Data-Driven Control for DC motor

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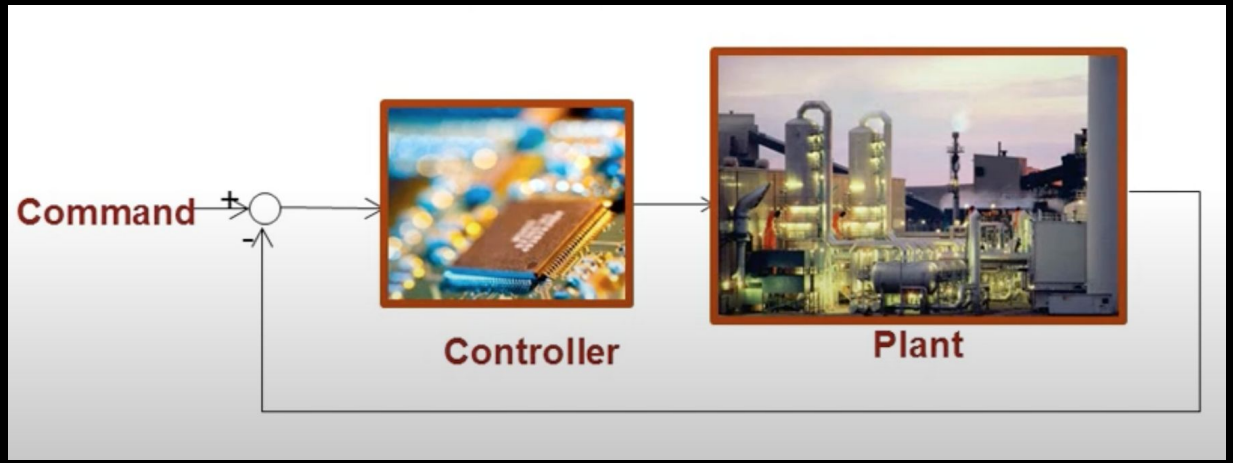
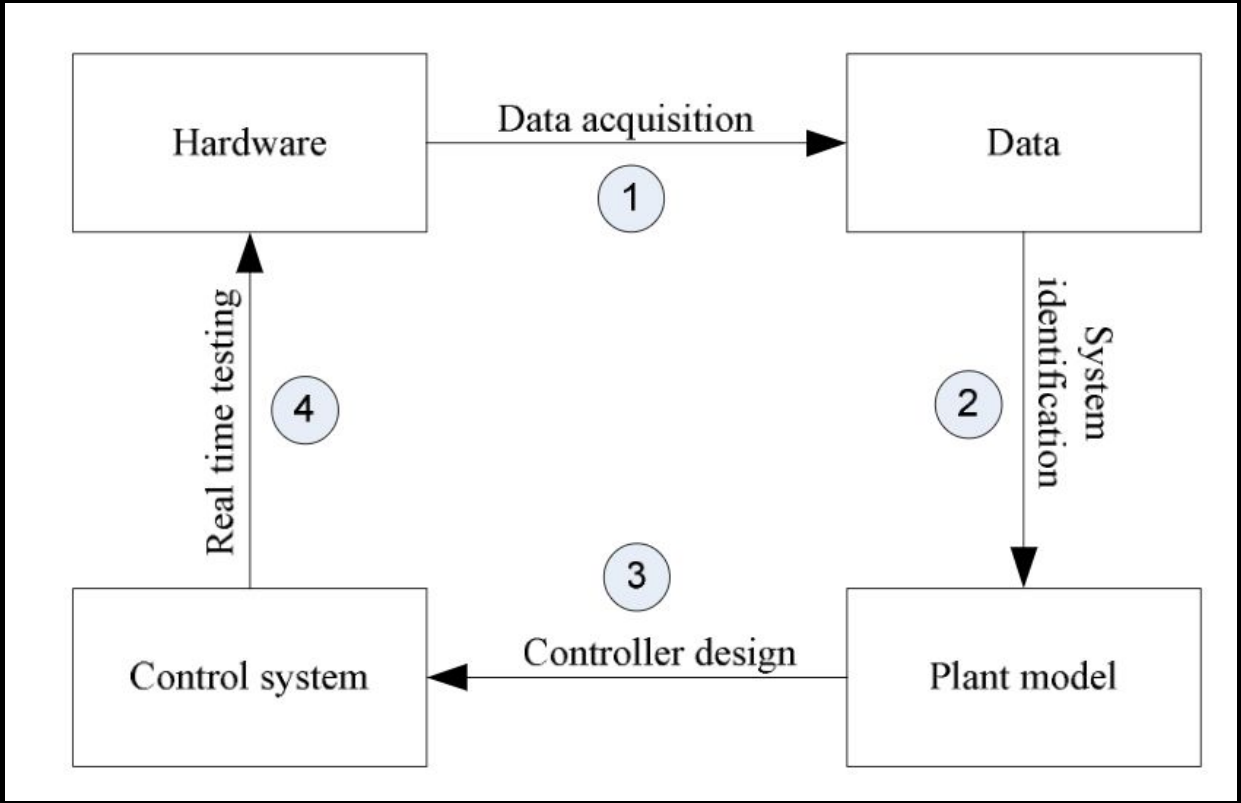
What is control theory?



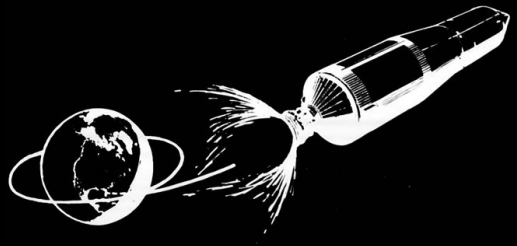
Data-driven control. (n.d.). Retrieved February 18, 2021, from https://www.mathworks.com/matlabcentral/fileexchange/42758-data-driven-control

Data-Driven approach



Y. Naung, A. Schagin, H. Oo, K. Ye, and Z. Khaing, “Implementation of data driven control system of dc motor by using system identification process,” in 2018 IEEE Conference of Russian Young Researchers in Electrical and Electronic Engineering

