

(1)

→ Your Motorbike (MB) on a flat stretch of straight road.

→ You want to maintain a target cruise speed of say 40 kmph.

→ Output for speed control: accelerator plus brake. We view it as a single unit - either + (ve) or - (ve).

→ Input variables:

1. Speed error e : Current S - Desired S
Let's take a range of -40 to $+40$
 -10 to $+10$.

2. Rate of change: $\frac{\partial S}{\partial t} \rightarrow [-10 : 10] \text{ m/s}^2$

→ We will design a system that provides best value of output 'Z' given a value of e and $\frac{\partial S}{\partial t}$.

→ We divide the range of e into (say) 5 overlapping^(?) sets and give them easy linguistic names as $[N - SN - Z - SP - P]$

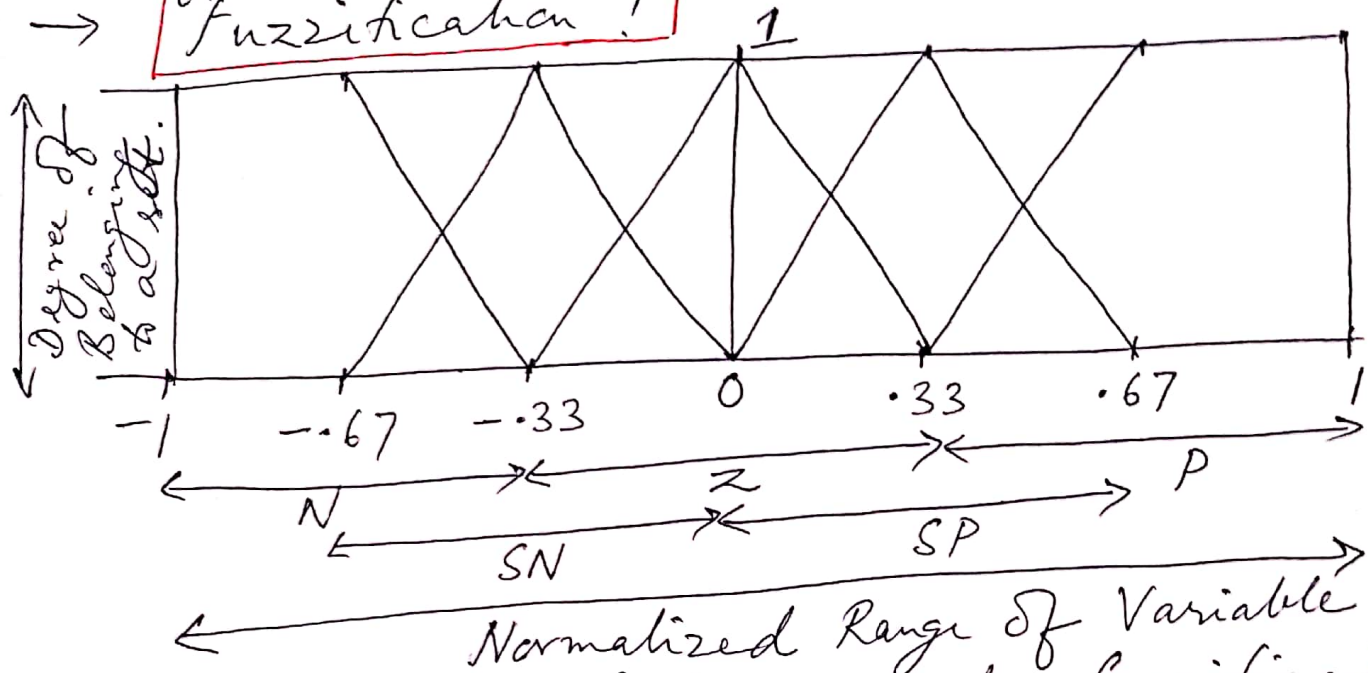
→ Likewise the range of $\frac{\partial S}{\partial t}$.

