MATLAB-SIMULINK MODELING OF FUZZY SCHEDULING ALGORITHM FOR OPERATING SYSTEM

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Agenda

- Problem Statement
- Workflow
- Tools Used
- Results
- Takeaways

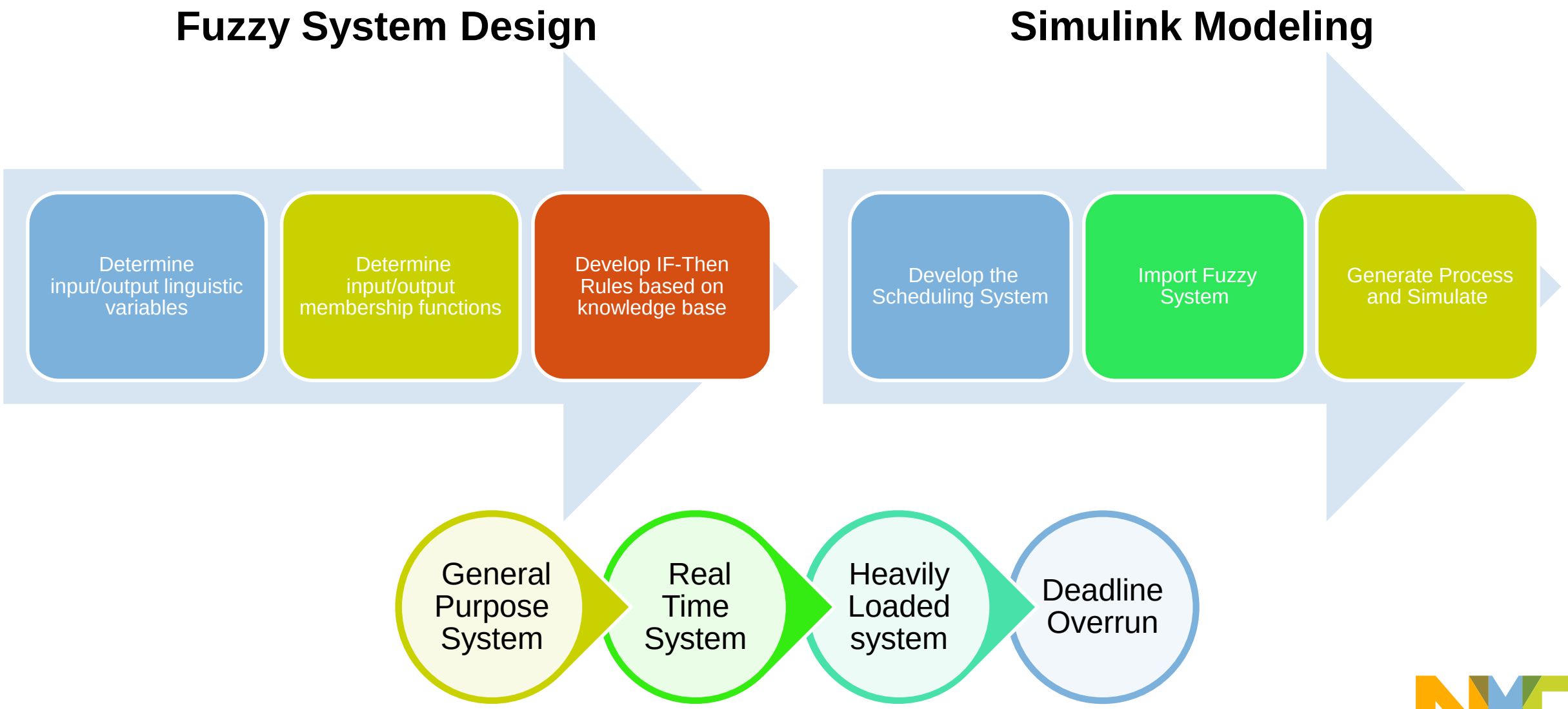
PROBLEM STATEMENT

Problem Statement

- KPI
  - Waiting time
  - Turnaround time
- Multiple deciding factors
- Scheduling is no longer one dimensional
- Ambiguity in decision making
- Real Time Scheduling issues
- CPU Overloading
- Deadline Overrun Scenario handling

