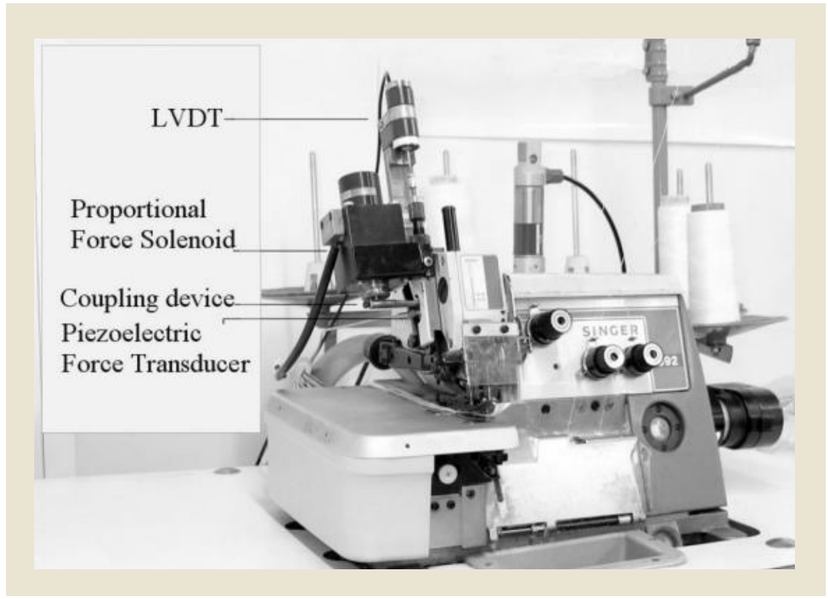
EN.525.770.82.FA24

FUZZY LOGIC IN INDUSTRIAL SEWING MACHINES

BREANNA BURD

COURSE PROJECT



Email
bburd1@jh.edu

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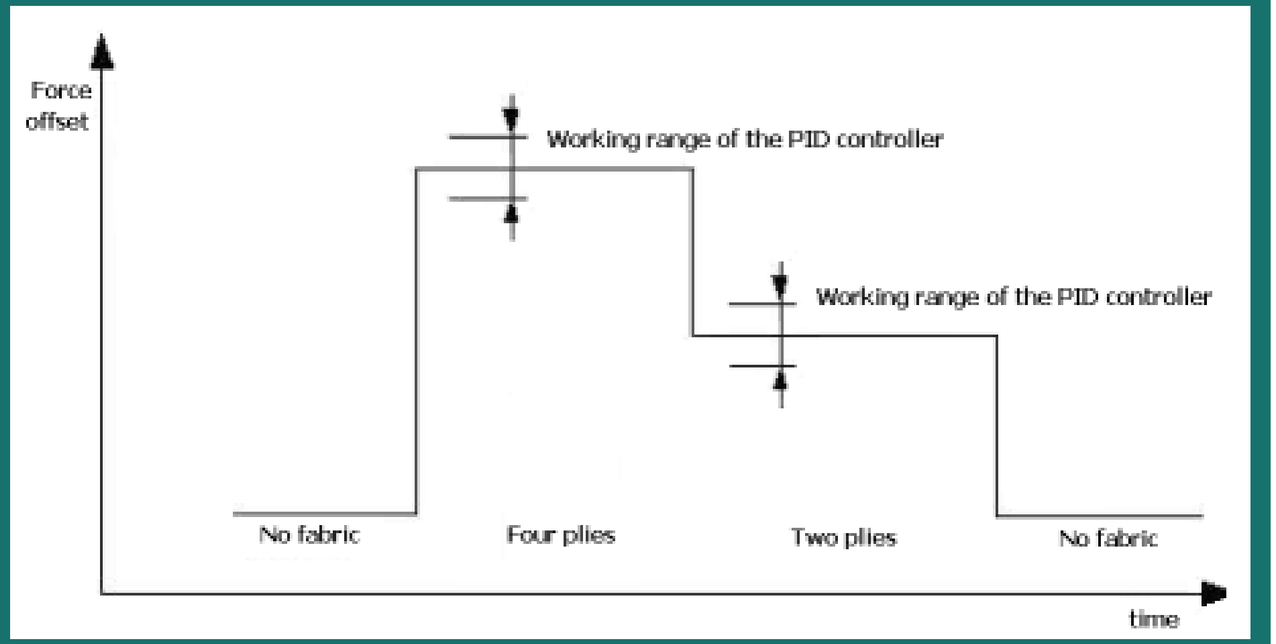


