



MODERN TECHNOLOGY IN WASHING MACHINE DUE TO FUZZY LOGIC

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Abstract

This paper reviews fuzzy logic as a modern technology for Washing Machine. The greatest success of fuzzy logic has been in the area of control system. Among all the products equipped with fuzzy controllers washing machines were the earliest. Fuzzy Controllers has made functions of washing machines more economical, energy saving and less time consuming.

Keywords: *Fuzzy Logic, Washing Machine, Fuzzy Controllers.*

Introduction:

Humans have a remarkable capability to reason and make decision in an environment of uncertainty, imprecision, incompleteness of information etc. But machines don't have such ability few decades before. In fact operating machines automatically was a topic of considerable research in the area of technical system that time. Lotfi Zadeh father of Fuzzy Logic have built capability of dealing with imprecise information in Machines through fuzzy controllers. The earliest consumer product equipped with fuzzy controllers was Washing Machine.

Working of Fuzzy Controllers:

Fuzzy algorithm execute in three major stages – 1) Fuzzification

2) Inference

3) Defuzzification

In fuzzification stage, real world sensory inputs in a given universe of discourse are characterized on closed interval $[0,1]$ according to their level of membership in fuzzy set. After taking inputs it determines the degree to which they belong in order to express qualities of input variable (Linguistic Variable) to a degree of membership in each of Fuzzy set.

e.g. Cloth is dirty , cloth is very dirty and so on...

Now the rules must be combined in some manner in order to make a decision. The inference stage applies the fuzzified input value to a rule base to determine a command output.

The defuzzification stage extracts a crisp command output from inference drawn from fixed rules. The input for defuzzification process is a fuzzy set and output is a single number, Aggregate output is a fuzzy set. Techniques for defuzzification generally involve some analysis of regions created by cutting output fuzzy set using adaptabilities from each fixed rule. Most popular defuzzification method is centroid calculation which returns centre of area under curve.

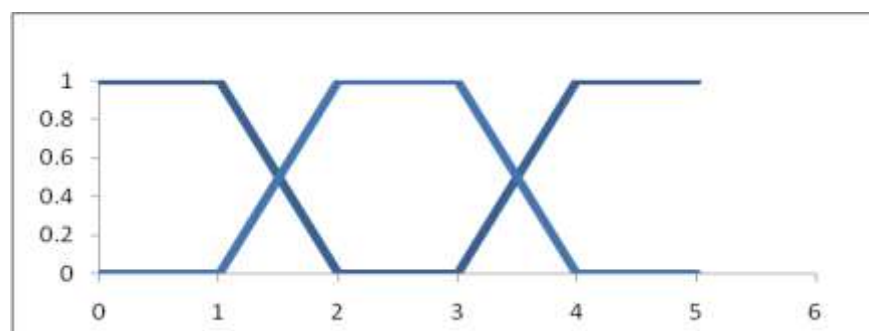
Through fuzzy controllers this type of algorithm is executed in Washing Machine. Here, the purpose of fuzzy controller is to determine proper operating time of Washing Machine for given laundry. Fully automatic Washing Machine uses this technology.

Once the washing machine is loaded with dirty laundry, it begins to calculate how dirty the laundry is and how long it would take to wash it. A fuzzy machine would also have to take into account the amount of soap it would require for dirty clothes, greasy clothes and dirty and greasy clothes. This requires complex calculations which the machine is programmed to do. The machine would also require drawing sufficient water to accommodate all the calculations into a wash cycle. The fuzzy washing machines have now begun to approximate subtle human functions. Fuzzy logic has made functions of washing machines more economical, energy-saving and less time-consuming.

The operating time of a washing machine depends on two properties of each given load of clothes

- 1) It depends on how dirty the clothes are
- 2) It depends on the type of soil

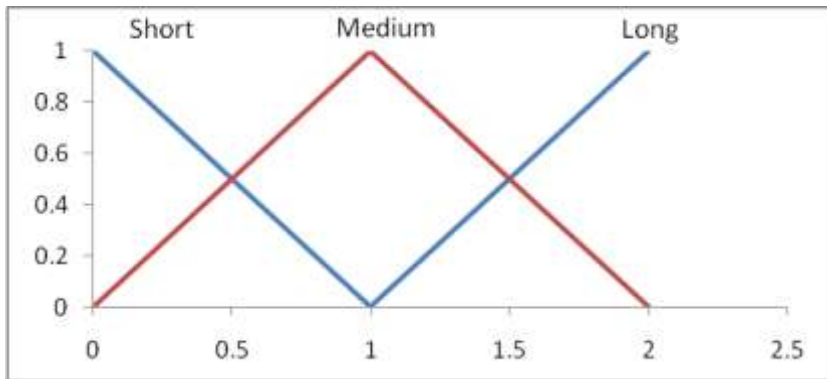
The degree of dirtiness is measured by a special sensor via the degree of water transparency. Less transparent the water, dirtier the clothes. The type of soil is determined by measuring the time needed, after the machine has started, to reach a state in which the water transparency remains constant. This time is called saturation time and is different for different types of soil. Let degree of dirtiness 'd' is expressed by number in the interval $[0, d_{\max}]$. Also dirtiness is expressed as high, medium and low in natural language (linguistic variable).



