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Application of Fuzzy Logic Technique for Oil Drilling Problem

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ABSTRACT

In this research paper, we studied a Decision making for Oil Drilling Problem using Fuzzy Logic Technique. In this problem, a geological engineer who has been asked by the chief executive officer (CEO) of a large oil firm to help make a decision about whether to drill the natural gas in a particular geographic region of northwestern new maxico. The first attempt at the decision process that there are only two states of nature regarding the existence of natural gas in the region. The CEO provides the utility matrix table. Further, CEO has asked you to collect new information by taking eight geographical boring samples from the region being considered the drilling. You have a natural gas expert examine the results of these eight tests; get the expert opinion about the conditional probabilities in the form of matrix.

For drilling problem, we have used two methods: Conditional probabilities for imperfect information & Conditional Probabilities of perfect information. From this method, we have calculated the expected utility, prior probabilities, conditional and unconditional probabilities of perfect and imperfect information and value of information is calculated. This totally fuzzy information and we have studied the value of fuzzy information which is less than the perfect and less than the imperfect information.

The problem of Oil Drilling Problem for Fuzzy logic technique is solved using the MATLAB programming software. This paper is totally based on software implementation of MATLAB.

Keywords : Oil drilling, Decision Making, Perfect, Imperfect Information And Uncertainty.

I. INTRODUCTION

1.1 Fuzzy Logic

The real world is complex , complexity arises from uncertainty in the form of ambiguity.“ as the complexity of the system increases , our ability to make precise and yet significant statements about its behavior diminishes until a threshold is reached beyond which precision and significance (or relevance) become almost mutually exclusive characteristics.” These are the words of the LOTFI ZADEH who introduced fuzzy logic in 1965. “ The closer looks at a real world problem , the fuzzier becomes its solution”, observed Dr. Zadeh who published his seminal work “FUZZY SETS” in the journal or information and control.

When there is imprecision (more uncertainty) and inadequate data the fuzzy logic technique is useful.

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Secondly, the cost of information increases with precision. But the cost of fuzzy information is far less than the perfect or imperfect information. Thus, there are two – fold advantages of the fuzzy logic technique: Understanding of complex systems becomes easier and analysis makes the system costs effective. He used the linguistic variable and further suggested that set membership function is the key to decision making when there is uncertainty.

The attention currently being paid to fuzzy logic is most likely the result of present popular consumer products such as washing machine, cameras, elevators, air conditioners, rice cookers, automobile, dishwashers etc. The nature of uncertainty in a problem is a very important point that engineers should ponder prior to their.

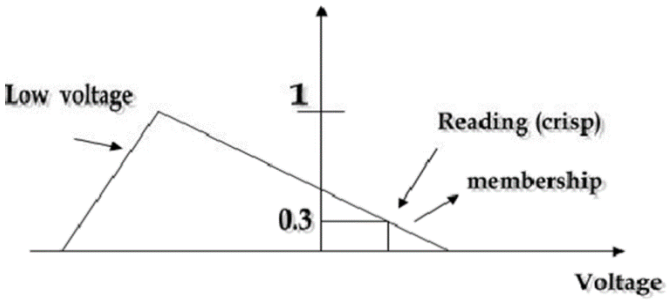

Fig.1.2 Fuzzy sets and crisp reading

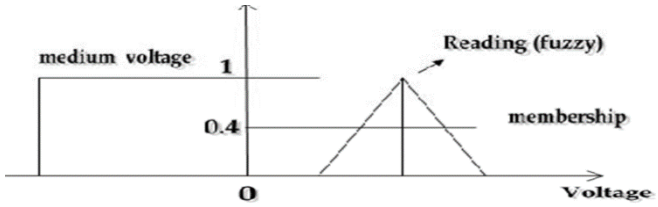

Fig. 1.3 Fuzzy set and fuzzy reading

1.2 Fuzzificaion

Fuzzification is the process of making a crisp quantity fuzzy. We do this by simply recognizing that many of the quantities that we consider to be crisp and deterministic are actually not deterministic at all. They carry considerable uncertainty. If the form of uncertainty happens to arise because of imprecision, ambiguity or vagueness then the variable is probably fuzzy and can be represented by a membership function.

In the real world such as, digital voltmeter generates crisp data, but these data are subject to experimental error. The below fig 1.1 shows one possible range of errors for a typical voltage reading and associated membership function that might represent such imprecision

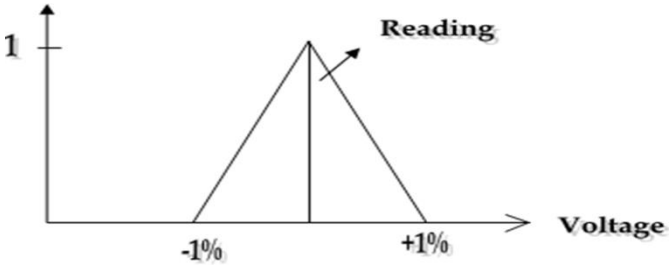

Fig 1.1 Membership function of crisp voltage reading

1.3 Defuzzification

It is the conversion of fuzzy quantity to a precise quantity. The output of a fuzzy process can be the logical union of two or more fuzzy membership functions defined on the universe of discourse of the output variable.

