DESIGN AND DEVELOPMENT OF A PLANA ONE-LEGGED HOPPING ROBOT

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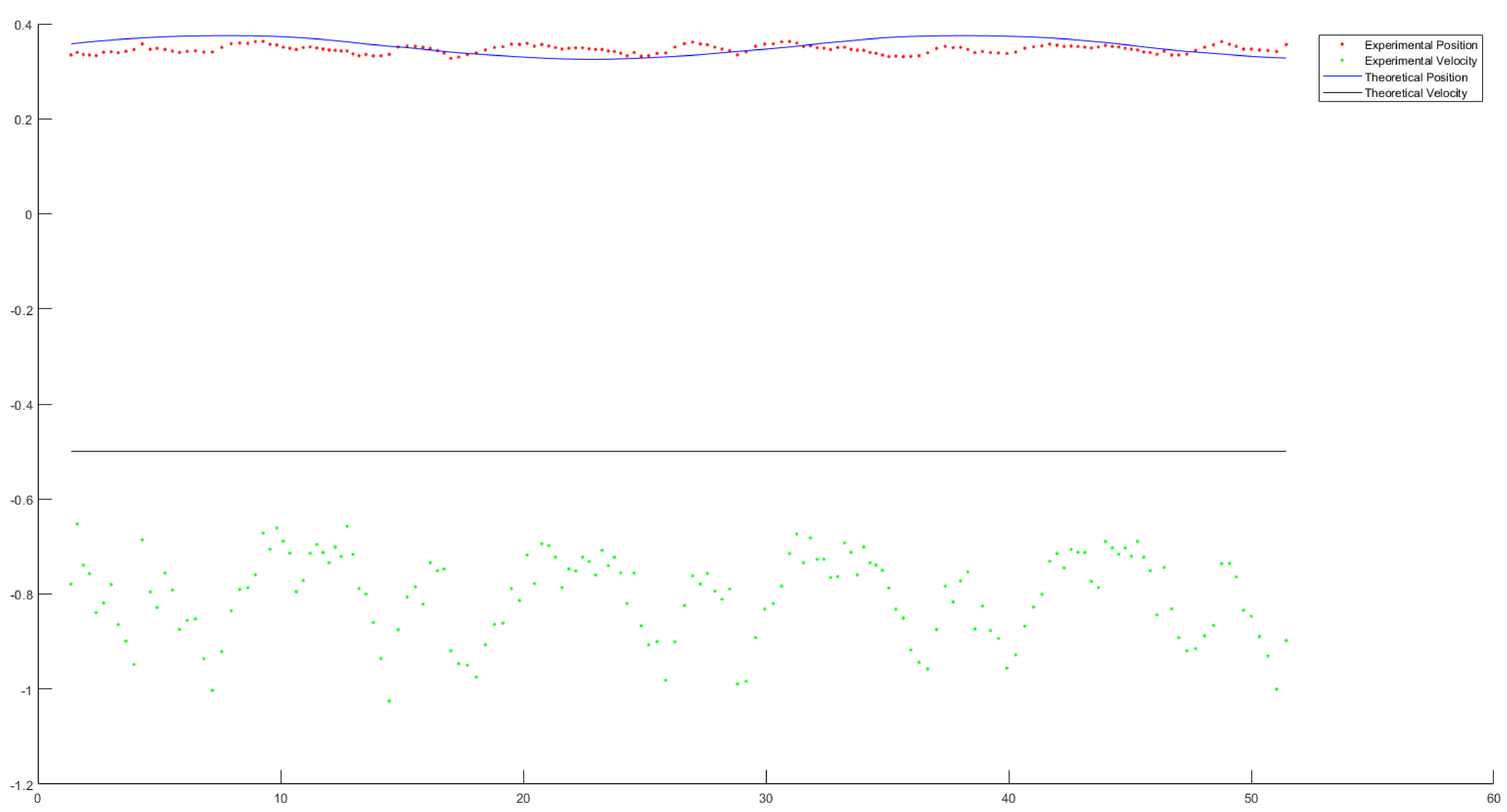
Introduction

- In this project, we want to reconstruct one-legged hopping robot and compare the parameter estimation methods.
- Our focus in this study is the experimental evaluation of the Neural Network performance at the decision of the robot about the next stage.
- Keywords – legged-robots, spring-loaded interted pendulum(SLIP), system identification

