International Journal of Engineering Research and Development
***e**-ISSN: 2278-067X, **p**-ISSN: 2278-800X, www.ijerd.com*
Volume 3, Issue 3 (August 2012), PP. 17-21

Simulation of Fuzzy Based Power System Stabilizer

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Abstract—In recent years, voltage instability has been responsible for many major network collapses throughout the world; hence the growing interest of power engineers and researchers to address this problem. This thesis provides an introduction to the concepts and definitions related to voltage stability problems in power systems. It also gives a concise description of the stability problems of the distribution system. Observations made from extensive simulations using the software Fuzzy toolbox have been included to give a better understanding about the dynamic behavior of this system under various operating conditions and contingencies.

Keywords—Compensation, System Stability, Reactive Power, Active Power, Voltage Regulation

I. DEFINING THE STRUCTURE

In FIS editor first of all the structure of the system is defined. Here in the structure shown below there are 2 inputs and one output. The 2 inputs are:

1. Load in KW
2. Compensator

The one and only output is

- Change in KW

The middle block contains the rules which are formed using different combinations of the inputs used. One in all it can be said that the the FIS editor displays the information about the fuzzy inference system.

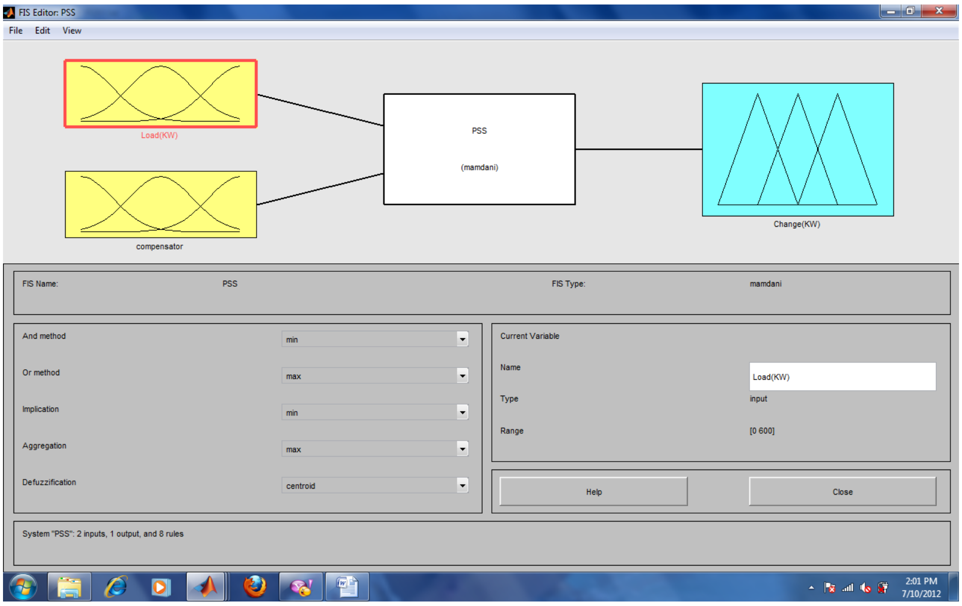

Fig.1 Structure building using FIS editor

II. DEFINING THE MEMBERSHIP FUNCTION AND MEMBERSHIP DEGREE FOR ALL THE INPUT OUTPUT VARIABLES

After defining the structure in FIS editor the GUI tool that come into play is membership editor. As discussed in previous chapter we can choose any type of membership function among the various types like trapMF, triMF, GuassMF etc. For the first input variable i.e 'Load' in this project the type of membership function used is trapMF. Also we can use any number of membership degrees for the membership function of a variable. There are 8 membership degrees have been used for the first input variable. They are:
VLL (VERY LIGHT LOADED)

LL (LIGHT LOADED)
ML (MEDIUM LOADED)
PL (POSITIVE LOADED)
SOL (SMALL OVER LOADED)
MOL (MEDIUM OVER LOADED)
OL (OVER LOADED)
HOL (HIGLY OVER LOADED)
The range of the membership degree can be varied according to the requirements.