OVERVIEW

- Industry sewing machines identifying defects/error states
- The machines must be able to successfully change the speed the fabric is fed into the machine depending on the type of fabric and number of layers
- Fuzzy logic systems were used to test the accuracy of adapting the feeding system based on speed, layers of fabric, and type of fabric
- Automating the feeding system can greatly reduce defects in products

INITIAL PROBLEM

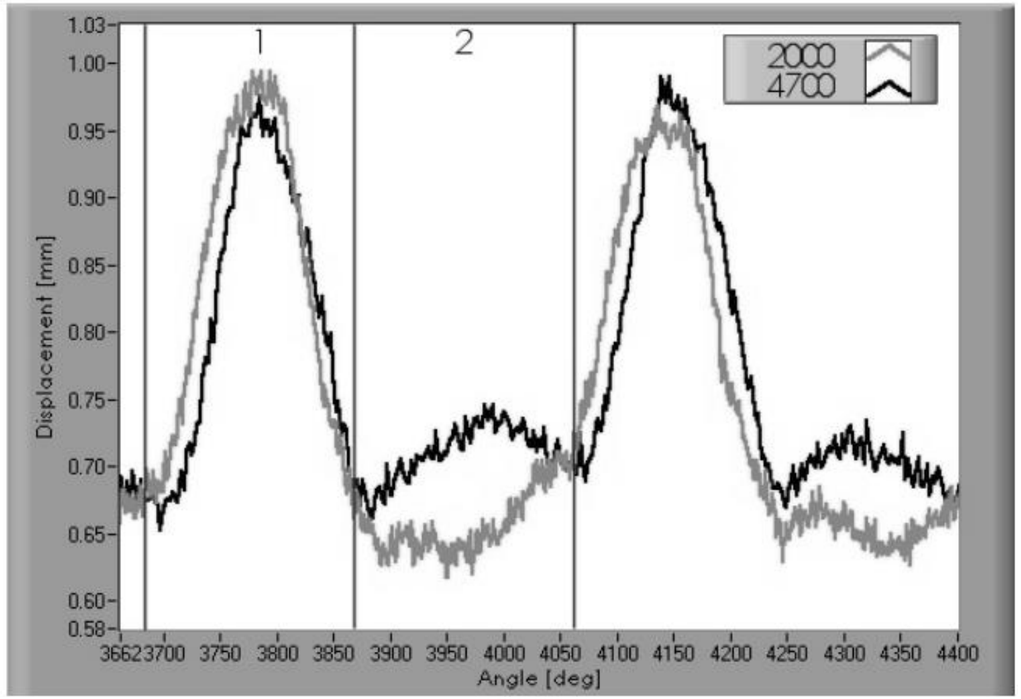
Identify Defects

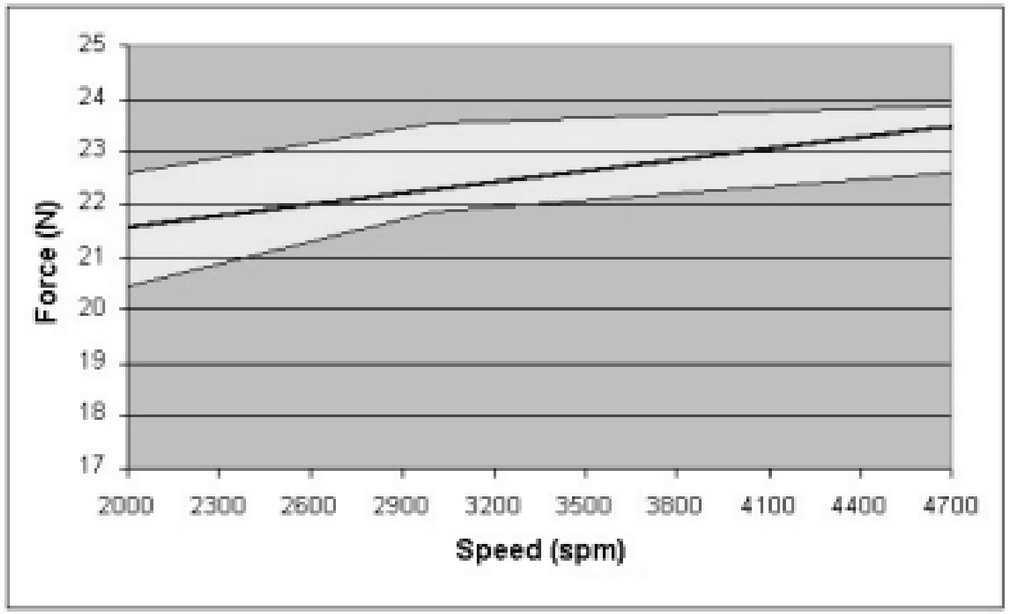
