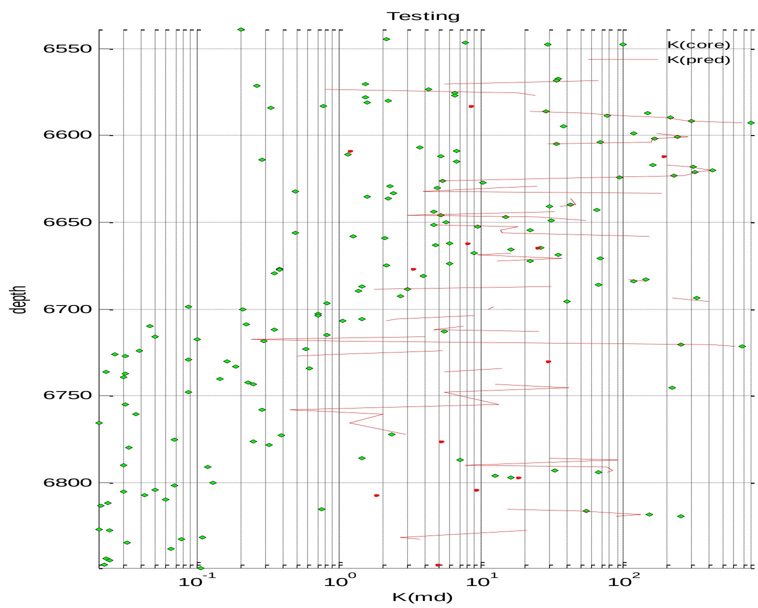

Fig. 2: For testing Predictions using Fuzzy Logic epoch_n_2, numMFs_5, mfType = gaussmf, m = 0.00 ; b = -18853.01 ; r = NaN.

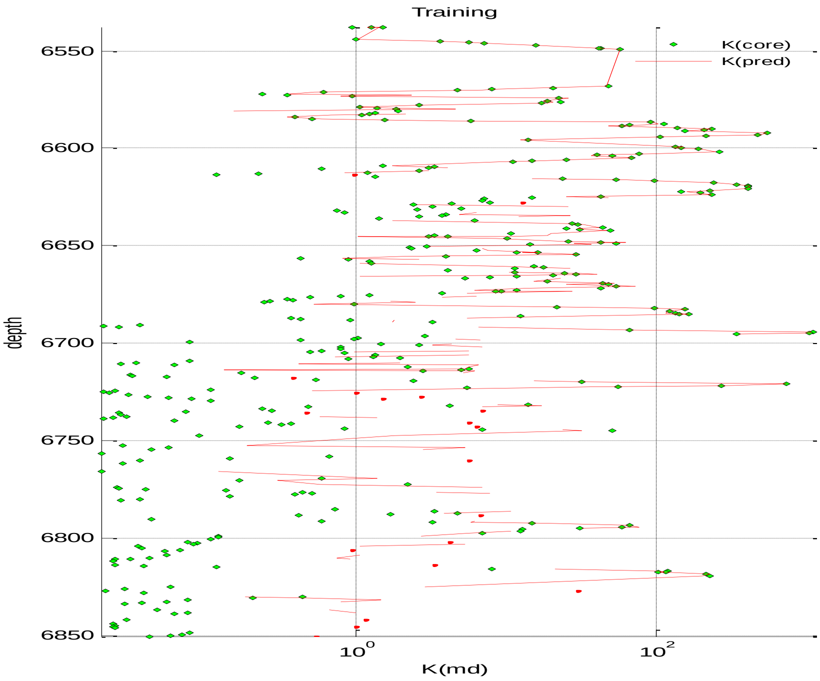

Fig. 3: Training Predictions using Fuzzy Logic
epoch_n_2, numMFs_5, mfType = trimf, for radii 0.9.