WORKFLOW

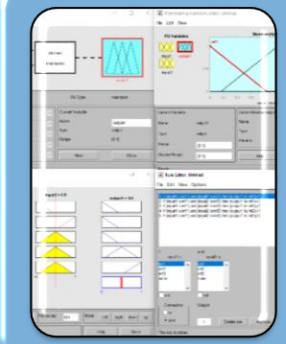
Workflow


Fuzzy System Design
Determine input/output linguistic variables
Determine input/output membership functions
Develop IF-Then Rules based on knowledge base
Simulink Modeling
Develop the Scheduling System
Import Fuzzy System
Generate Process and Simulate
General Purpose System
Real Time System
Heavily Loaded system
Deadline Overrun

TOOLS USED

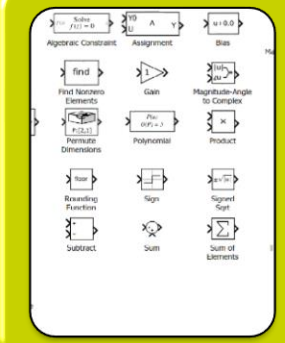
MATLAB®

Tools Used



Fuzzy Logic Toolbox

- Analyze
- Design
- Simulate



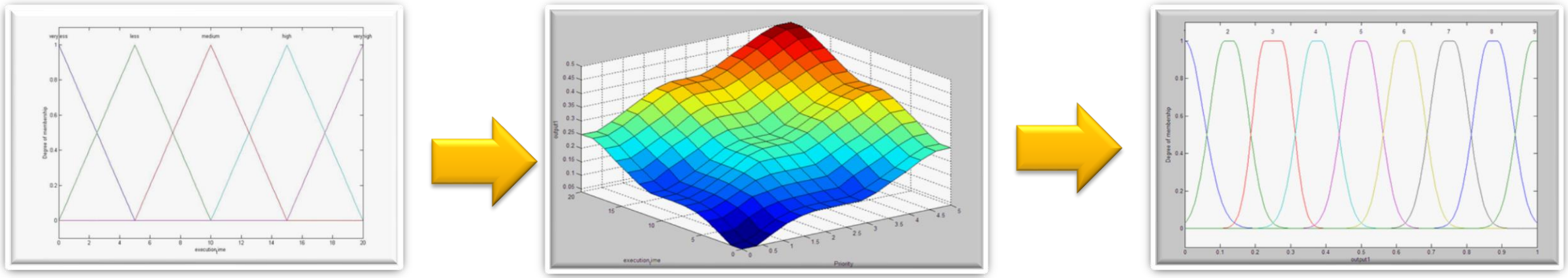
Simulink

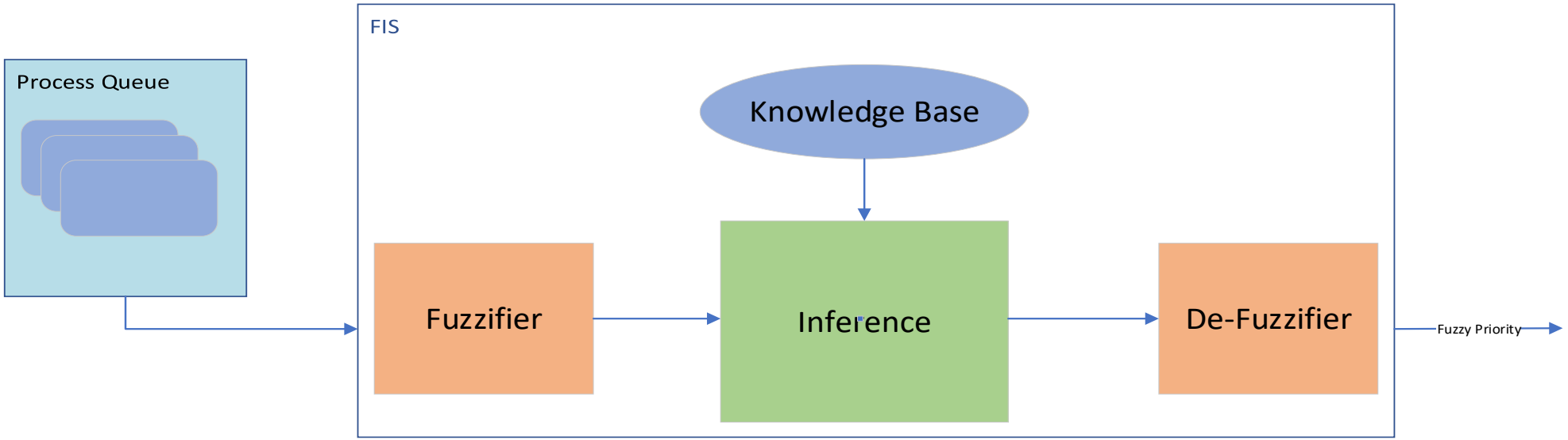
- Design
- Simulate

NXP

RESULTS

Fuzzy Scheduling System





KPI for General Purpose System with N=5

FCFS: First Come First Serve
SJF: Shortest Job First
PS: Priority Scheduling

Algorithm	Case 1	Case 2	Case 3	Case 4	Case 5
FCFS	16.2	17.2	20.2	23.6	10.4
SJF	14	10.8	11	21.2	10.4
PS	19.8	16	23.4	25	19.8
Proposed	17	11.2	12.6	23.4	12.6

Average Waiting Time for Randomly Generated Processes with N = 5

Algorithm	Case 1	Case 2	Case 3	Case 4	Case 5
FCFS	26.4	27.4	30.2	37	20.4
SJF	24.2	21	21	34.6	20.4
PS	30	26.2	33.4	38.4	29.8
Proposed	27.2	21.4	22.6	36.8	22.6

Average Turnaround Time for Randomly Generated Processes with N = 5

5 set of process are generated with random execution time and are scheduled using general purpose Scheduling Algorithm and KPIs are presented

KPI for General Purpose System with N=10

FCFS: First Come First Serve
SJF: Shortest Job First
PS: Priority Scheduling