Many clothing items made industrially are made with flexible materials (i.e. stretchy fabrics).

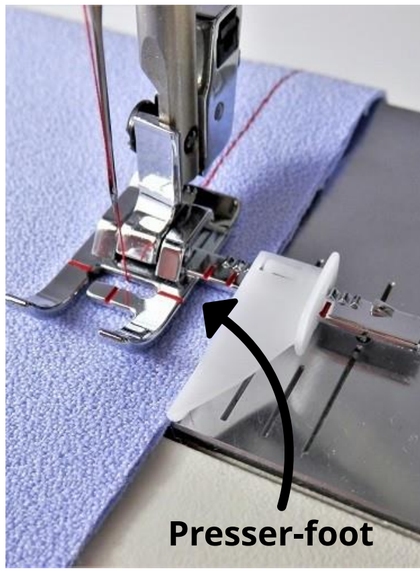
The sewing machine must be equipped to handle changing the number of plies of fabric (layers of fabric)

Indicators of a defect with the feeding mechanism can be identified by presser-foot bouncing as seen in the graph provided by the initial research

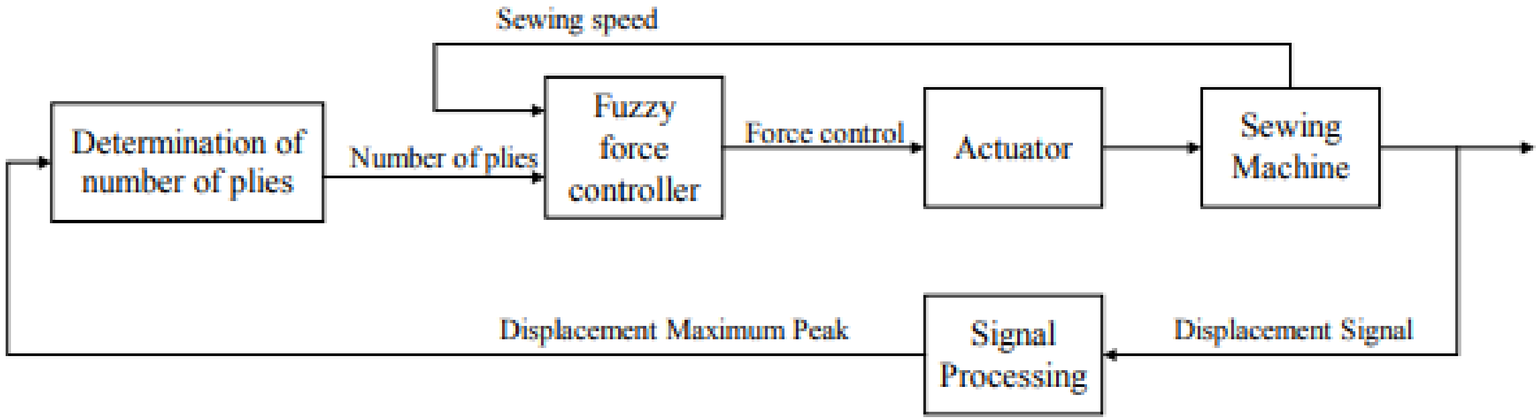
The feeding mechanism controls the speed at which the fabric is “fed” into the sewing machine. Presser-foot bouncing can lead to uneven or missed stitches