Motivation for Data-Driven approach



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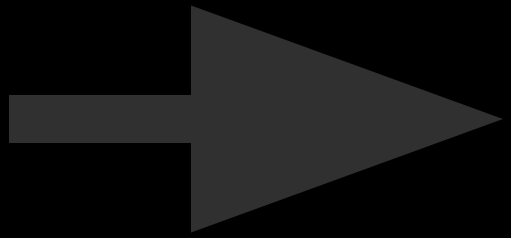
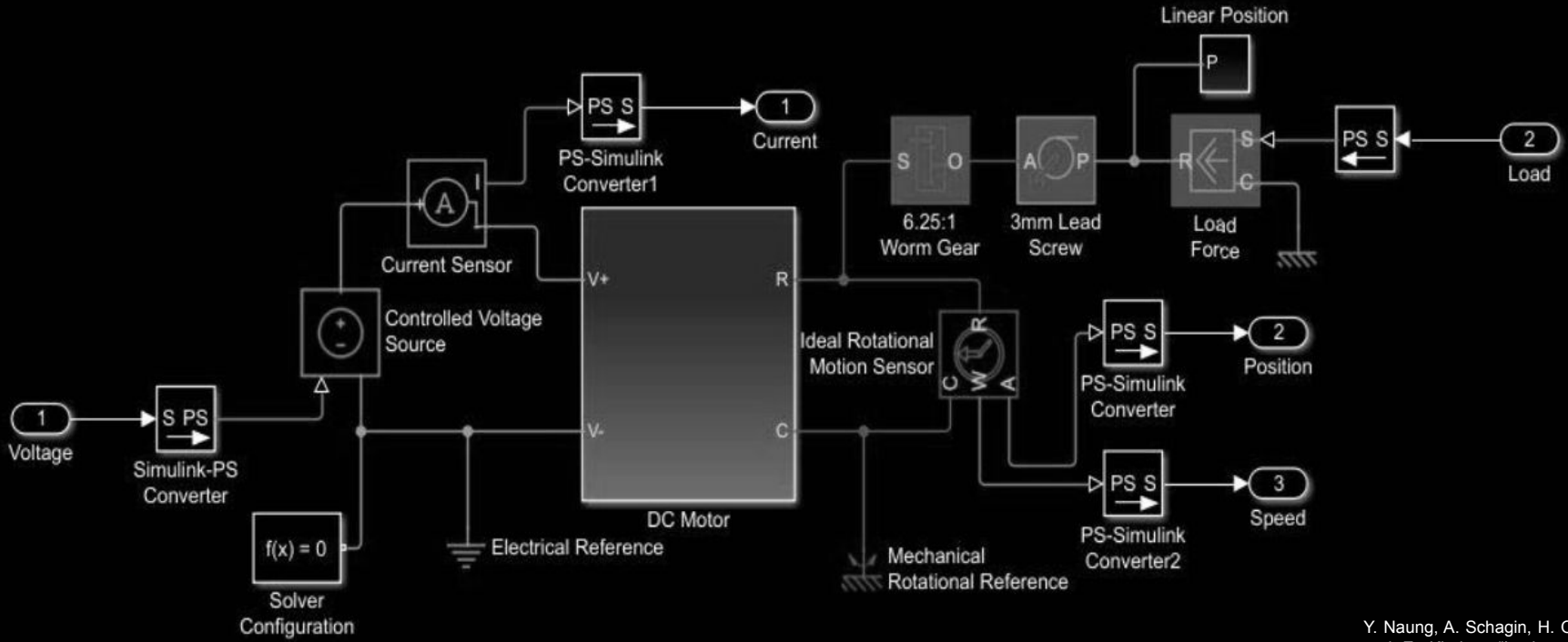
Related work

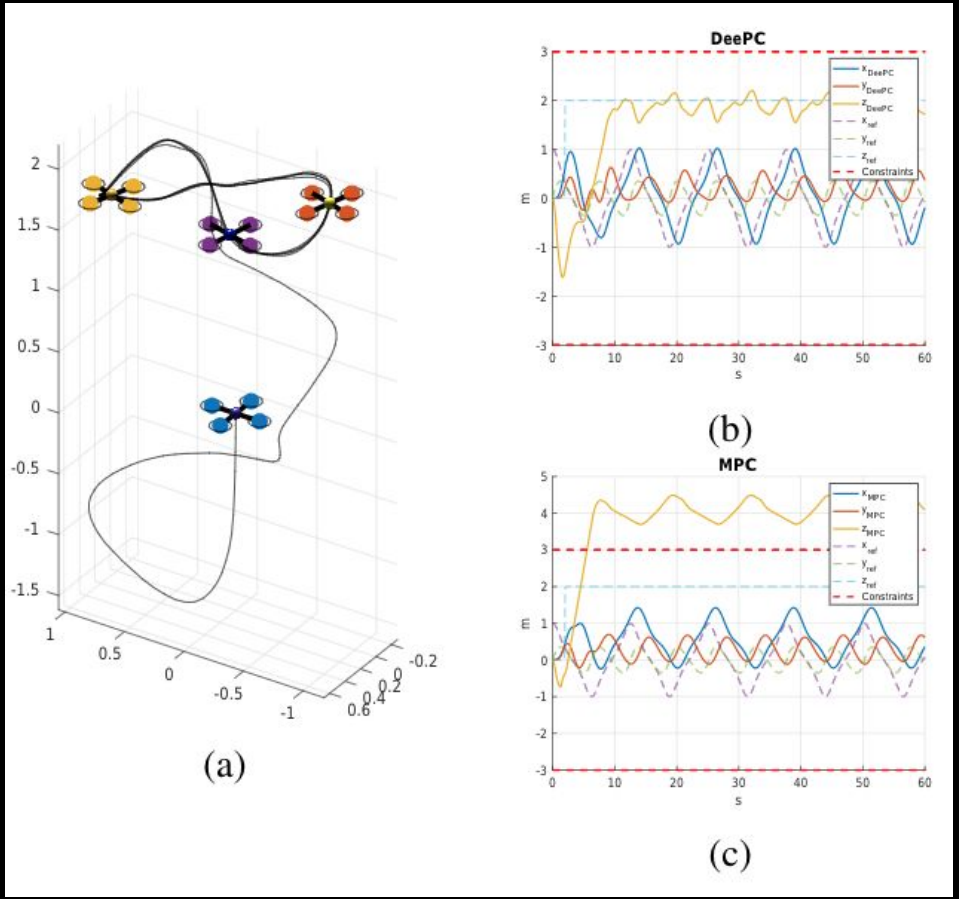


DDC for Simulated DC motors



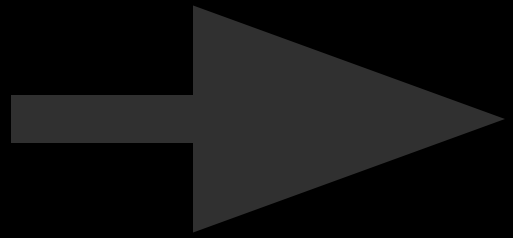
Y. Naung, A. Schagin, H. Oo, K. Ye, and Z. Khaing, “Implementation of data driven control system of dc motor by using system identification process,” in 2018 IEEE Conference of Russian Young Researchers in Electrical and Electronic Engineering

