Fuzzy Technique for Assessment the software Productivity

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ABSTRACT

Software engineering is a field of computer science that concerns the establishment and use of engineering principals for the development of high quality reliable software at a consistent productivity rate, with minimal cost within a scheduled time. There is a myth that software does not wear out deform or crack. But recent research found that software can wear-out and deform. Software maintenance claims a large proportion of organizational resources .however it is difficult to assess the actual maintenance performance effects of software practices because their impacts is realized over the software life cycle to estimate the impact of development activities in a more practical time frame, this research develops a fuzzy logic based model in which software complexity density is a key intermediate variable that links design and development decisions to their downstream effects on software maintenance. Our results show an important link between software development and maintenance performance

Keywords: Cyclomatic complexity density, Defuzzification, Fuzzy logic, fuzzy set, triangular fuzzy number.

1. INTRODUCTION.

The productivity is measured on the basis of work done on a software system per unit time after it becomes operational and is regarded as maintenance productivity. Cyclomatic complexity [5] is computed using control flow graph of the program.cyclomatic complexity may also be applied to individual functions, modules, methods or classes with in a program. The cyclomatic complexity per lines of code is the most important complexity density is inversely proportional to maintenance productivity. This paper discusses the fuzzy logic based precise approach for quantifying the maintenance productivity of software.

2.Fuzzy logic

Fuzzy logic (FL) can be applied in two different ways; in a narrow sense and in a broad sense The narrow sense of FL is the theoretical concept of fuzzy reasoning. Its broad sense consists of classes with continuous values and is based on classical set theory. In a real life situations most attribute costs fall within boundaries of two values; a minimum and a maximum. Within that interval, cost boundaries are not abruptly demarcated but tend to model a continuous graph. Some time the boundary value analysis fails .in between two boundaries there exist other boundaries in which it is not clear whether we can say too expensive or not. To limit this problem from cascading, grades can be allocated to represent intervals. The basis of this approach is fuzzy set theory. Members of the fuzzy set have grades in the interval [0, 1]

3. Fuzzy based Approach for assessment of maintenance productivity:

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Software maintenance claims a large proportion of organizational resources[6]. However, it is difficult to assess the actual maintenance performance effects of software development practices because their impact is realized over the software life cycle. To estimate the impact of development activities in a more practical time frame ,this research develops a fuzzy logic based model in which software complexity density is a key intermediate variable that links design and development decisions to their downstream effects on software maintenance. These results suggest an important link between software development practices and maintenance performance.

Classification of cyclomatic complexity density (CCD) in different classes is done and corresponding complexity attribute and co-efficient of productivity are defined

.Table1:Cyclomatic Complexity density and Corresponding complexity

CCD	Complexity	Co-efficient of productivity (R)
0-0.167	Very-Low	W_1
0.01-0.333	Low	W_2
0.167-0.5322	Medium Low	W_3
0.333-0.667	Medium	W_4
0.5-0.8333	Medium High	W_5
0.667-1.0	High	W_6
0.833 or more	Very-High	W_7

The fuzzy sets for complexity attributes shown in table 1. Are represented by figure 1. Input can be classified in to fuzzy set Viz.,Very low ,Low ,medium low ,medium, medium high ,high and very high. In order to fuzzify the inputs, triangular membership functions (TFN) are used. A rule base is created as shown in figure Mamdani –style [7] inference is used.

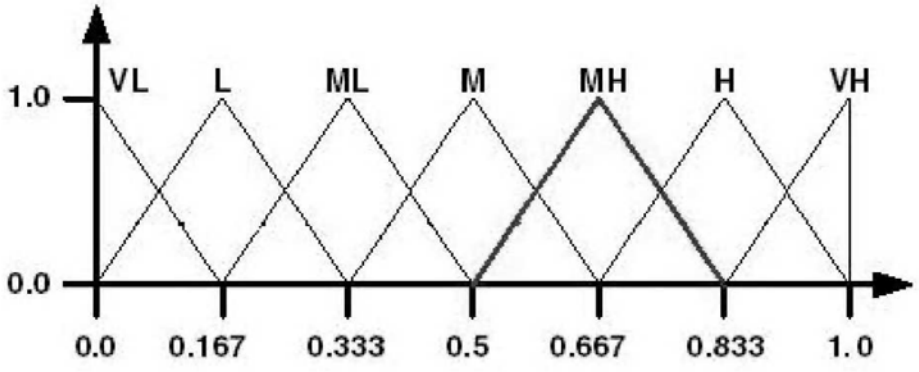

Figure1:Fuzzy Inference system for software maintenance productivity

4. Defuzzification: Crisp value of maintenance productivity is evaluated by applying defuzzification rule specified in the following equation:

$$P=\begin{cases}\mu*W_i & 0.0\le CCD\le 0.167\\ \mu*W_1+(1-\mu)*W_2 & 0.167\le CCD\le 0.333\\ \mu*W_2+(1-\mu)*W_3 & 0.333\le CCD\le 0.5\\ \mu*W_3+(1-\mu)*W_4 & 0.5\le CCD\le 0.667\\ \mu*W_4+(1-\mu)*W_5 & 0.667\le CCD\le 0.883\\ \mu*W_6+(1-\mu)*W_6 & 0.883\le CCD\le 1\end{cases} \quad \text{.....1}$$

Where

P=Maintenance productivity

μ=Grade of membership function

5. Experimental Design and Results:

The dataset for small pilot project on actual maintenance data used for empirical study is given in table 2.productivity estimates of Gill model [11]are used for evaluation of performance of purposed model and are calculated using equation 2.