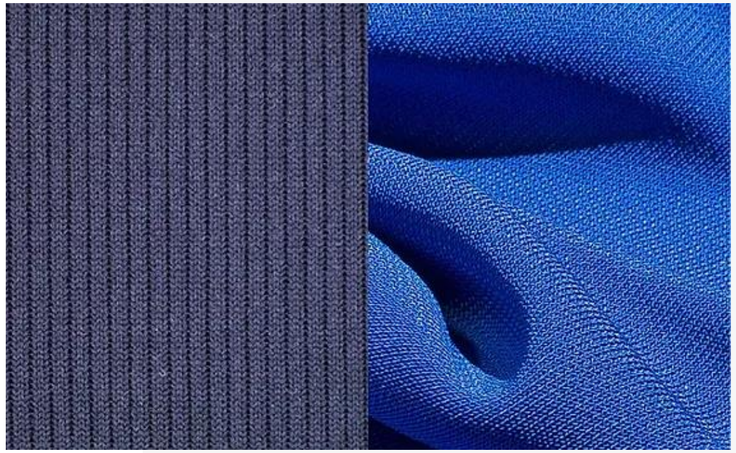






APPROACH





Several Controller Designs

Above is the final controller designed, which was optimized to avoid overhead for industry usage

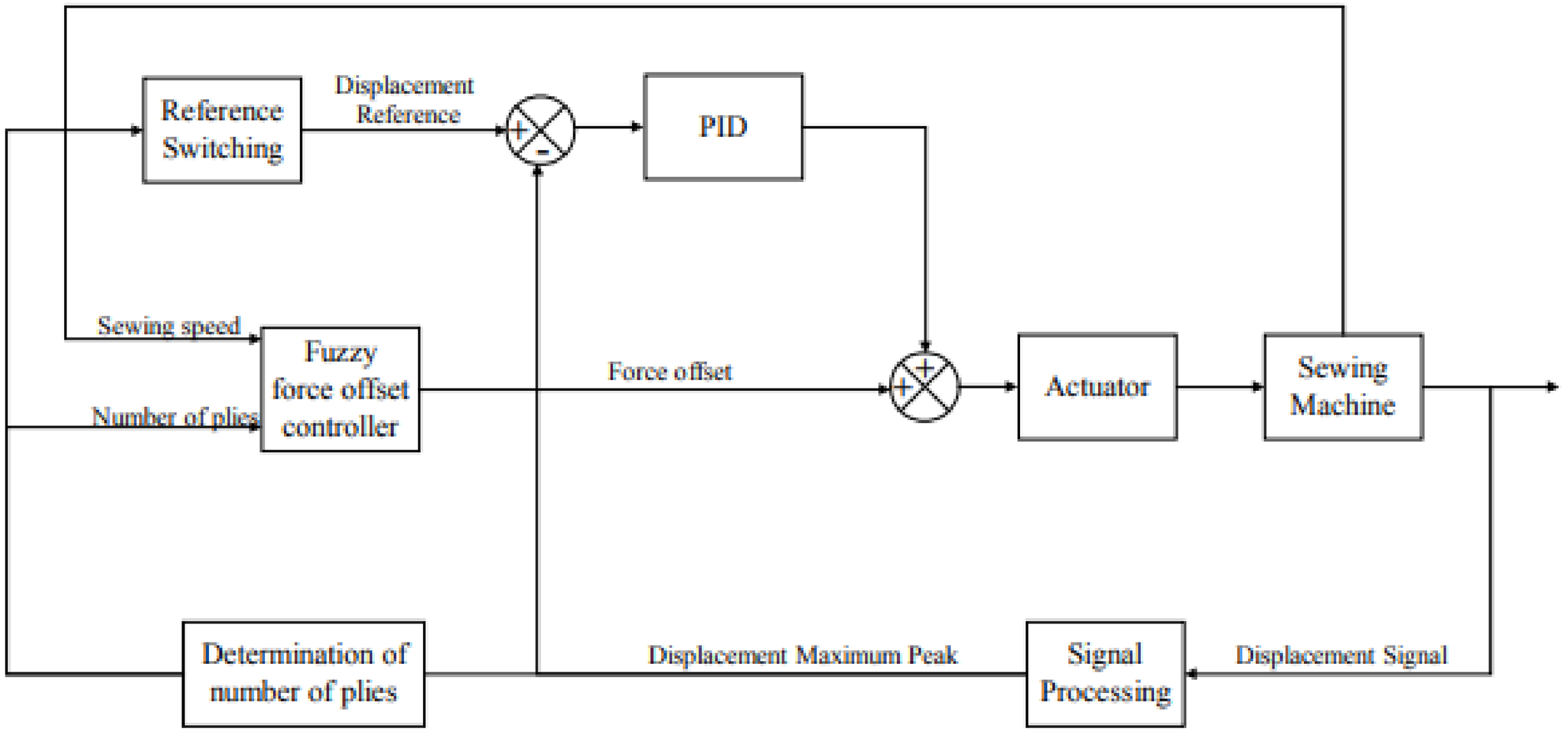
Upating the Reference Point