DeePC algorithm for real-time DDC

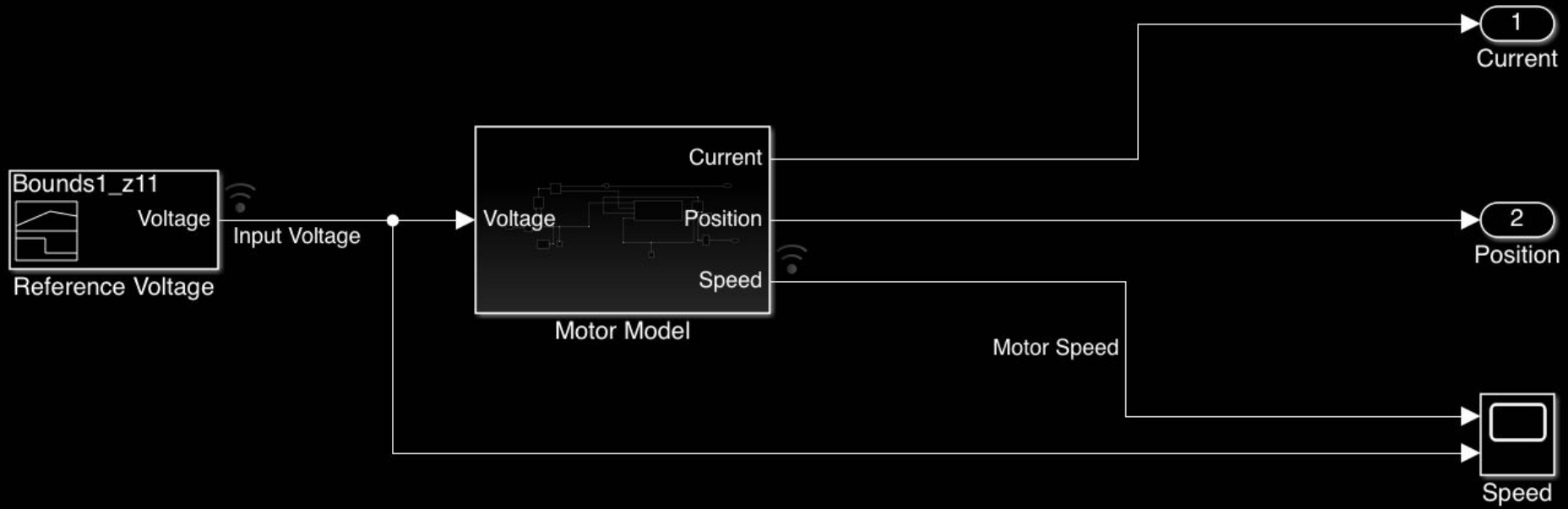


J. Coulson, J. Lygeros, and F. D ̈orfler, “Data-enabled predictive control: In the shallows of the deepc,” in 2019 18th European Control Conference (ECC) pp. 307–312, IEEE, 2019.

Approach



Simulation: Model for Data acquisition with MATLAB



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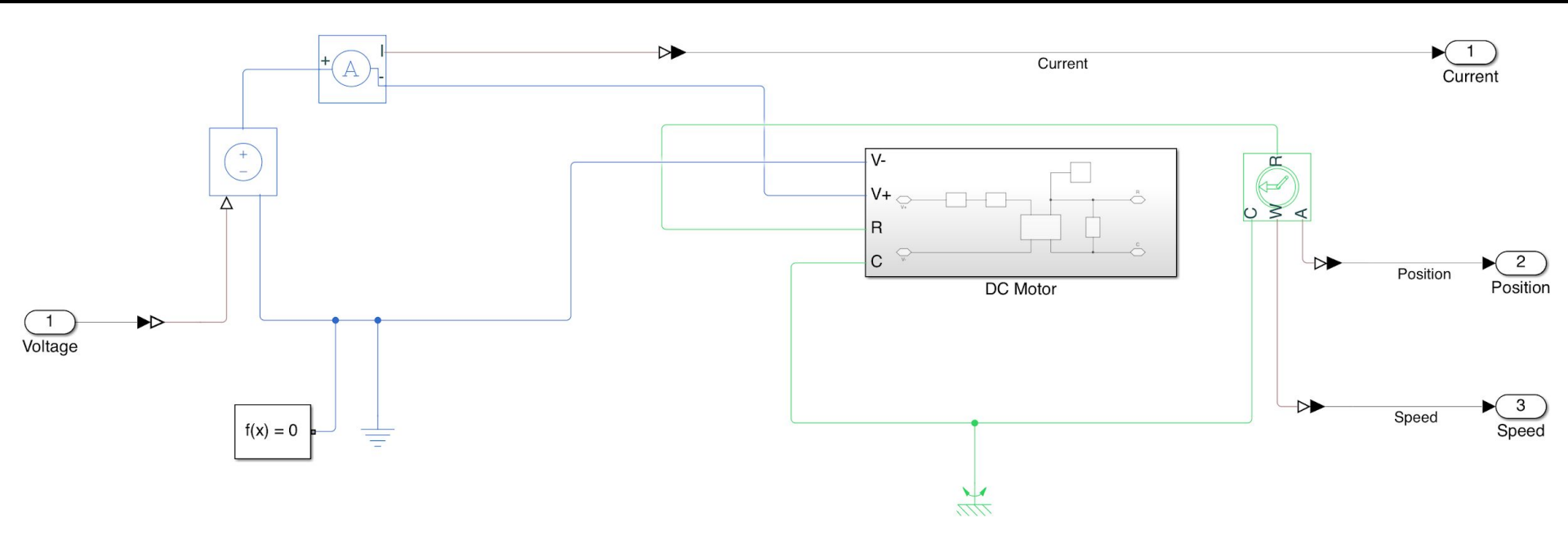
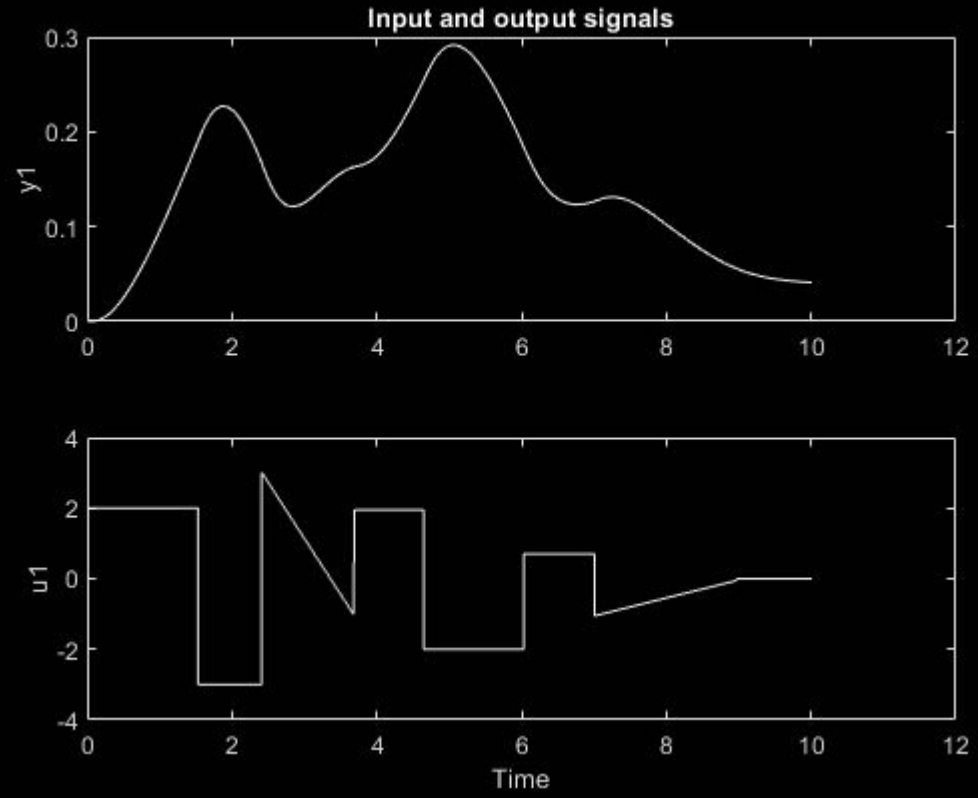
DC motor model in MATLAB simulation