Fig 1. 4 Block diagram of Fuzzy to Crisp Conversion

1.4 Oil drilling concept

A geological engineer who has been asked by the chief executive officer (CEO) of a large oil firm to help make a decision about whether to drill the natural gas in a particular geographic region of northwestern new maxico. The first attempt at the decision process that there are only two states of nature regarding the existence of natural gas in the region. The CEO provides the utility matrix table. Further, CEO has asked you to collect new information by taking eight geographical boring samples from the region being considered the drilling. You have a natural gas expert examine the results of

these eight tests; get the expert opinion about the conditional probabilities in the form of matrix.

II. METHODOLOGY

For solving the oil drilling problem using fuzzy logic technique number of methods are available like Fuzzy Sets, Fuzzy relation, Cartesian product, alpha- cut, Non-transitive ranking methods etc. For oil drilling problem, we have two methods:

1) Conditional probabilities for imperfect information
2) Conditional probabilities of perfect information

From this method, we have calculated expected utility, maximum expected utility, prior probabilities, conditional and unconditional probabilities of perfect and imperfect information and value of the information calculated. This is totally fuzzy information which is less than the perfect and less than the imperfect information.

2.1. Nontransitive Ranking Method

When we compare objects that are fuzzy, ambiguous, or vague, we may well encounter a situation where there is a contradiction in the classical notions of ordinal ranking and transitivity in the ranking. To accommodate this form of nontransitive ranking, we introduce a special notion of relativity.

Let x and y be variables defined on universe X. We define a pairwise function fy(x) as the membership value of x with respect to y

And we define another pairwise function

fx(y) as the membership value of y with respect to x then the relativity function is given by

$f(x/y) = fy(x)/ \max[fy(x),fx(y)]$ (1)

is a measurement of the membership value of choosing x over y. The relativity function f(x/y) can be through of as the membership of preferring variable x over variable y.

To develop the genarl case for many variables, define variables x1,x2,------, xi,xi+1, ……,xn. All defined on universe X, and let these variables be collected in a set A i.e A= {x1,x2,……,xi-1,xi, xi+1, ……,xn}. We then define a set identical to set a except this new set will be missing one element xi, and this set will be termed A'. The relativity function then becomes

$f(xi/A') = f(xi/ \{x1,x2,……,xi-1,xi, xi+1, ……,xn\})$

$= \min\{f(xi/x1), f(xi/x2),……, f(xi/xi-1), f(xi/xi+1), ……,f(xi/xn)\}$ (2)

Which is fuzzy measurement of choosing xi over all elements in the set A'. The expression in equ(2) involves the logical intersection of several variables; hence the minimum function is used. Since the relativity function of the variable with repsect to itself is identity.

$f(xi/xi)=1$ (3)

then

$f(xi/A') = f(xi/A)$ (4)

We can now form a matrix of relativity values. f(xi/xj), where i,j=1,2, n, and where xi and

xj are defined on a universe X. This matrix will be square and of order n, and will be termed the c matrix (c for comaprision). The c matrix can be use to rank many different fuzzy sets.

To determine the overall rnking, we need to find the smallest value in each of the rows of the C matrix; that is,

$Ci' = \min f(xi/X), i= 1,2,……,n.$ (5) Where Ci' is the membership ranking value for the ith variable.

III. EXPERIMENTAL WORK

Program:-

```
% s1 = there is natural gas
% s2=there is no natural gas
% prior probabilities for each state is p=inline('s1=0.5')
p=inline('s2=0.5')
syms ps1 ps2 uji s1 s2 a1 a2 px1 px2 ps1=0.5
ps2=0.5
% probabilities sum to unity
% There are two alternatives
```

% a1=drill for gas
% a2= do not drill for gas
% The CEO provides the utility matrix is given by U=[uji s1 s2;a1 4 -2;a2 -1 2]
u11=4 u12=-2 u21=-1 u22=2
% utility matrix for this situation U1=[4 -2;-1 2]
% the expected utility matrix is E1=ps1*u11+ps2*u12 E2=ps1*u21+ps2*u22
% maximum utility (E=E(u*)) E=max(E1,E2)

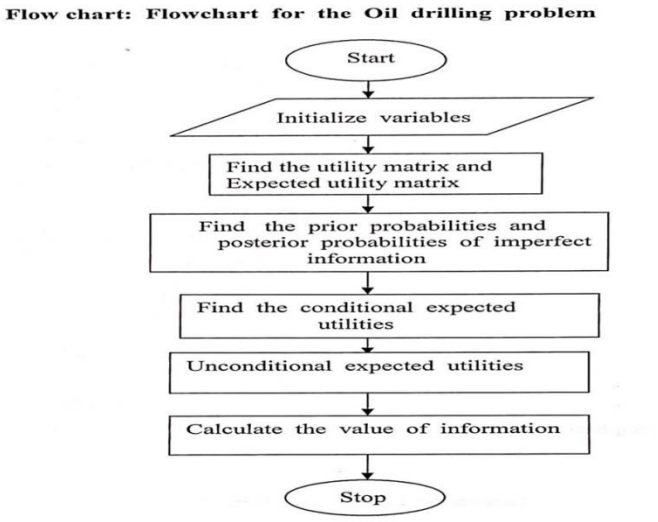

Fig 1.5 Flowchart for oil drilling problem

IV. RESULT AND DISCUSSION

In this example of the oil drilling problem, we studied about the large oil firm to help make a decision about whether to drill for natural gas in a particular geographical region. The prior probabilities geographical region. The prior probabilities of drilling information was