The reference point is used as a baseline for the expected force on the presser-foot for the given type of fabric and number of plies

Fabrics Used

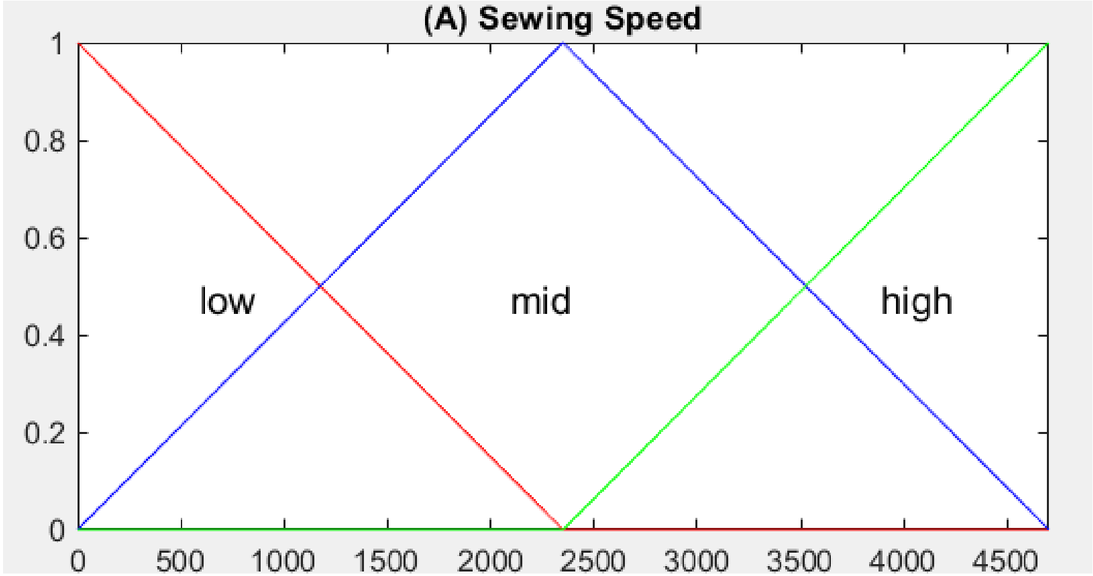
The rib and interlock fabrics were used in this research

