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Fuzzy Controller for Adjustment of Oil Level in the Tank

Abstract. This paper presents the fuzzy controller for adjustment of oil level in the tank. Using the fuzzy controller will be maintained constant the oil level. The fuzzy controller was elaborated in MatLab and operation was simulated in SIMULINK.

***Keywords**: fuzzy, controller, oil tank*

1. Introduction

The fuzzy controller used maintains constant the oil level in tank at a same value, initially established, through adjustment of adduction and evacuation pipes valves, because in tank interfere the following perturbations:

- variation of oil quantity at tank inlet and at outlet
- variation of pressure in pipes
- variation of oil temperature
- variation of tank steams stress which modified the oil volume, respectively modified the oil level in tank

The fuzzy controller provides at outlet modification of oil level value at which must be finding the float with regard the system perturbations.
This value of oil level can be:

- positive, in this case the fuzzy controller command the opening of evacuation pipe valve for can be evacuated the oil so that oil level come to the initial value
- negative, in this case the fuzzy controller command the opening of adduction pipe valve for can be insert the oil so that oil level come to the initial value

2. Presentation of fuzzy controller

The fuzzy controller is presented in figure 1.

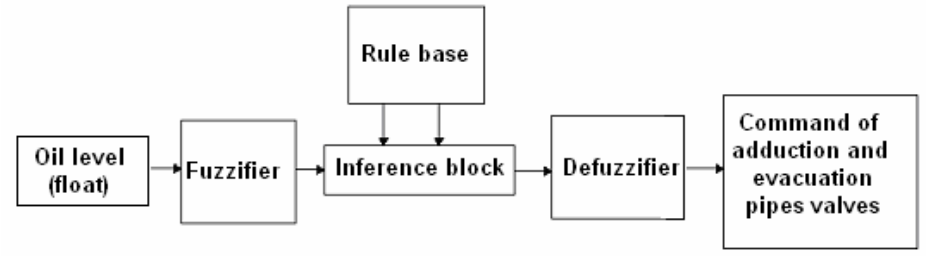

Figure 1. Fuzzy controller

The implementation of fuzzy controller involves three stages:

- information fuzzification;
- inference operation;
- information defuzzification.

Information fuzzification

The information fuzzification consists in fuzzy values assumption of input measures, respectively output in/from controller. These measures are established being determined value domains of input and output measures. The each input or output measure to attach a set of linguistic terms. The one terms from set describe a variation interval of one measure.

The fuzzification operation will be finalised by to define of specific functions for each measure.

In this case the linguistic terms are:

- for oil level error attached the linguistic terms:
  - negative
  - zero
  - positive

  with specific functions shows in figure 2
- for oil level error derivative attached the linguistic terms:
  - negative
  - zero
  - positive

  with specific function shows in figure 3
- for adjustment of adduction and evacuation pipes valves attached the linguistic terms:
  - negative
  - zero
  - positive