Algorithm	Case 1	Case 2	Case 3	Case 4	Case 5
FCFS	72.3	84.2	50.8	62.6	75.8
SJF	43.5	65.7	27.4	40.9	47
PS	64.9	81.3	66.6	65.1	75.2
Proposed	48.1	70.4	36.9	48.4	58.9

Average Waiting Time for Randomly Generated Processes with N = 10

Algorithm	Case 1	Case 2	Case 3	Case 4	Case 5
FCFS	87.1	104.5	63.2	76.5	91.8
SJF	58.3	86	39.8	54.8	62.4
PS	79.7	101.6	79	79	90.6
Proposed	62.9	90.7	49.3	62.3	74.3

Average Turnaround Time for Randomly Generated Processes with N = 10

With increased number of process in ready queue, proposed algorithm performs better than FCFS and PS algorithm

Results: Real Time System

RM: Rate Monotonic
EDF: Earliest Deadline First
LLF: Lowest Laxity First

Process ID	Period	Execution Time
P1	2	1
P2	5	1
P3	7	2

Highly Loaded System with loading factor 0.98

Process ID	Period	Execution Time
P1	2	1
P2	4	1
P3	7	2
P4	10	3

Overloaded System with Loading factor 1.33

- With underloaded Scenario, RM policy fails to schedule the process, but EDF, LLF and Proposed Algorithm effectively schedule the process within the deadline.
- With overloaded Scenario, Proposed Algorithm performs better than RM policy and equally efficient as EDF and LLF

Results: Overload Scenario

RM: Rate Monotonic
EDF: Earliest Deadline First
LLF: Lowest Laxity First

Process ID	Period	Execution Time
P1	2	1
P2	4	1
P3	8	3

OVERLOADED SYSTEM WITH LOADING FACTOR 1.125

Algorithm		P1	P2	P3
Expected		4	2	3
RM	Scheduled	4	2	2
	Miss	0	0	1
EDF	Scheduled	4	2	2
	Miss	0	0	1
LLF	Scheduled	4	2	2
	Miss	0	0	1
PROPOSED	Scheduled	4	2	2
	Miss	0	0	1