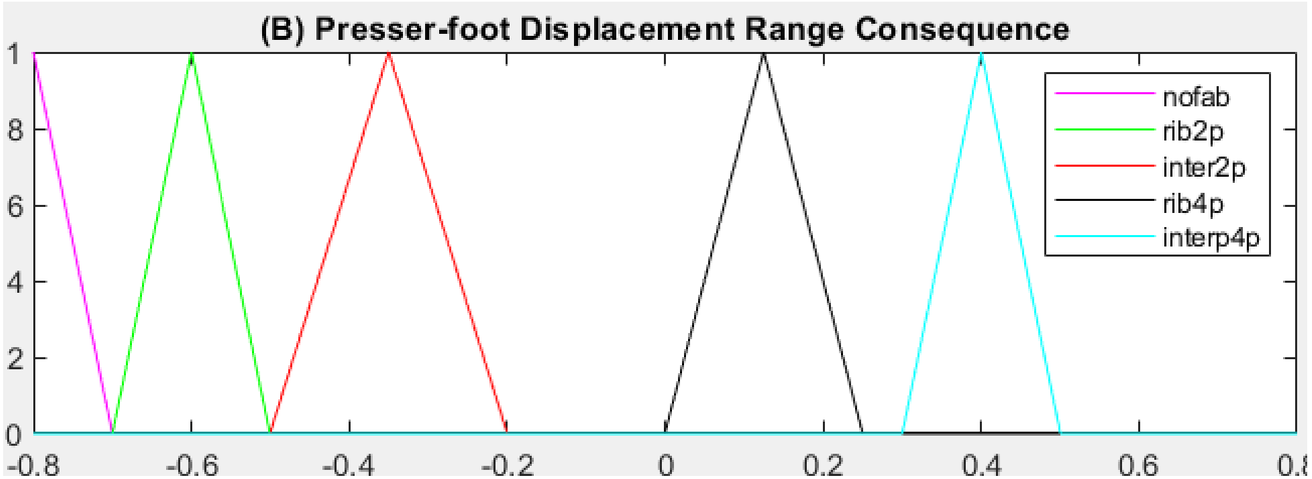
PID/FUZZY LOGIC CONTROLLER

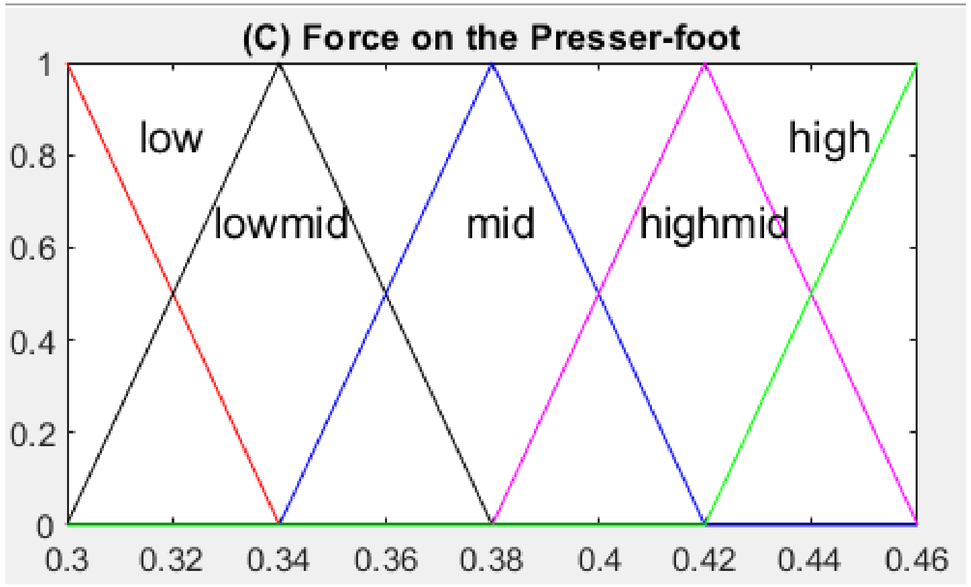


RULES

SET OF RULES IMPOSED ON THE FUZZY INFERENCE ENGINE







Rule Output

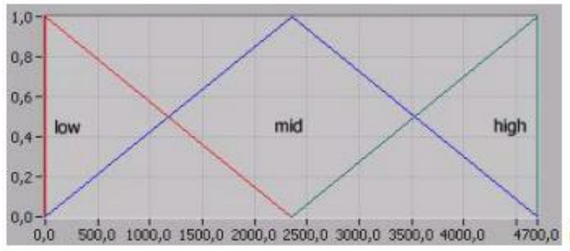
Since there are 3 sewing speed linguistic variables, and 5 displacement range linguistic variables, we know there must be 15 rules to define this fuzzy system.

One thing to note is that the displacement ranges do not overlap, which we will see later will cause the crisp output to not be smooth.