→ And we also divide the range of output Z into 5 overlapping sets and name them as $[VL - L - Z - H - VH]$.

→ We will map each crisp value of an input into 'degrees of belonging' to each of 5 sets.

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→ Fuzzification!



In a similar fashion, we do fuzzification of output variable. For the output, we actually defuzzify, i.e. go from 'degree of belonging' to each set, to a crisp value.

→ We convert (transform) from 'degrees of belonging' of input fuzzy sets to 'degrees of belonging' to output fuzzy sets. HOW?

→ Fuzzy Associative Matrix (FAM)

→ also called Fuzzy Inference Engine

→ WHO tells us what 'degree of belonging' to which fuzzy ^{input} set maps into what 'degree of belonging' to which fuzzy output set?

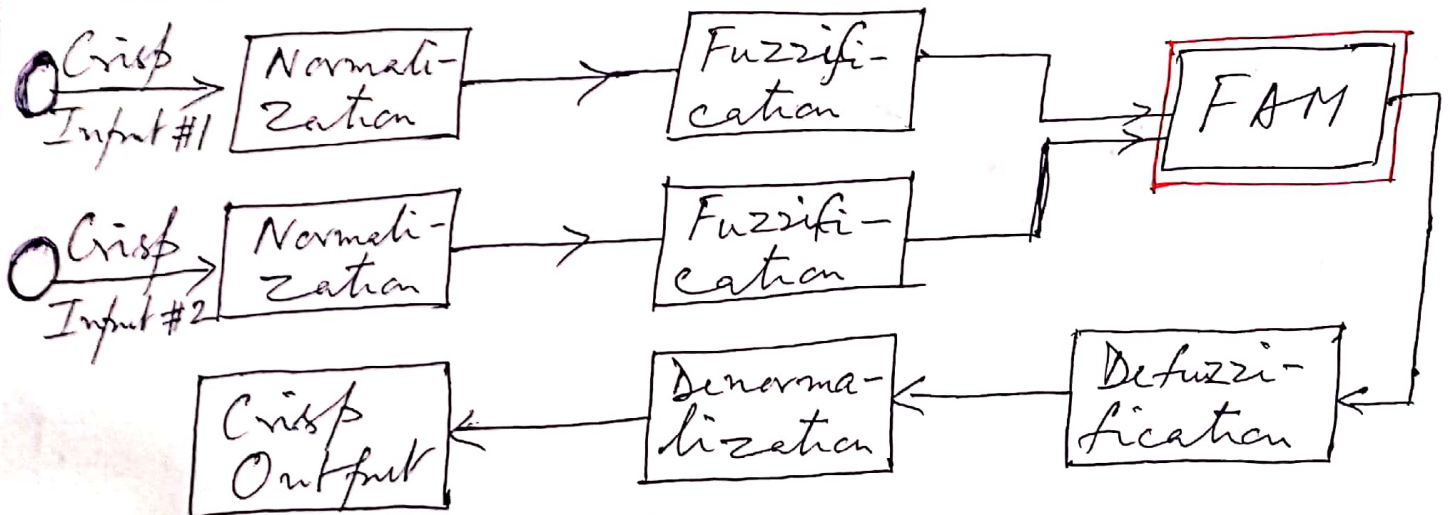
→ YOU! ⇒ You design your own FAM.

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(3)

$\frac{\partial S}{\partial t}$	P	H	?	L	VL	VH
	SP	H	Z	L	L	VL
	Z	VH	H	Z	L	VL
	SN	VH	H	H	Z	L
	N	VH	VH	H	?	L
		N	SN	Z	SP	P

Quick Review:



Defuzzification formula:

$$Z = \frac{\sum_{k \in FAM} w_i \hat{C}_i}{\sum_{k \in FAM} w_i}$$

where C_i is the Centroid of each fuzzy output set contained in the element 'i' of the FAM.