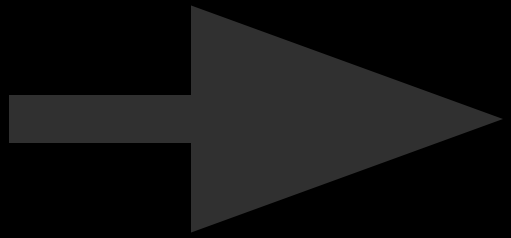


Data-driven control. Retrieved February 18, 2021, from https://www.mathworks.com/matlabcentral/fileexchange/42758-data-driven-control

Sample of data acquisition experiment

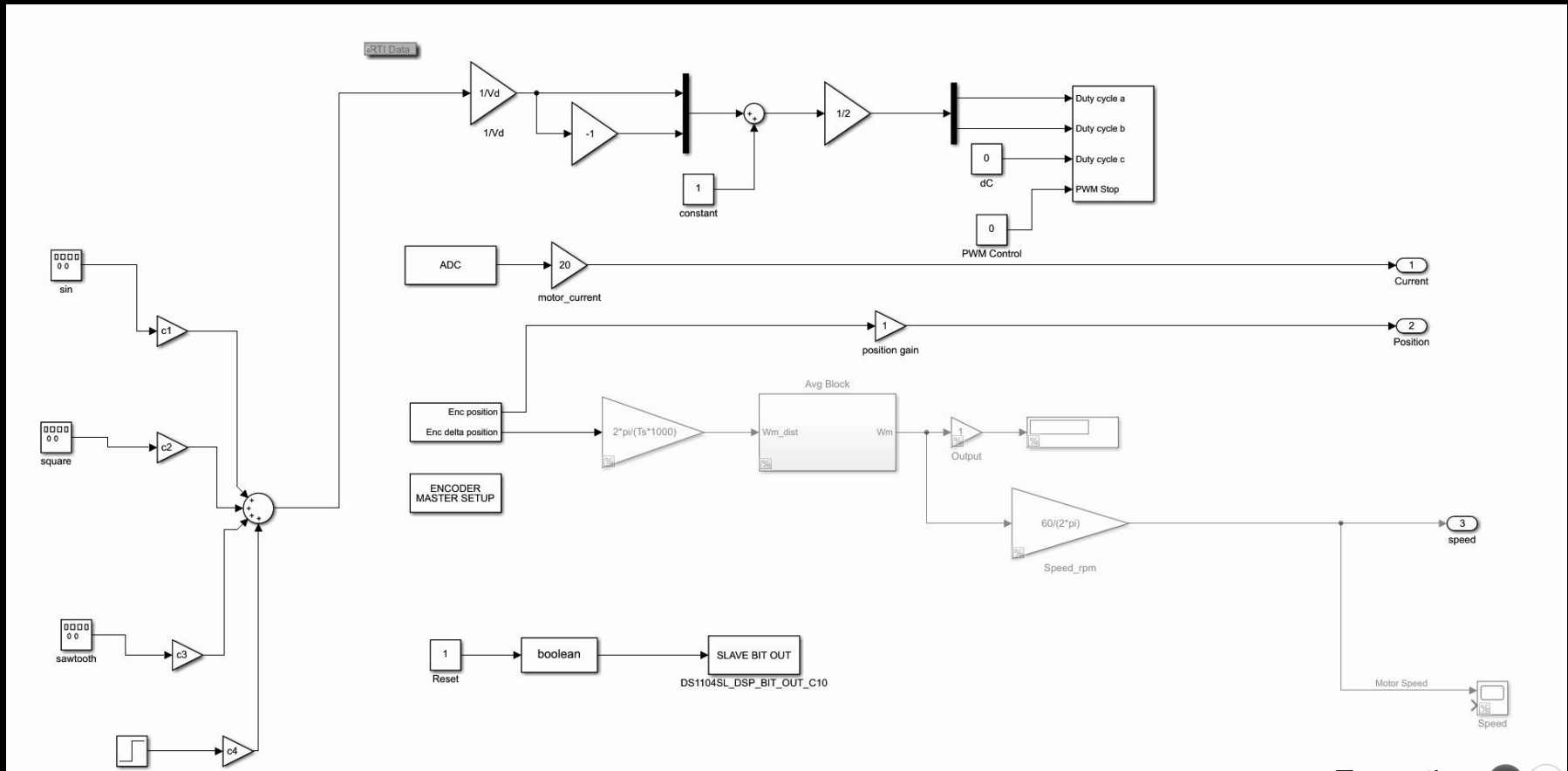


Execution

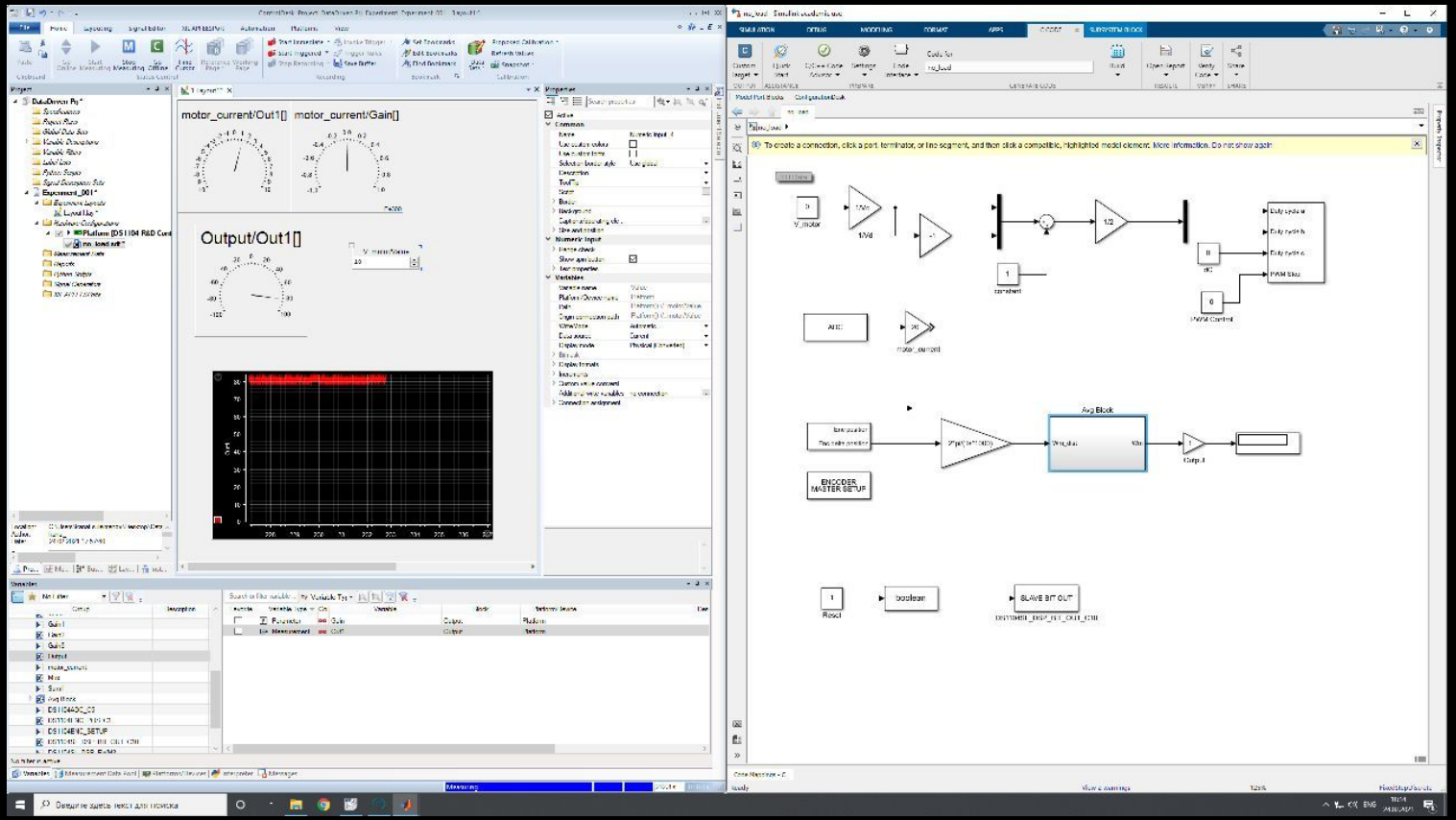


dSpace Hardware setup

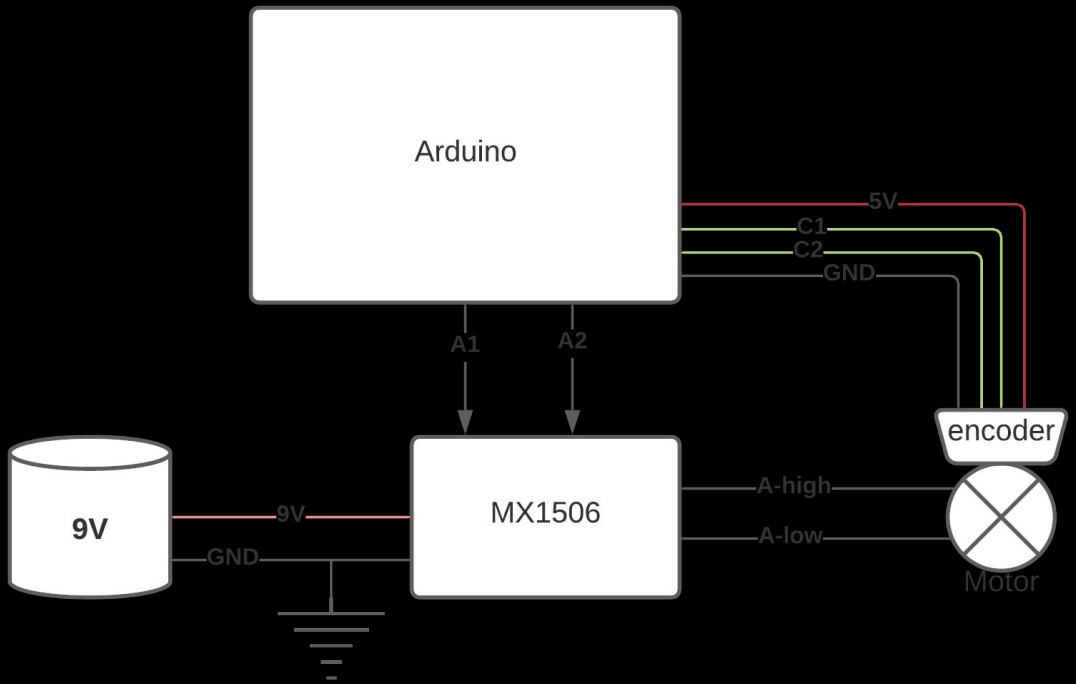
dSpace control model



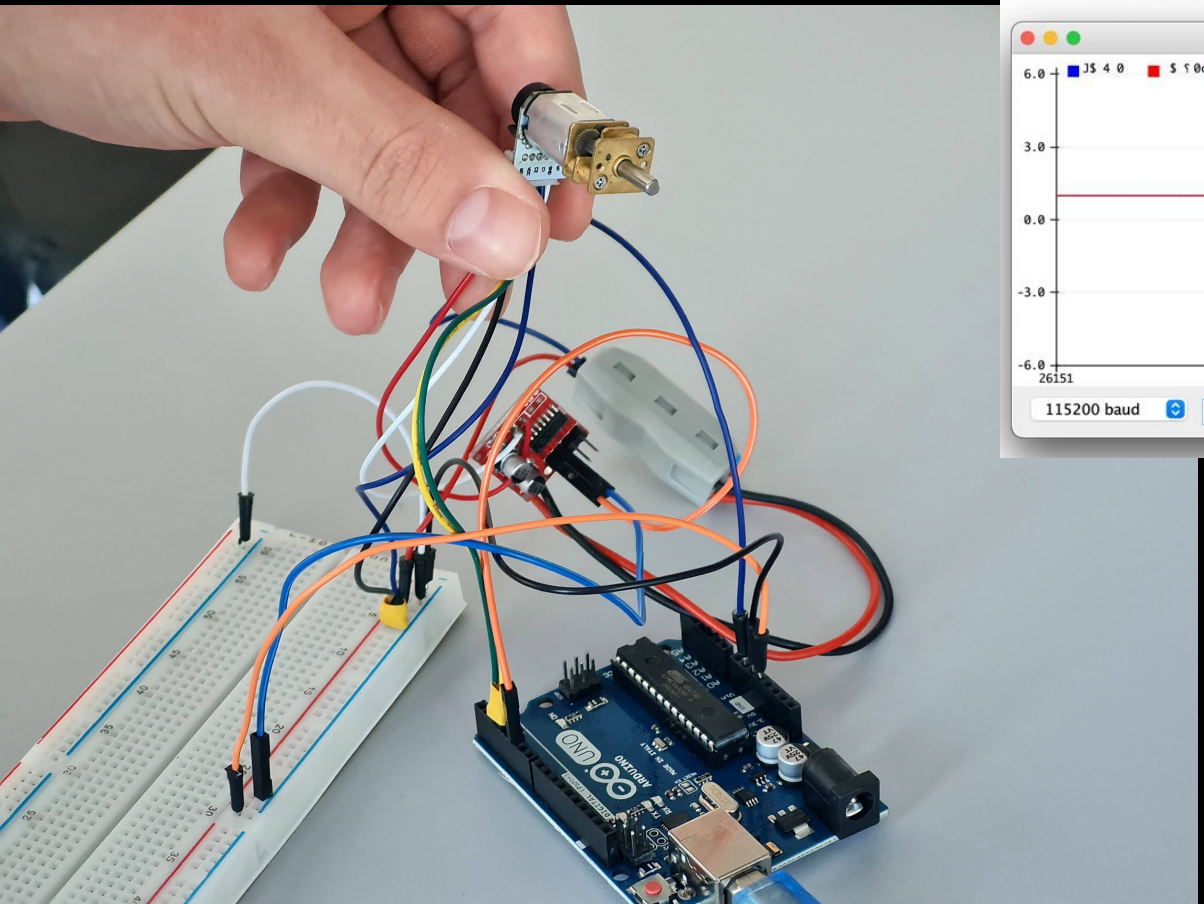