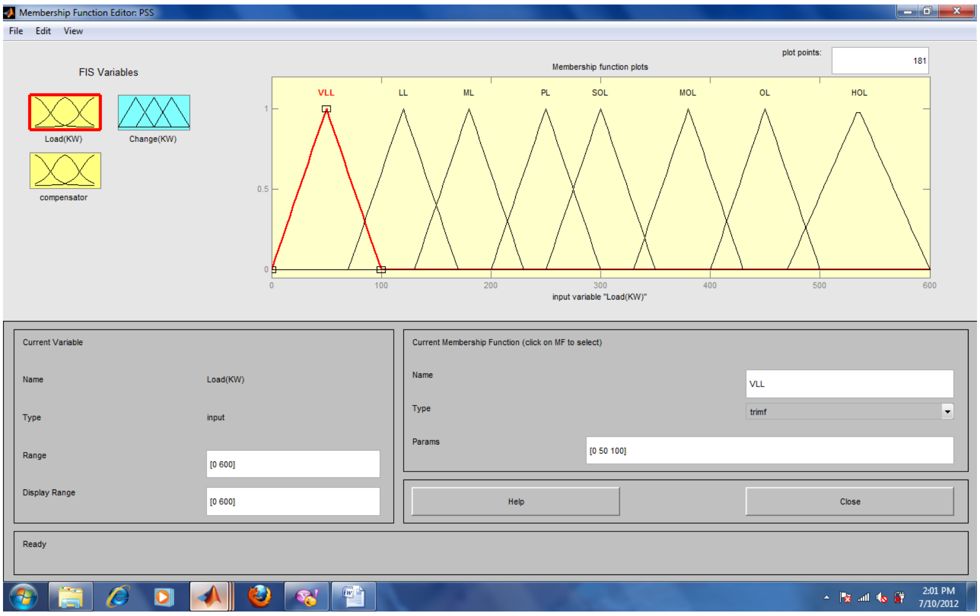

Fig. 2 Membership editing for first input variable

For the second input variable i.e 'Compensator' in this project the type of membership function used is trapMF. There are 5 membership degrees have been used for the second input variable. They are:
Very negative
Negative
Zero
Positive
Very positive
Similarly here also the range of the membership degree can be varied according to the requirement.

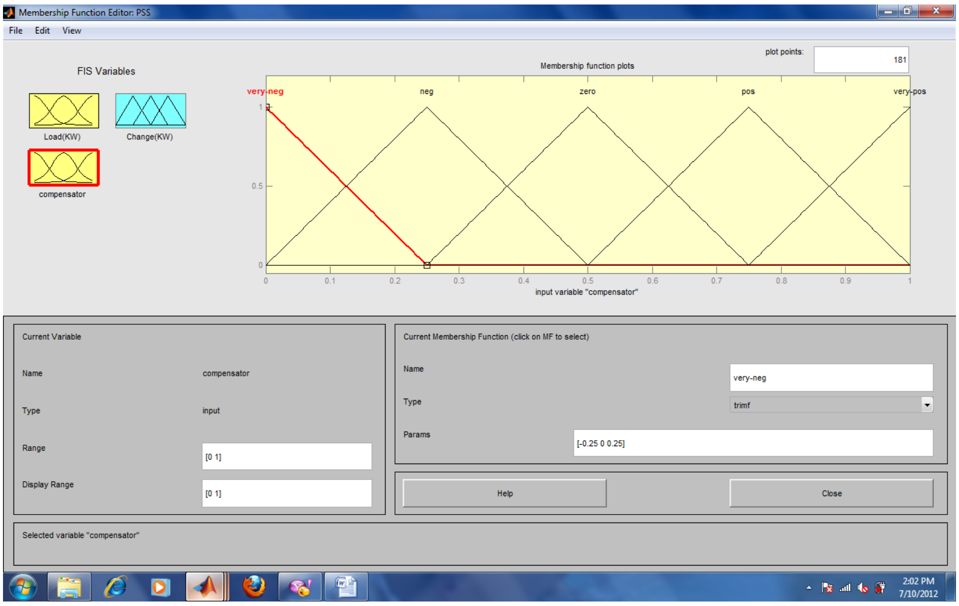

Fig. 3 Membership editing for second input variable

The ouput variable is 'Change in KW' .There are 8 membership degrees have been used for the output variable. They are:
NS
S
MS
SS
PA
MA
LA
VLA

Similarly the range of the membership degree can be varied according to the requirements.