Ps1= p(s1) =0.5
Ps2 =p(s2) =0.5

The expected utility matrixes have been done by using utility matrix and prior probabilities. The eight geographical boring samples from the region have been considered for drilling. The table of imperfect and perfect information was very useful for this problem. The marginal probabilities for the new imperfect information, conditional probabilities, conditional expected utilities for imperfect and perfect information was studied. At last the values of new information have been calculated of both imperfect and perfect information. Some procedure will be happened in case of perfect information.

In this result, the fuzzy information was considered and fuzzy conditional probabilities have been derived. The fuzzy posterior probabilities P(Si/M) and fuzzy expected utilities E(uj/Mt) was done. The maximum conditional probabilities have been calculated and at last the fuzzy information calculated. The fuzzy information is less than the value of perfect information and less than the value of imperfect information. The result of imperfect information and perfect information is as shown in below table.

	X1	X2	X3	X4	X5	X6	X7	X8
p(s1/xk)	0	0.3333	0.2000	0.3333	0.6667	0.8000	0.6667	1.0000
p(xk/s2)	0.05	0.1	0.4	0.2	0.1	0.1	0.05	0
p(xk)	0.0250	0.0750	0.2500	0.1500	0.1500	0.2500	0.0750	0.0250
E(u*/xk)	2.0000	0.6667	1.2000	0.6667	2.0000	2.8000	2.0000	4.0000
aj/xk	a2	a2	a2	a2	a1	a1	a1	a1

Table 1. Posterior probabilities based on imperfect information

	X1	X2	X3	X4	X5	X6	X7	X8
P(s1/xk)	0	0	0	0	1	1	1	1
P(xk/s2)	0	0	0	0	1	1	1	1
P(xk)	0.05	0.1	0.25	0.1	0.1	0.25	0.1	0.05
E(u*/xk)	2	2	2	2	4	4	4	4
aj/xk	a2	a2	a2	a2	a1	a1	a1	a1

Table 2. Posterior probabilities based on perfect information

V. DISCUSSION

One area in which fuzzy set theory has a great potential that in psychology; in particular the psycho logistics which is essential for studying the connection between human communication and decision machines. Today, close to four decades after the artificial intelligence (AI) was born. It can finally be said that intelligent systems are becoming a reality. The soft computing has direct bearing on machine

intelligence. Neuro fuzzy soft computing has a special role in the design of modern intelligent systems.

VI. APPLICATIONS OF FUZZY LOGIC

- Control systems
- Pattern recognition
- Robotics
- Consumer electronics
- Automobiles
- Intelligent systems

VII. FUZZY LOGIC IN CONSUMER GOODS

Cameras , Washing machine , Air conditioners , Luxury cars , Elevators , Rice cookers , Automobile , Dishwashers , Refrigerator , Camcorders , Vac. Cleaner etc.

VIII. SCOPE OF WORK

The scope of further research work is to develop and design some electronic circuits such as speed control motor, automatic control system and some decision making problem like weather forecast. This has been recently used for user-oriented verification of probability forecasts, but there is applied to aid forecast users in optimizing their decision making from probability forecasts.

IX. REFERENCES

[1]. Ross T J , "Fuzzy logic with engineering applications" , MGH,(1997.

[2]. Klir G J , " Fuzzy sets , uncertainty, and information" , PHI, 2002.

[3]. J. E. Colgate and K. M. Lynch, "Mechanics and Control of Swimming: A Review," IEEE Journal of Oceanic Engineering, vol. 29, pp. 660-673, July 2004.

[4]. R. Ramamurti and W. C. Sandberg, "Computational Fluid Dynamics Study for Optimization of a Fin Design," In Proc. of the 24th AIAA , Applied Aerodynamics Conference, AIAA- 2006- 3658, San Francisco, CA, 2006.

[5]. Lee C. C, "Fuzzy logic in control systems", IEEE Trans. On Systems, Man, and Cybernetics, SMC, Vol.20, No.2, 1990, pp. 404-35

[6]. Rudra Pratap, "MATLAB A quick Introduction for Scientist and Engineers", Oxford University Press 2004

[7]. Bernardinis L A, " Clear Thinking on Fuzzy Logic", Machine Design, April 23, 199.

[8]. Engineering(An ISO 3297: 2007 Certified Organization ,Vol. 2, Issue 1, January 2014 p-p 2626-2631

[9]. system and simulation, , IACSIT Press, Singapore, pp. 92–95, Vol.7., 2011 [10]Cooper J A, "Fuzzy algebra uncertainty analysis for abnormal environment safety assessment", J intelligent and fuzzy systems, January vol 3, issue 4, 337-346