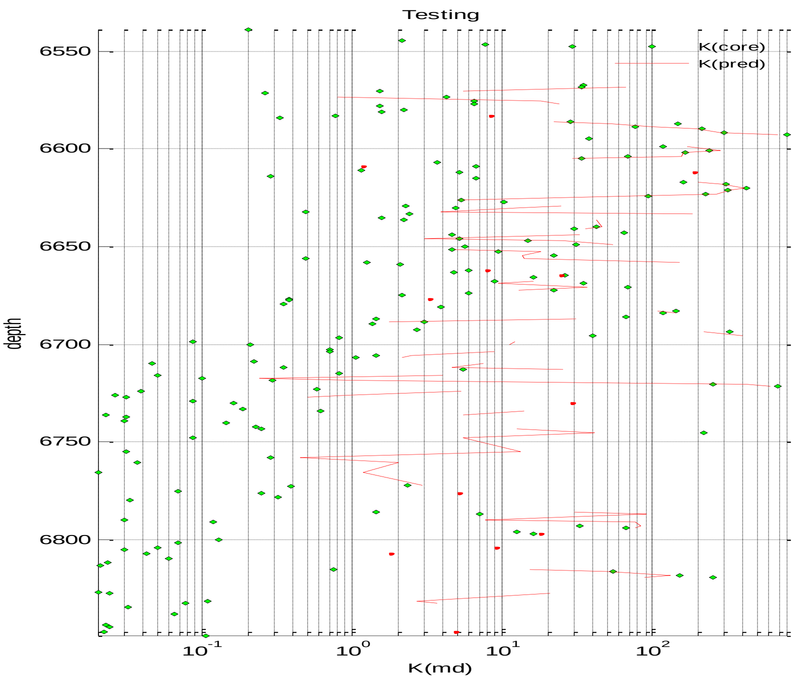

Fig. 4: Testing Predictions using Fuzzy Logic
epoch_n_2, numMFs_5, mfType = trimf, m = 0.00 ; b = -18853.01 ; r = NaN.

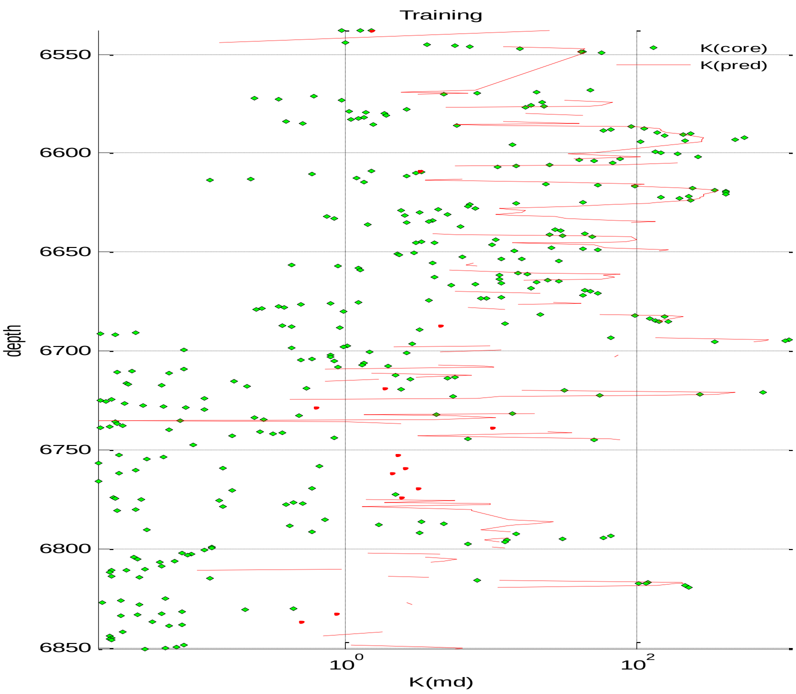

Fig. 5: Training Predictions using Fuzzy Logic, MFtype is trimf, with radii 0.5.

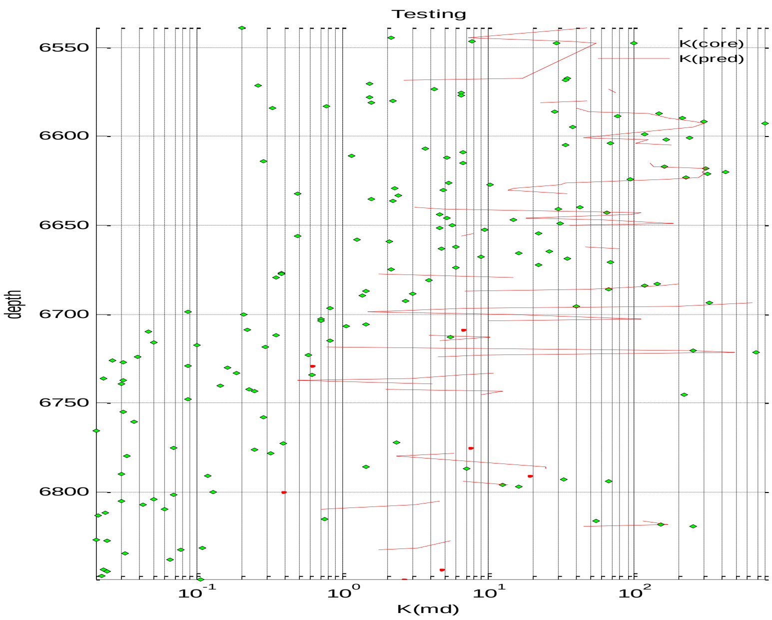

Fig. 6: Testing Predictions using Fuzzy Logic, MFtype is trimf, getting m = 0.00 ; b = 2.13 ; r = NaN.