  with specific function shows in figure 4

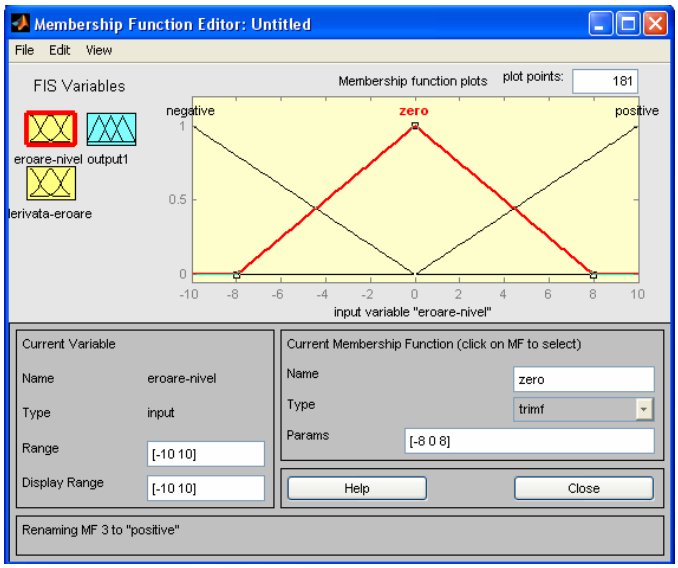

Figure 2. Specific functions for oil level error

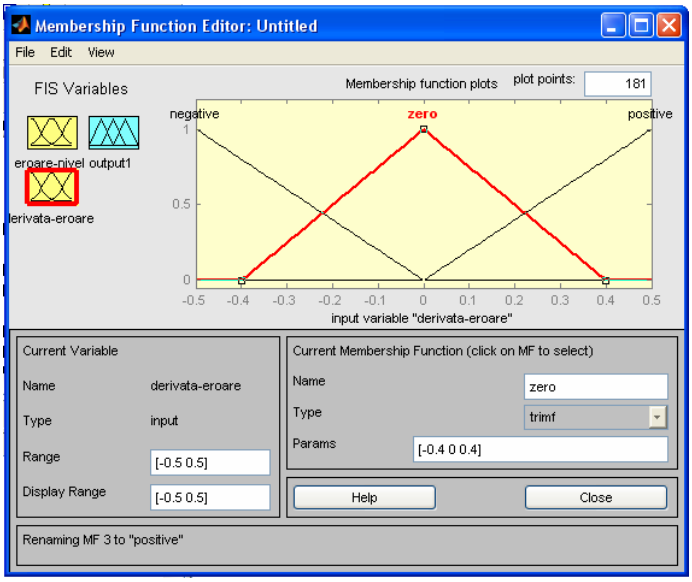

Figure 3. Specific functions for oil level error derivative

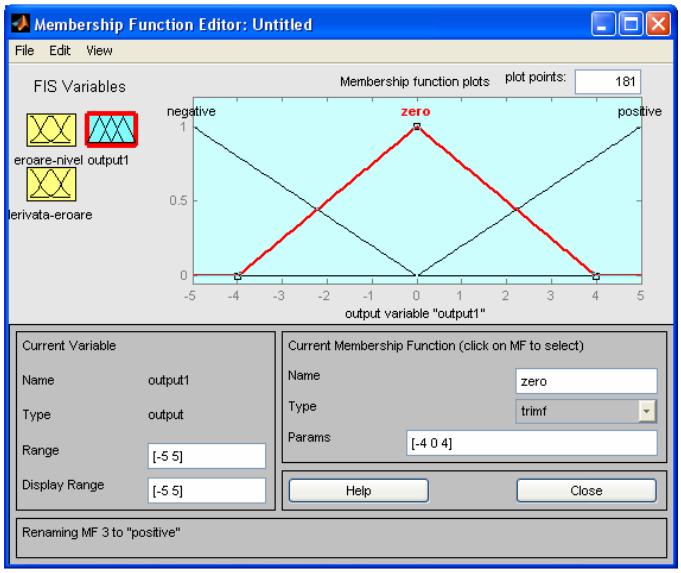

Figure 4. Specific functions for adjustment of adduction and evacuation pipes valves

Inference operation

The driving strategy have an essentially element the inference method. The inference connects the measurable input measures (fuzzy input variables, linguistic expression) of the output measure (linguistic expression).

The inference operation will be make by inference table or decision table which described the linguistic rules adopted. In table 1 is presented the decision table (inference) for this case.

Table 1.

Adduction and evacuation pipes valves		Oil level error derivative		
		negative	zero	positive
Oil level error	negative	**negative**	**negative**	**negative**
	zero	**negative**	**zero**	**positive**
	positive	**positive**	**positive**	**positive**

This table corresponding of three linguistic terms involves a nine linguistic rules, linguistic rules shows in figure 5.

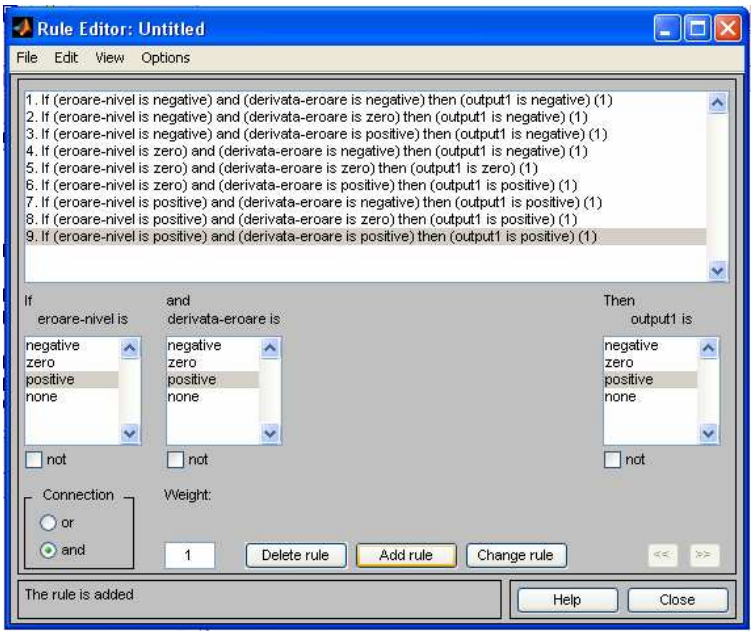

Figure 5. Linguistic rules

For this case is used inference of Mamdani type.

Information defuzzification

The obtaining values from inference operation are used in defuzzification for obtaining concrete command values.

The defuzzification method used is a weight centre.

3. Results obtaining in MATLAB/SIMULINK program

On base of specific functions, an inference table and a defuzzification method was simulated through by MATLAB/SIMULINK program, the various cases which appear in practice, the obtained results shows in figure 6 and figure 7.