Position and Velocity Statement

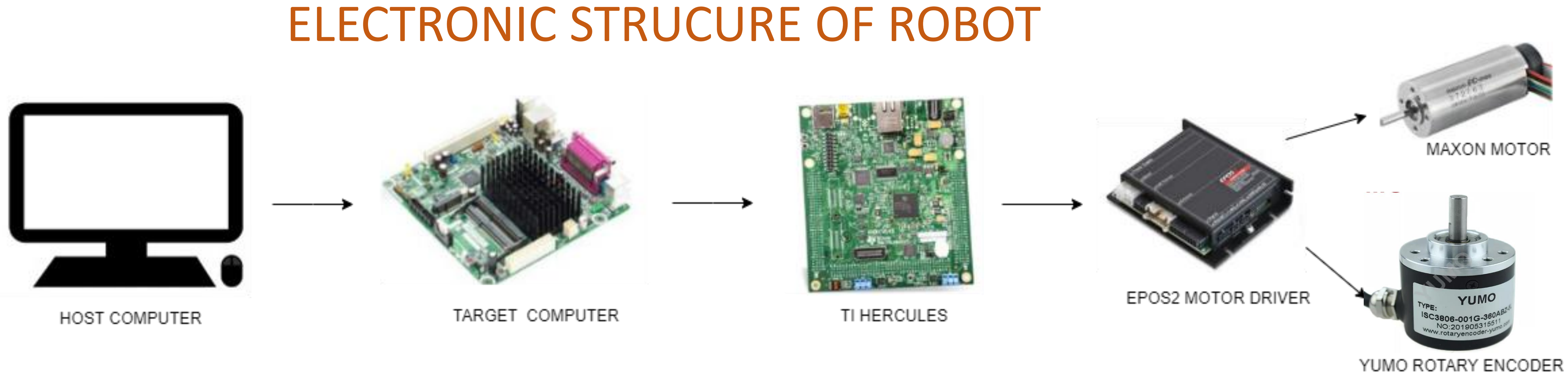
- We collected horizontal position, horizontal velocity and vertical position data then used them to train and test Neural Network.



Solution Methodology

- We use MATLAB/Simulink based real time data collection and control architecture. The real-time operating systems (RTOS) guarantees the tasks to be completed in a specified time interval. Electronic structure of this robot platform is based on gathering position data from encoders and controlling motor inputs to manipulate leg angle and hip torque.

ELECTRONIC STRUCURE OF ROBOT



- We collect horizontal position, horizontal velocity, vertical position data from the robot and save the parameters and change apex to apex. After data collection we trained our neural network then tested the neural network performance.
- We compare SLIP, SLIP-TD, Geyer, AAS and Neural Network predictor performance.

Results and Discussion

- We compare the result of mathematical model based parameter estimation results and neural network based parameter estimation results. The quantity of information a neural network can process determines its results.

		Test Run			Training Runs		
	Method	Eap	Eav	Eat	Eap	Eav	Eat
HARD	SLIPD	1.41 ± 0.51	3.98 ± 1.04	1.69 ± 0.62	1.36 ± 0.01	3.75 ± 0.04	1.54 ± 0.02
	AAS	1.53 ± 0.40	4.23 ± 1.12	1.74 ± 0.54	1.52 ± 0.02	4.21 ± 0.04	1.74 ± 0.02
	SLIP	8.13 ± 0.63	4.32 ± 1.22	3.17 ± 0.67	7.9 ± 0.01	4.18 ± 0.04	3.06 ± 0.03
	Geyer	10.46 ± 0.43	8.82 ± 2.28	2.74 ± 0.99	10.45 ± 0.03	8.68 ± 0.07	2.75 ± 0.04
	NN	2.51±0.54	5.71±1.49	1.52±0.56	2.18±0.75	4.74±1.46	1.34±0.55
MEDIUM	SLIPD	1.69 ± 0.46	5.41 ± 1.34	1.24 ± 0.42	1.54 ± 0.02	5.26 ± 0.06	1.19 ± 0.02
	AAS	1.89 ± 0.40	6.31 ± 1.20	1.27 ± 0.35	1.88 ± 0.02	6.29 ± 0.04	1.26 ± 0.01
	SLIP	7.43 ± 0.56	6.24 ± 1.35	3.44 ± 0.32	6.92 ± 0.01	5.34 ± 0.06	3.47 ± 0.04
	Geyer	9.49 ± 0.35	9.11 ± 2.54	2.09 ± 0.43	9.49 ± 0.01	9.05 ± 0.09	2.10 ± 0.02
	NN	3.74±0.89	9.64±2.67	1.88±0.41	2.98±1.18	7.61±2.16	1.57±0.59
SOFT	SLIPD	1.88 ± 0.72	5.56 ± 2.34	1.98 ± 0.64	1.83 ± 0.02	5.34 ± 0.06	1.72 ± 0.02
	AAS	2.07 ± 0.66	7.54 ± 2.45	2.68 ± 0.72	2.06 ± 0.02	7.54 ± 0.08	2.68 ± 0.03
	SLIP	8.37 ± 0.92	8.12 ± 2.55	2.48 ± 0.41	7.93 ± 0.02	7.73 ± 0.06	2.13 ± 0.02
	Geyer	12.29 ± 0.68	15.25 ± 4.12	3.47 ± 0.91	12.28 ± 0.03	15.23 ± 0.13	3.48 ± 0.04
	NN	3.49±2.0	8.67±2.02	1.89±1.34	3.19±2.55	6.95±2.95	1.60±1.39
SOFTER	SLIPD	2.03 ± 0.40	8.23 ± 1.74	1.67 ± 0.62	2.02 ± 0.02	8.22 ± 0.09	1.65 ± 0.02
	AAS	2.21 ± 0.47	7.80 ± 1.84	1.68 ± 0.49	2.19 ± 0.03	7.74 ± 0.06	1.67 ± 0.02
	SLIP	7.14 ± 0.86	11.57 ± 2.36	3.06 ± 0.61	5.95 ± 0.01	9.19 ± 0.11	2.79 ± 0.03
	Geyer	9.49 ± 1.15	19.97 ± 5.85	1.37 ± 0.40	9.47 ± 0.06	19.78 ± 0.19	1.38 ± 0.02
	NN	16.78±16.66	54.44±49.27	19.19±42.19	7.85±3.38	34.41±24.41	3.42±1.45

References

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