dSpace Model for data acquisition

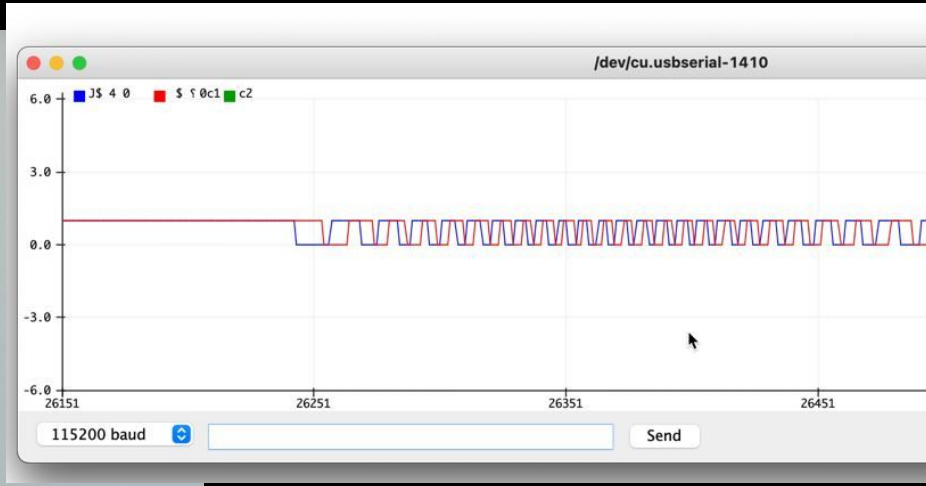


Arduino Hardware Setup #1 (diagram)



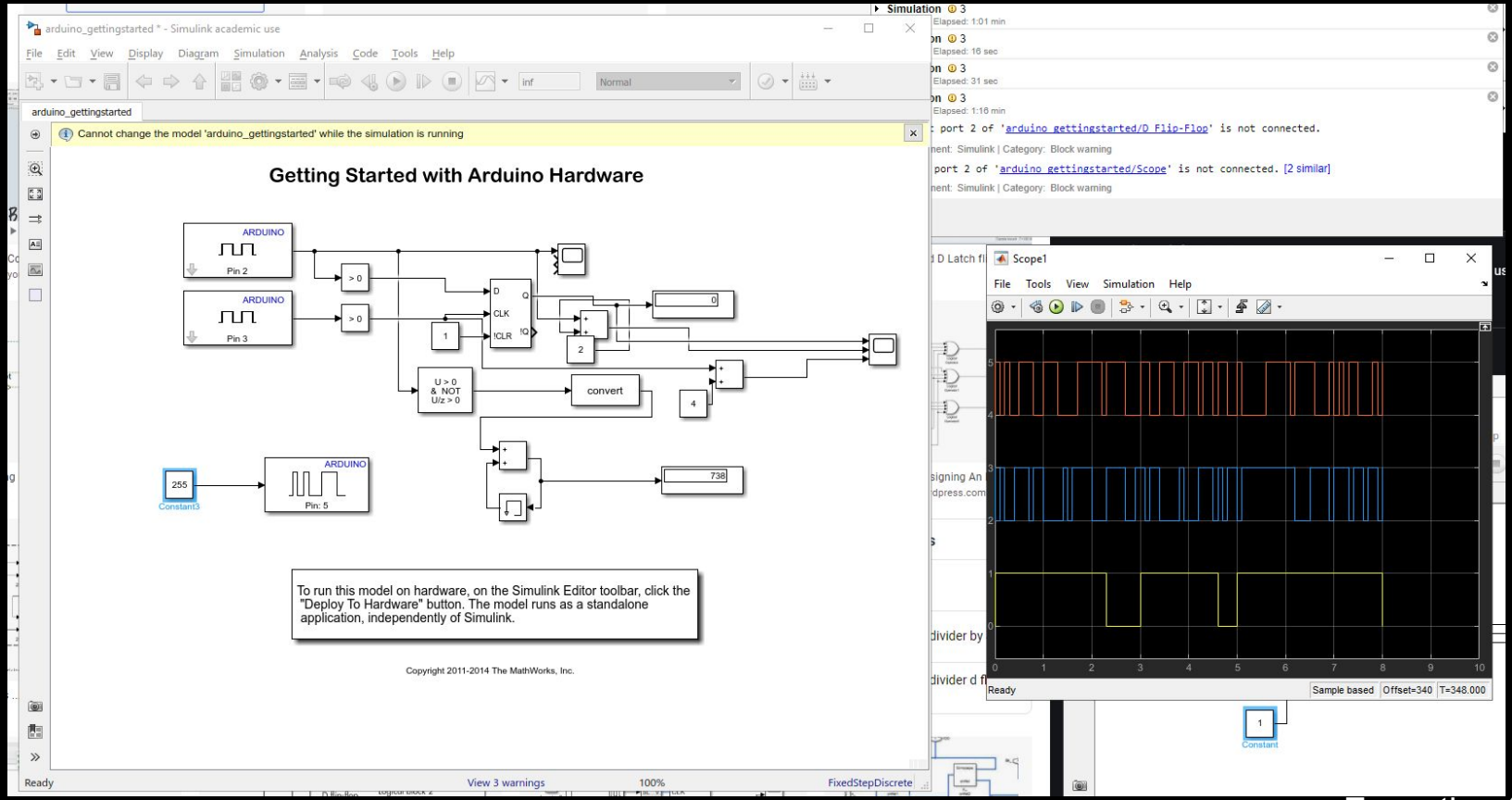
Arduino Hardware Setup (photo)





