Bridging Theory and Practice: An Interactive Workshop on Control Theory using a Robotic Arm

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Workshop trial setup

- URL to download Simulink: https://tinyurl.com/FYEEMWQworkshop
- Click on 'Download Software' and follow next steps as prompted.

- Link to exercise files: https://tinyurl.com/FYEEMWQExFiles

Workshop Agenda

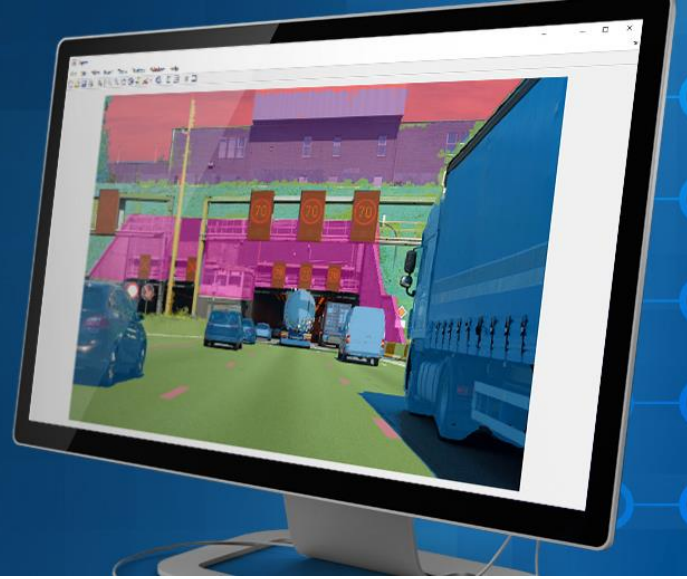
- Quanser Introduction
- MathWorks Introduction

- Simulink workshop
  - Exercise 1 – Introduction to Simulink
  - Exercise 2 – Build a PID controller

- Quanser Exercises

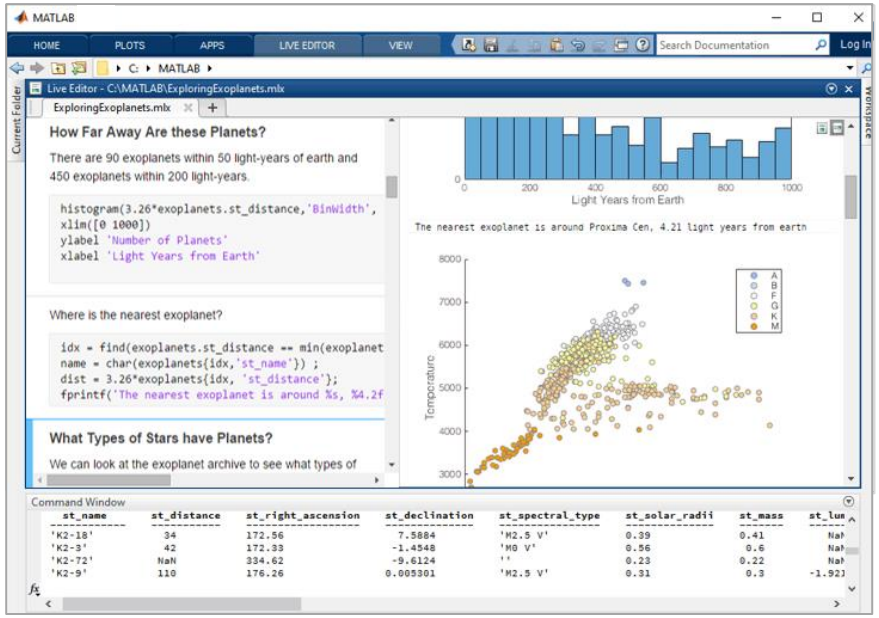
Our Products

MATLAB® & SIMULINK®



- **MATLAB** - Programming environment for algorithm development, data analysis, visualization, and numeric computation.
- **Simulink** - Block diagram environment for simulation and Model-Based Design of multidomain and embedded engineering systems.
- **130+ add-on products** for specialized tasks.