OBSERVATIONS FOR THE PROCESSES IN READY QUEUE

For an Overload Scenario, with loading factor 1.125 all the algorithms miss P3

Results: Overload Scenario

RM: Rate Monotonic
EDF: Earliest Deadline First
LLF: Lowest Laxity First

Process ID	Period	Execution Time
P1	2	1
P2	4	1
P3	8	3
P4	16	1

Overloaded System With Loading Factor 1.1875

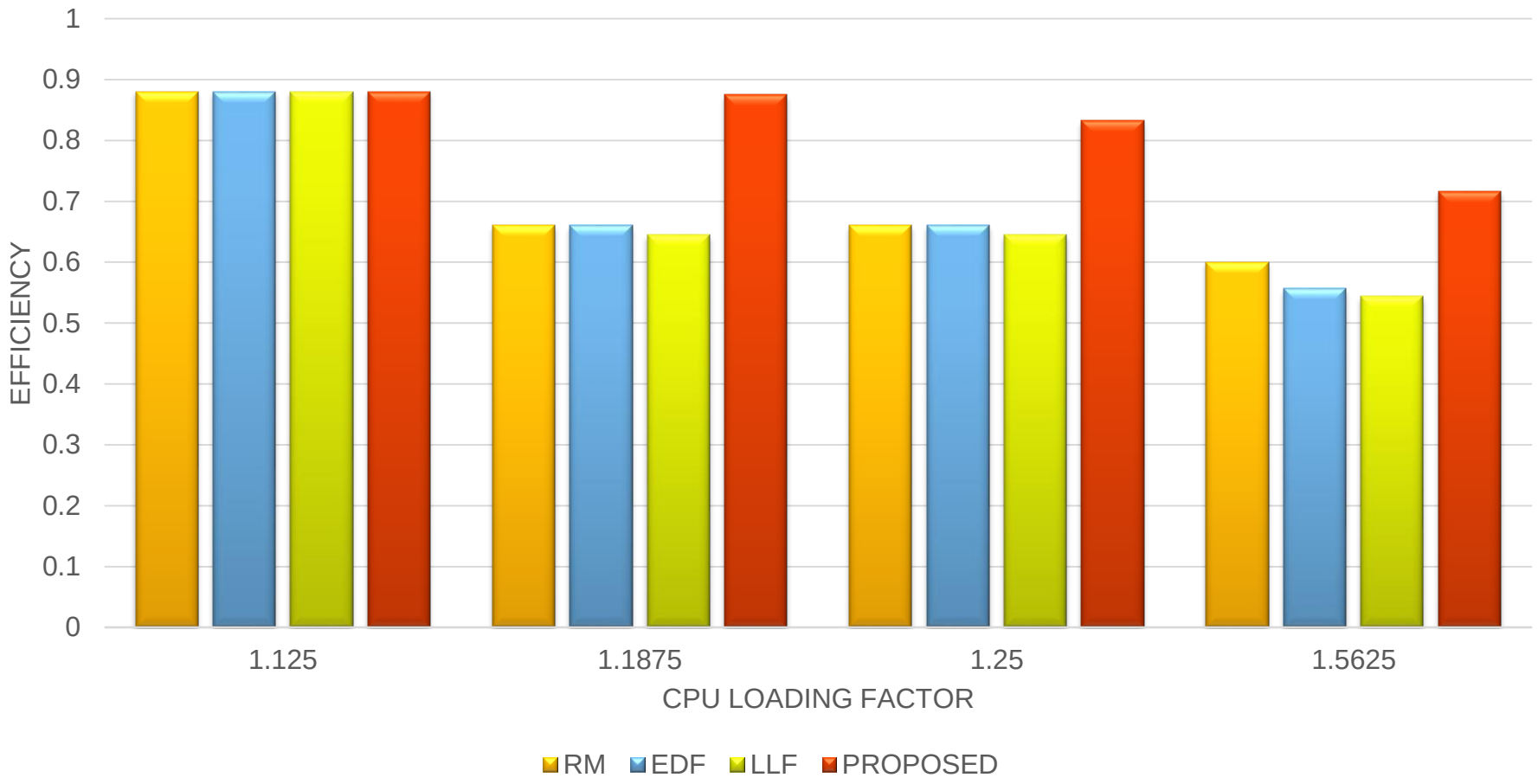
Algorithm		P1	P2	P3	P4
Expected		8	4	6	1
RM	Scheduled	8	4	4	0
	Miss	0	0	2	1
EDF	Scheduled	8	4	4	0
	Miss	0	0	2	1
LLF	Scheduled	8	3	5	0
	Miss	0	1	1	1
PROPOSED	Scheduled	8	4	3	1
	Miss	0	0	3	0

Observations for the processes in Queue

- For an overloaded scenario with loading factor 1.875, RM, EDF and LLF miss at least 2 process
- Proposed Algorithm miss only process P3

Results

RM: Rate Monotonic
EDF: Earliest Deadline First
LLF: Lowest Laxity First



TAKEAWAYS

Takeaways

- Fuzzy Logic Based Scheduling Algorithm provides better performance as with conventional algorithms
- Fuzzy Logic Tool box by MATLAB enables effective modeling and simulation of Fuzzy Inference System.
- Simulink Modeling is carried out to evaluate the performance of the proposed algorithm

SECURE CONNECTIONS
FOR A SMARTER WORLD