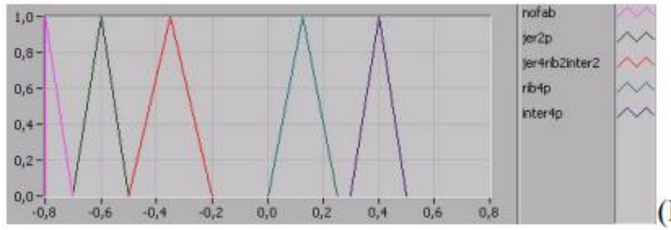
RULES

Rule No.	IF speed	AND displace	THEN force
1	low	nofab	low
2	low	rib2p	mid
3	low	inter2p	mid
4	low	rib4p	high
5	low	inter4p	highmid
6	mid	nofab	low
7	mid	rib2p	mid
8	mid	inter2p	mid
9	mid	rib4p	high
10	mid	inter4p	highmid
11	high	nofab	low
12	high	rib2p	mid
13	high	inter2p	mid
14	high	rib4p	high
15	high	inter4p	highmid

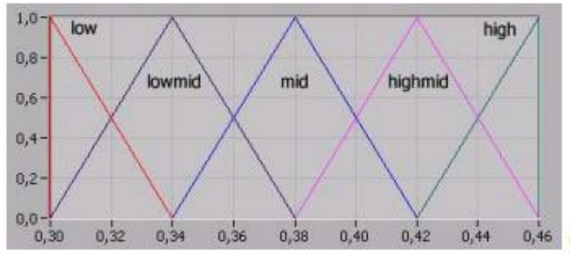
RESULTS



(A)



(B)