Fuzzy numbers representing the level of dirtiness

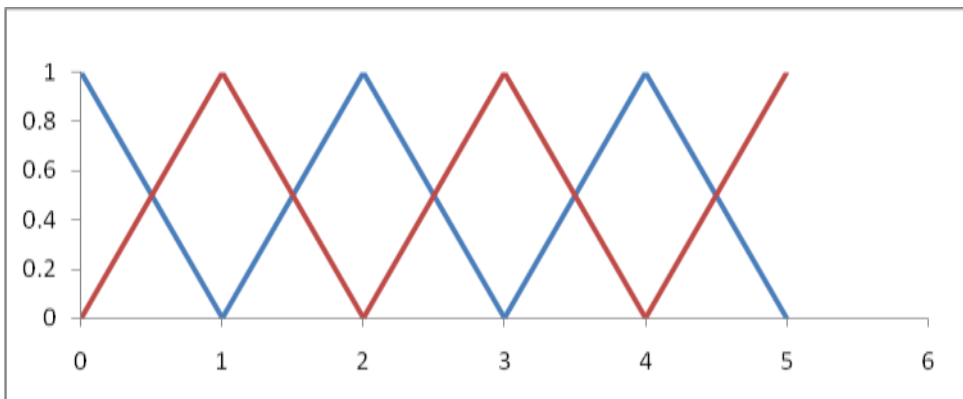


Let the saturation time is expressed by number in the interval $[0, s_{max}]$ and we have saturation time expressed as short, medium and long



Fuzzy numbers expressing short, medium and long saturation time.

Now required washing time should be some mathematical function of a degree of dirtiness and a saturation time. It is impossible to determine this function exactly but by using fuzzy controllers we can approximate this function on the basis of human intuition and experience. So we need to determine another linguistic variable representing required washing time 't' in the interval $[0, t_{max}]$.

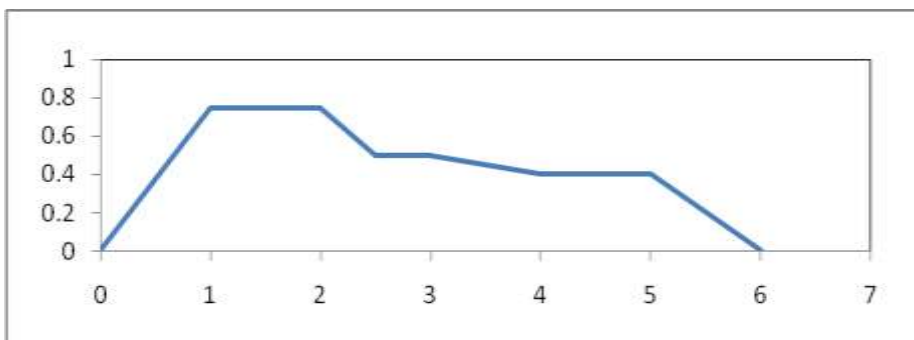


Fuzzy number characterizing required washing time.

We obtain overall conclusion by taking the union of all the individual conclusions.

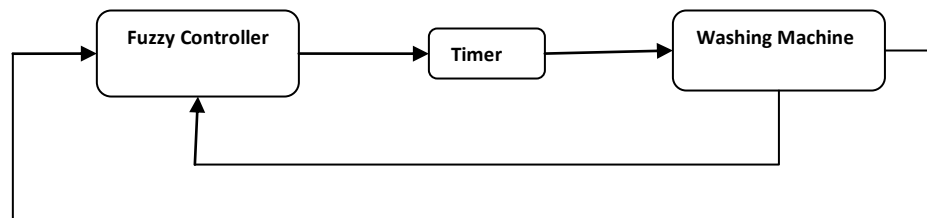
$$C_{d, s}(t) = \max \{ \min [L_d(d), M_s(s), S_t(t)], \min [L_d(d), L_s(s), S_t(t)], \min [M_d(d), M_s(s), M_t(t)], \min [M_d(d), L_s(s), L_t(t)] \}$$

The graph of this function so obtained is as follows



The fuzzy set which represents the overall conclusions for the measured values ‘d’ and ‘s’ and its defuzzified value ‘t’.

In this way desirable operating time of washing machine is calculated using fuzzy controller for conditions of dirtiness and saturation time.



Fuzzy Control of Washing Machine

Conclusion:

The ability of Fuzzy techniques to deal with imprecise data makes human work more easy and comfortable.

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