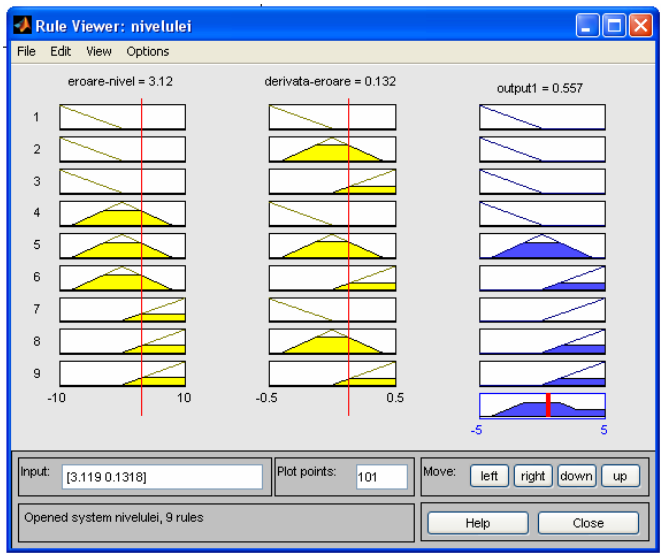

Figure 6. Inference at positive oil level error and positive oil error derivative

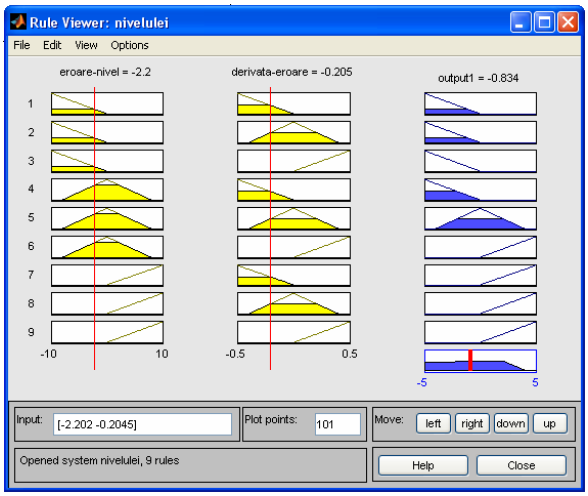

Figure 7. Inference at negative oil level error and negative oil error derivative

The SIMULINK model of adjustment oil level in the tank is presented in figure 8 and system response is presented in figure 9.

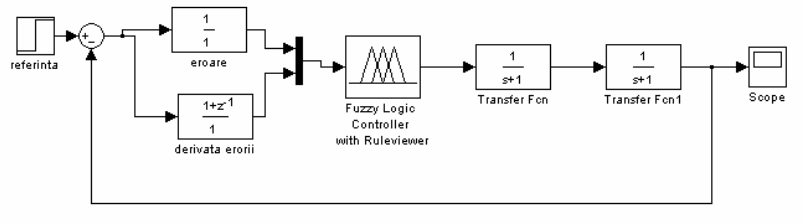

Figure 8. The SIMULINK model of adjustment oil level in the tank

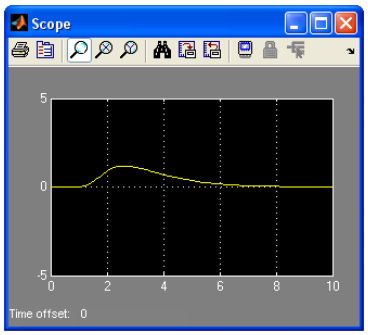

Figure 9. System response (wave form at output from system)

In figure 10 is presented the control surface of adjustment elements.

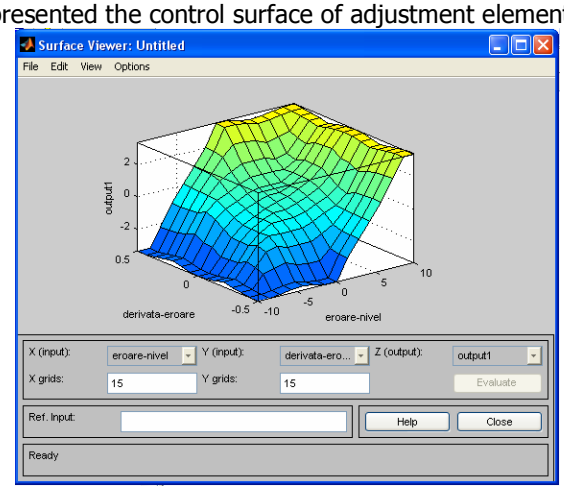

Figure 10. Control surface of adjustment elements

4. Conclusion

The fuzzy controller is very important in maintained the oil level constant.

Because, the fuzzy controller work with linguistic variables the oil level will be modified with a high precision.

The fuzzy controller of system provide at output modification of oil level hold of system perturbations.

References

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