Productivity=28.7-(134*cyclomatic density)……2

Table2: Maintenance project Dataset

Cyclomatic complexity density	Productivity in LOC/Hours	LOC Added	Fix hours	Initial cyclomatic Complexity	Initial LOC
0.132	10.1	451	45	882	6682
0.134	10.3	3143	305	958	7133
0.197	3.6	395	110	1054	5343
0.196	2.0	347	174	1126	5738
0.193	6.1	341	56	1176	6085
0.108	19.0	2147	113	370	3435

Validation results for the software productivity assessment are given in **Table3**. And are represented by figure 2.the purposed model is evaluated on the basis of variance accounted For(VAF).VAF for the proposed fuzzy model (custom defuzzification) is 90.825 and for centroid defuzzification is 87.008,while VAF for Gill model, using individual criteria for defuzzification gives better estimation.

Table3: Validation Results for Maintenance Productivity Assessment

P.NO	Cyclomatic density	Productivity			
		LOC/Hr	Centroid defuzzification	Custom Defuzzification	Gill Model
1	0.108	19	17.8	18.4	14.228
2	0.132	10.1	14.2	13.6	11.012
3	0.134	10.3	13.9	13.2	10.744
4	0.193	6.3	5.9	5.7	2.838
5	0.196	2	5.54	5.4	2.436
6	0.197	3.6	5.42	5.3	2.302

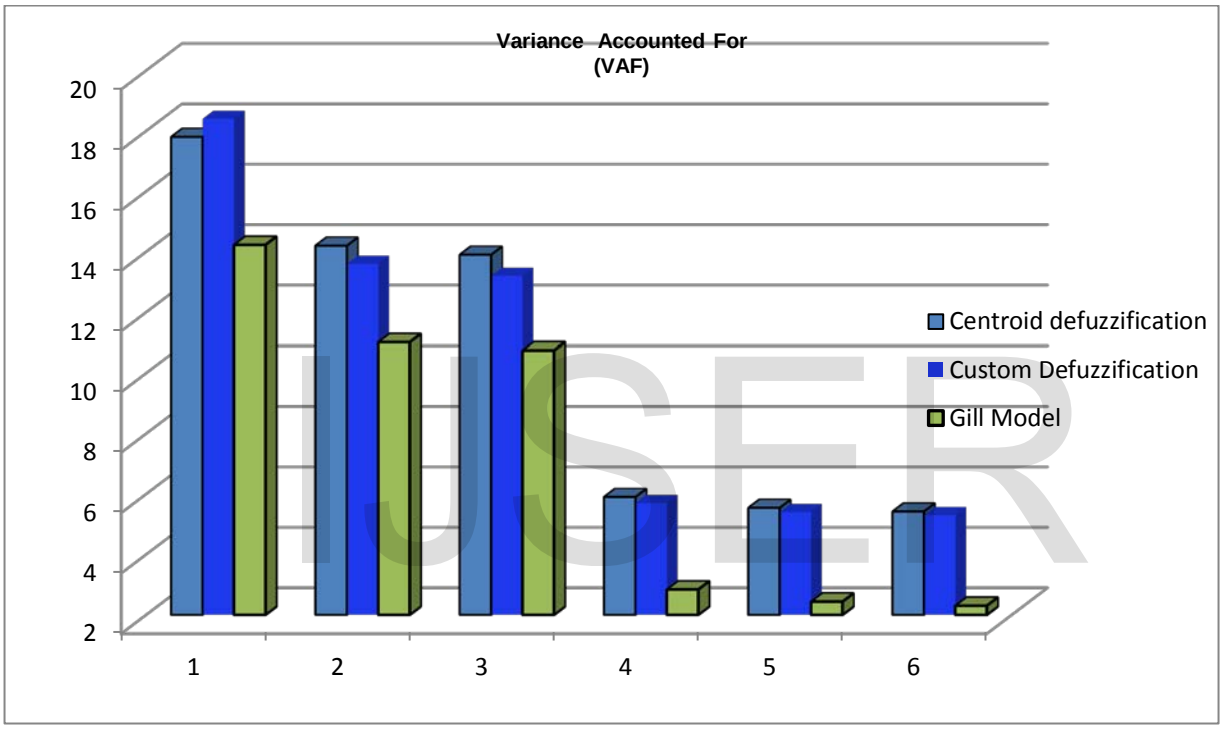

Figure2: Validation of Results for proposed fuzzy Technique.

6. Conclusion and Future Scope:

A fuzzy logic based precise approach to quantify productivity of software is proposed in this paper. The estimation of productivity of software is very easy by this approach. As triangular fuzzy numbers have been used for representing cyclomatic complexity density. The model was evaluated based on published data for small pilot project on actual maintenance data. However the technique is quite general and may be tested for medium and large projects.VAF for proposed model is highest among the other model under study.

7. REFERENCES

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