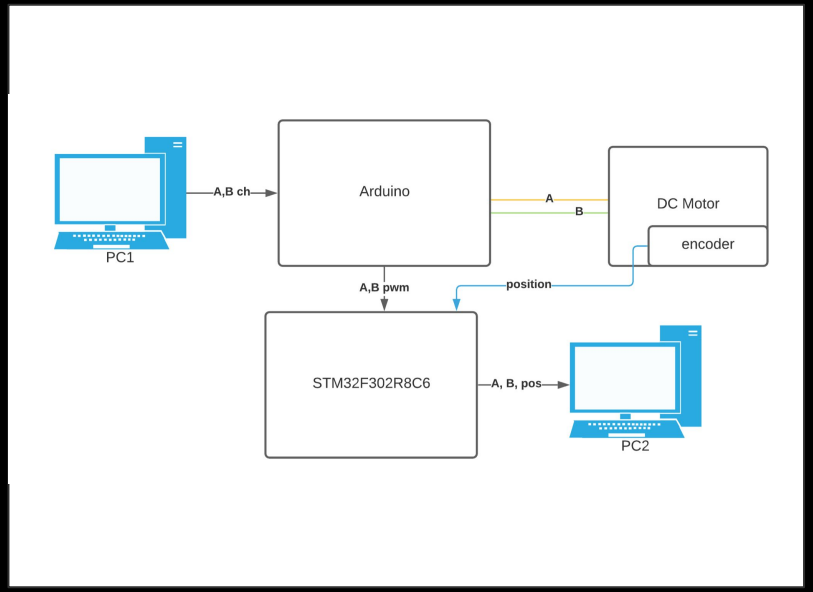
Execution

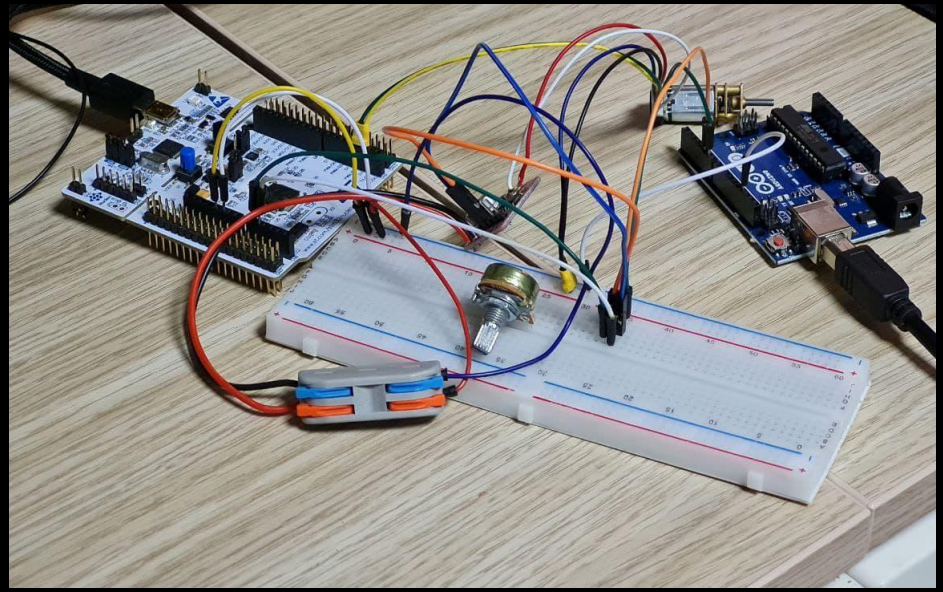
Arduino Hardware



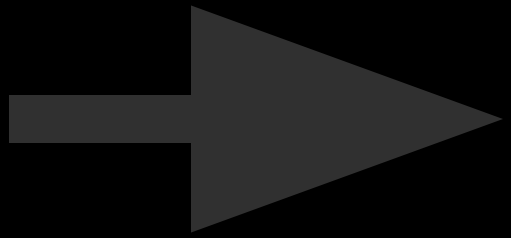
Execution

Arduino+STM32 setup



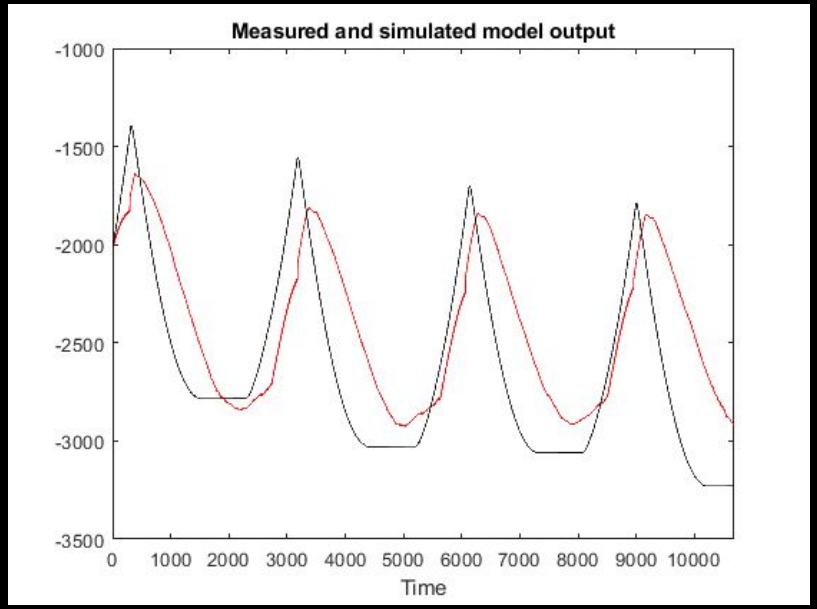


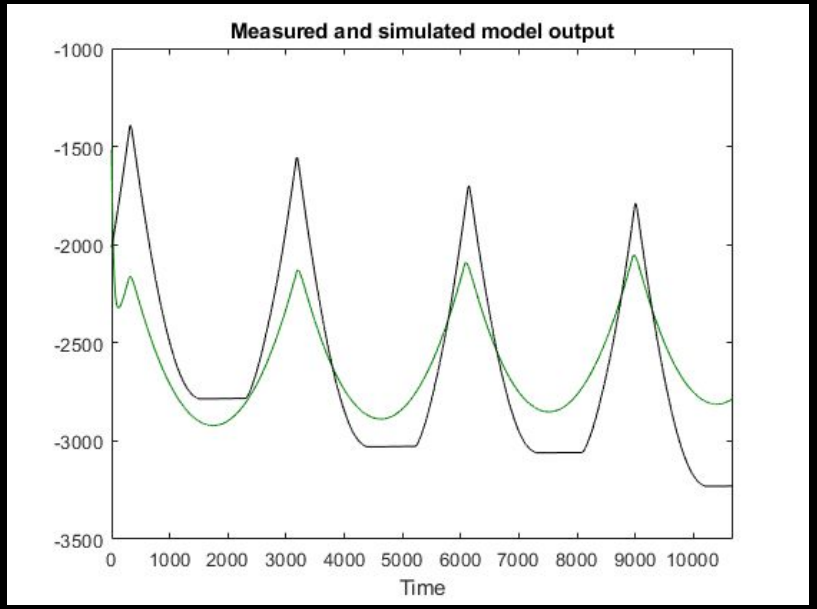
Results



Arduino+STM: Identified model validation

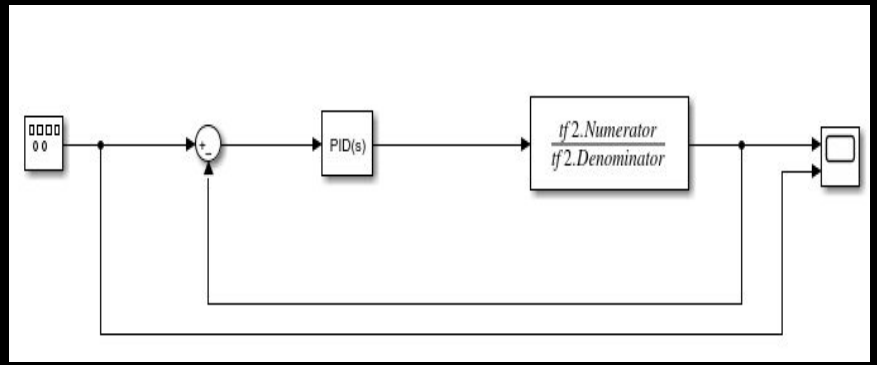
NARX and Transfer Function

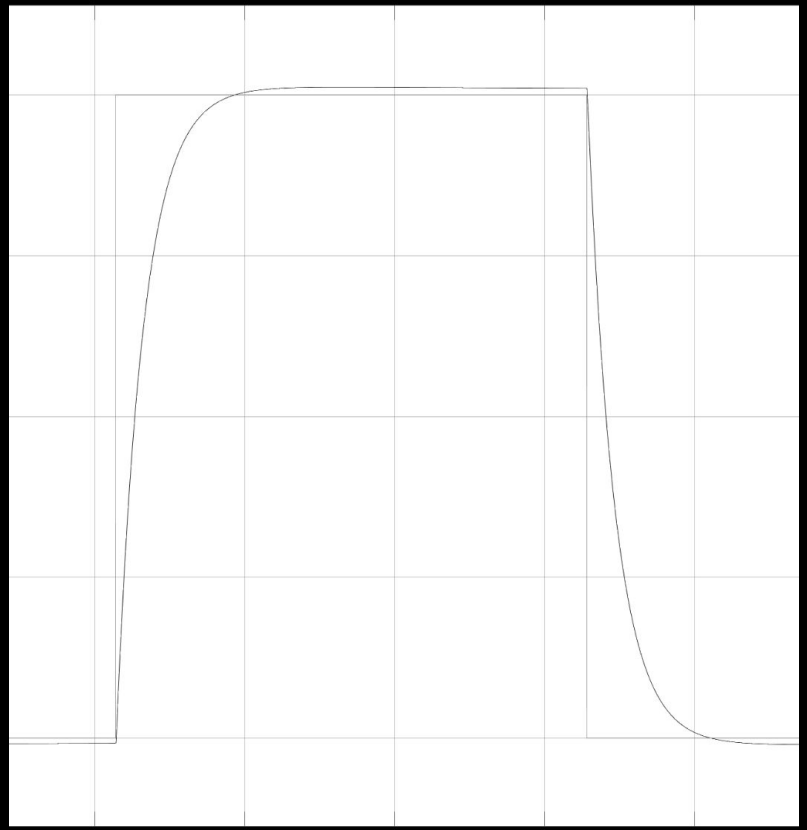




Controller evaluation

Rise time=21.3ms, Settling time=235ms

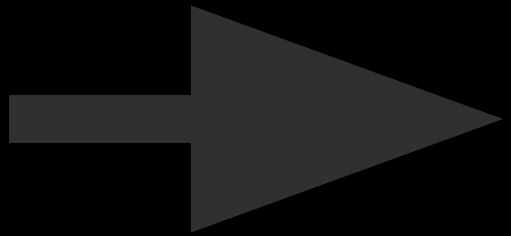




Synthesized plant model Results

- MATLAB simulation - 97% accuracy, linear approximation
- dSpace setup - 73% accuracy, linear approximation, can’t be tested
- Arduino setup - aliasing issue
- STM+Arduino setup - resolved aliasing issue, 41.07% accuracy

Conclusion



Conclusion and Future Work

- 4 different setups were built for DDC
- The acquired data was analyzed in MATLAB, controllers were synthesized
- The aim of the project was achieved with the Arduino #2 setup with STM32

- **Possible project extension:**
- Utilize analogous method for data-driven transfer function generation.