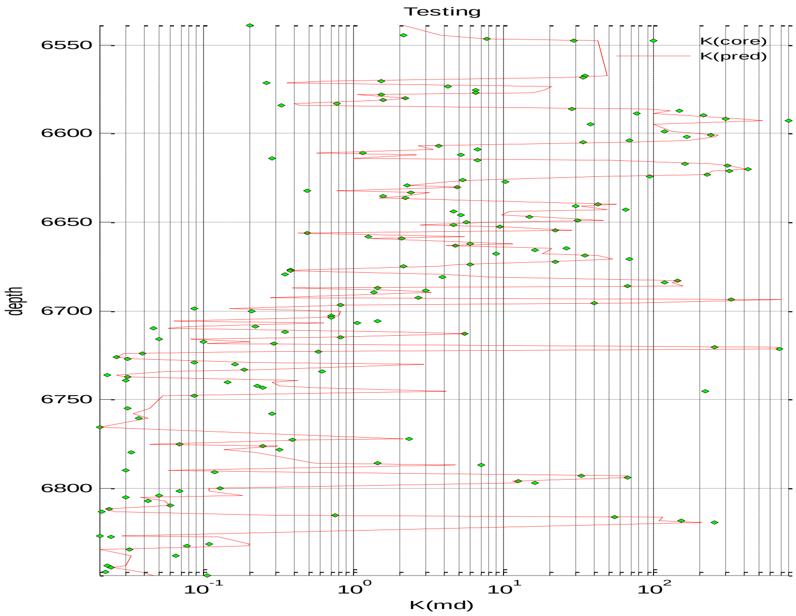

Fig. 7: Training Predictions using Fuzzy Logic, MF type trimf with radii 0.1.

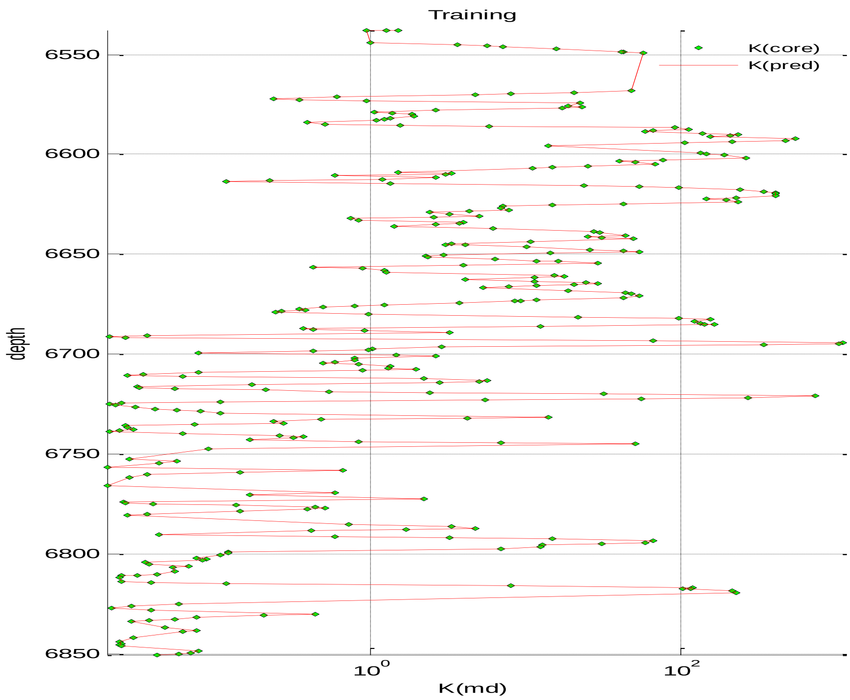

Fig. 8: Testing Predictions using Fuzzy Logic, MF type trimf getting m = 0.00 ; b = 47.87 ; r = NaN.

References

[1] Al-Harthi, M., Concentration and Chain Length Effects on Block Formation during Chain Shuttling Polymerization for Product Quality Enhancement Investigation, *International Journal of Engineering Science and Innovative Technology*, 1(2): 19-24, 2012.

[2] Calcium Carbonate Lab Scale Continuous Carbon Dioxide-jet Controlled Production Following Fuzzy Logic Model, *Journal of Chemistry and Chemical Engineering*, 5(6):535, 2011.

[3] Choice Modelling Of Styrene Tertiary Polymer under Various Monomer Compositions for Industrial Customer.

[4] Matlab Manuals, Math works. Mathworks.com.