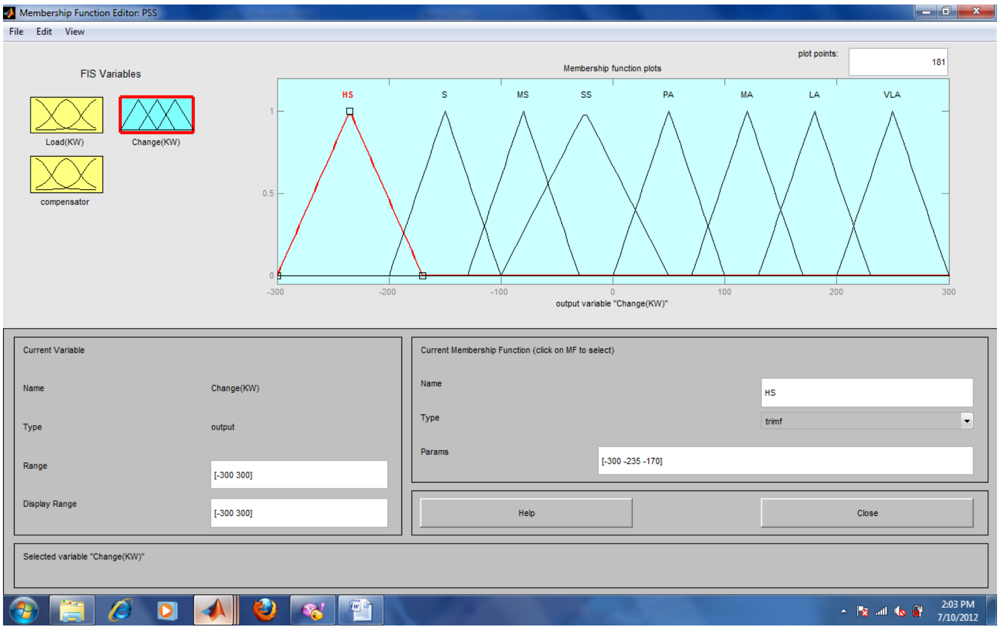

Fig 4 Membership editing for output variable

III. CONSTRUCTION THE RULES

When the membership editing comes to an end the next work starts is defining the rules by taking various combinations of the input variables. This is done using another GUI tool i.e.' Rule editor'. Here we can form as many as rules can be formed by using different combinations of input variable. Here for simplicity only 9 rules have been used. The structure of rules is in 'if-then' form as discussed earlier in the previous chapters.

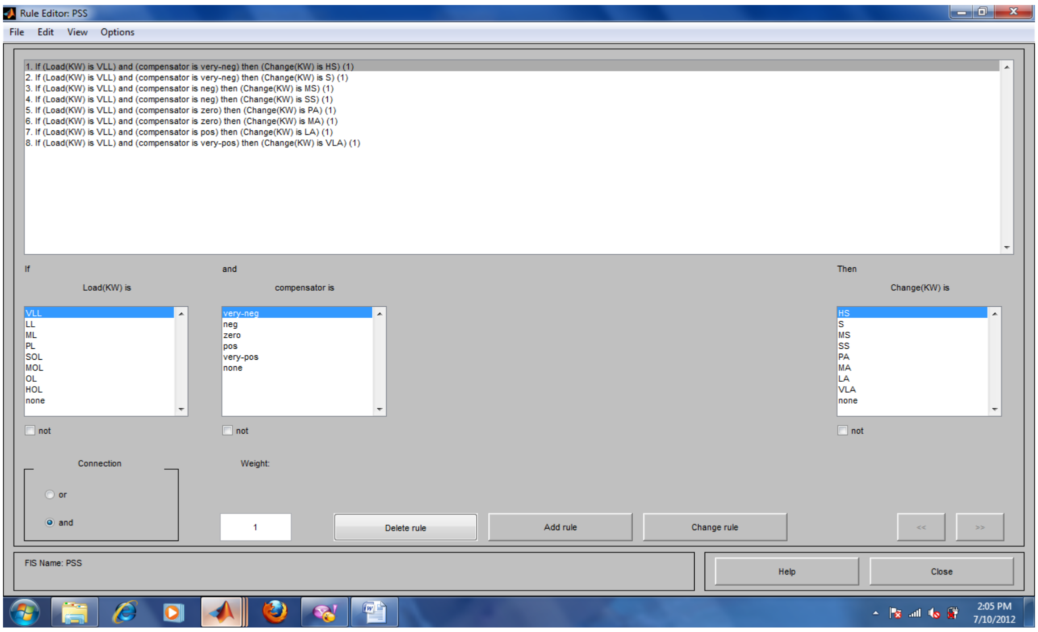

Fig 5 Constructing the rules

IV. PERFORMANCE ANALYSES

After editing the rules in the next GUI tool called ‘Rule viewer’ rules on a graph can be analysed. Here the output graphical presentation is also present on the same wizard. We can change the values of the inputs in this wizard by simply typing the character values and the graphical representations of the inputs and output change accordingly. As it can be seen all the inputs with their corresponding values and the output with the response value are shown on the same wizard.