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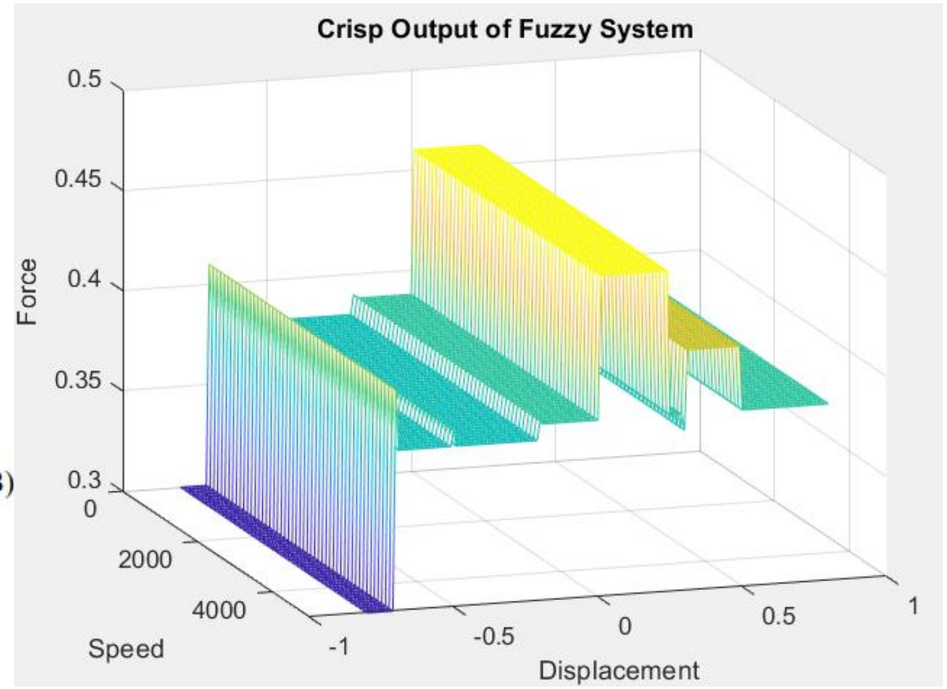

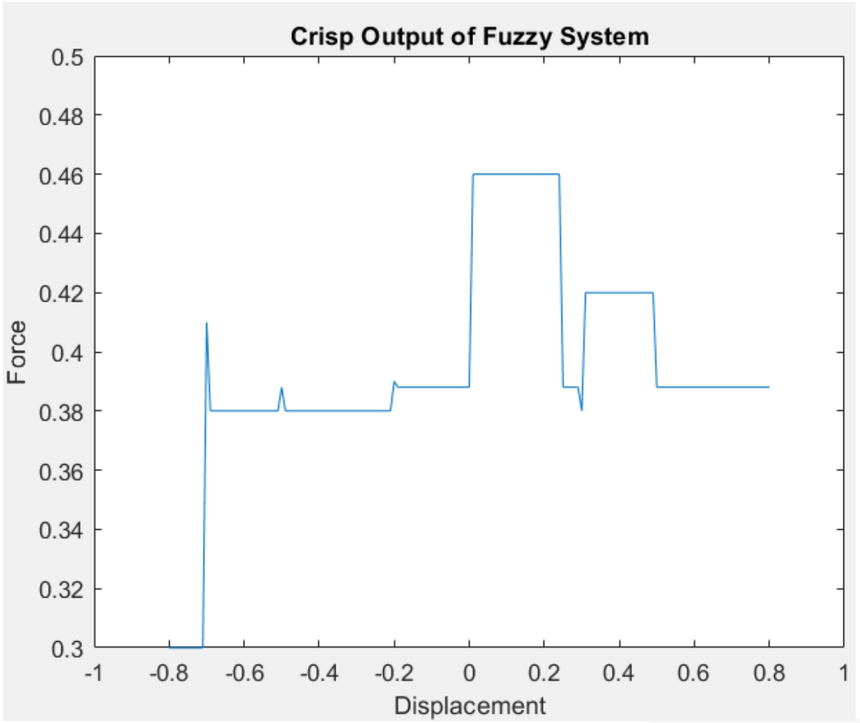

Author's Results

These are the graphs that the authors published to define the fuzzy inference set used in analysis

Crisp Output

The research paper did not provide a crisp output, so I simulated the output using MATLAB

REFERENCE

H. Carvalho, F. Soares, L. F. Silva and F. Guhr, "Adaptive control of an electromagnetically actuated presser-foot for industrial sewing machines," 2010 IEEE 15th Conference on Emerging Technologies & Factory Automation (ETFA 2010), Bilbao, Spain, 2010, pp. 1-8, doi: 10.1109/ETFA.2010.5641304.