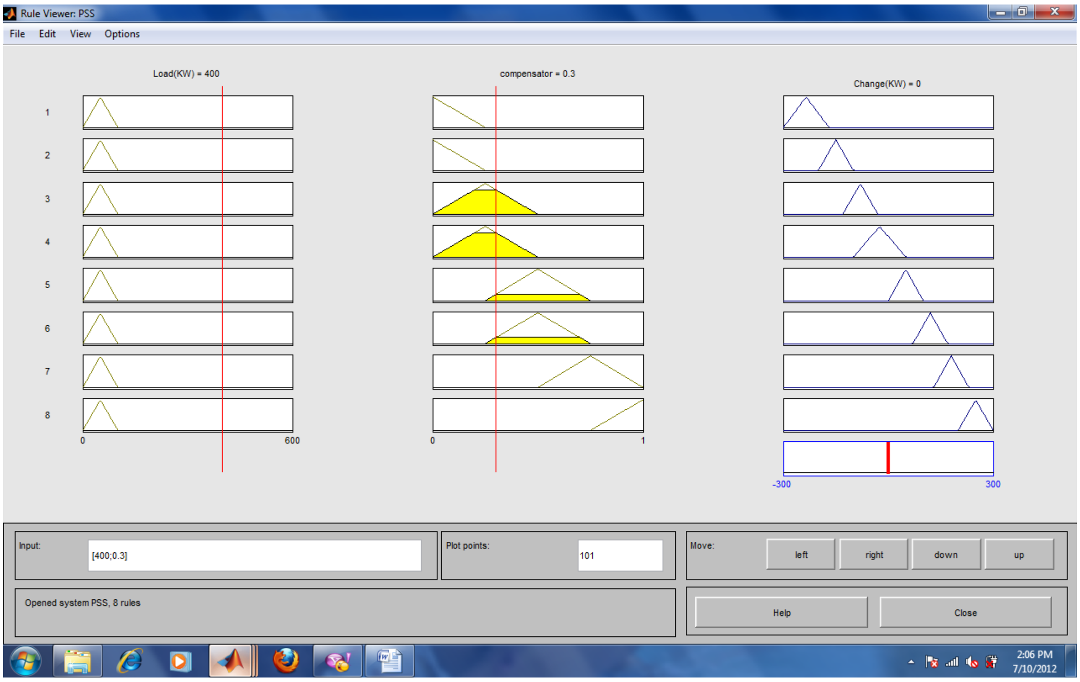

Fig.6 Graphical representation analyses

- Graphical view of performance

‘Surface viewer’ is another GUI tool in which the 3D response of the overall functioning of the system can be displayed. The overall response of our project has been displayed below using 3D surface viewer.

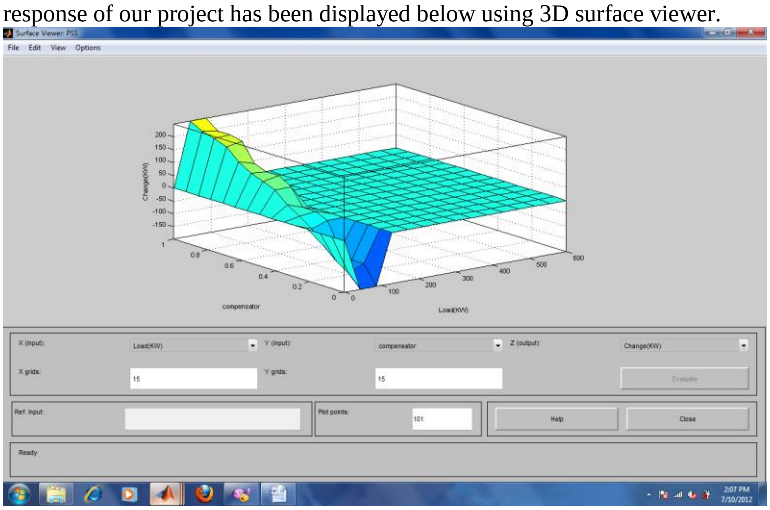

Fig. 7Surface view analyses

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