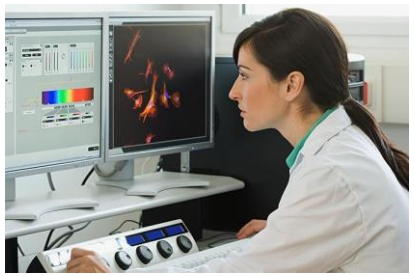
Computer Vision Toolbox



Our Customers / Key Industries


Aerospace and Defense


Automotive


Biological Sciences


Biotech and Pharmaceutical


Communications

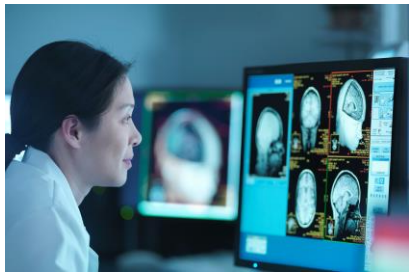

Electronics


Energy Production


Financial Services

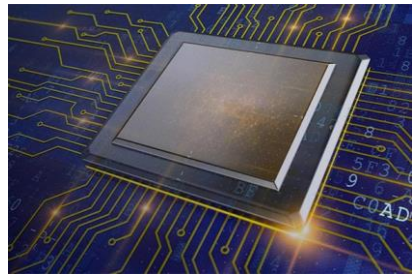

Industrial Machinery


Medical Devices


Neuroscience


Process Industries


Railway Systems


Semiconductors


Software and Internet

Our Customers / German Aerospace Center (DLR)

Autonomous Robots

Senses the environment using stereo cameras and tactile sensors on his skin

Performs human-like tasks

SIMULINK®

Simulation and Model-Based Design

Model and simulate your system

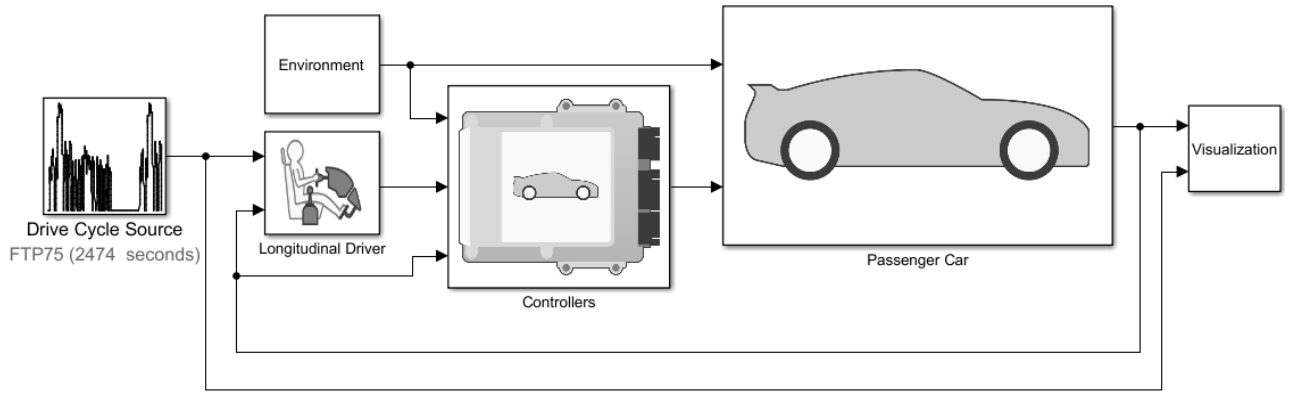
- Use one multi-domain environment
- Model the system under test and the plant
- Simulate closed-loop system behavior

Test early and often

- Test your system under all conditions
- Validate your design with real-time testing
- Trace from requirements to design to code

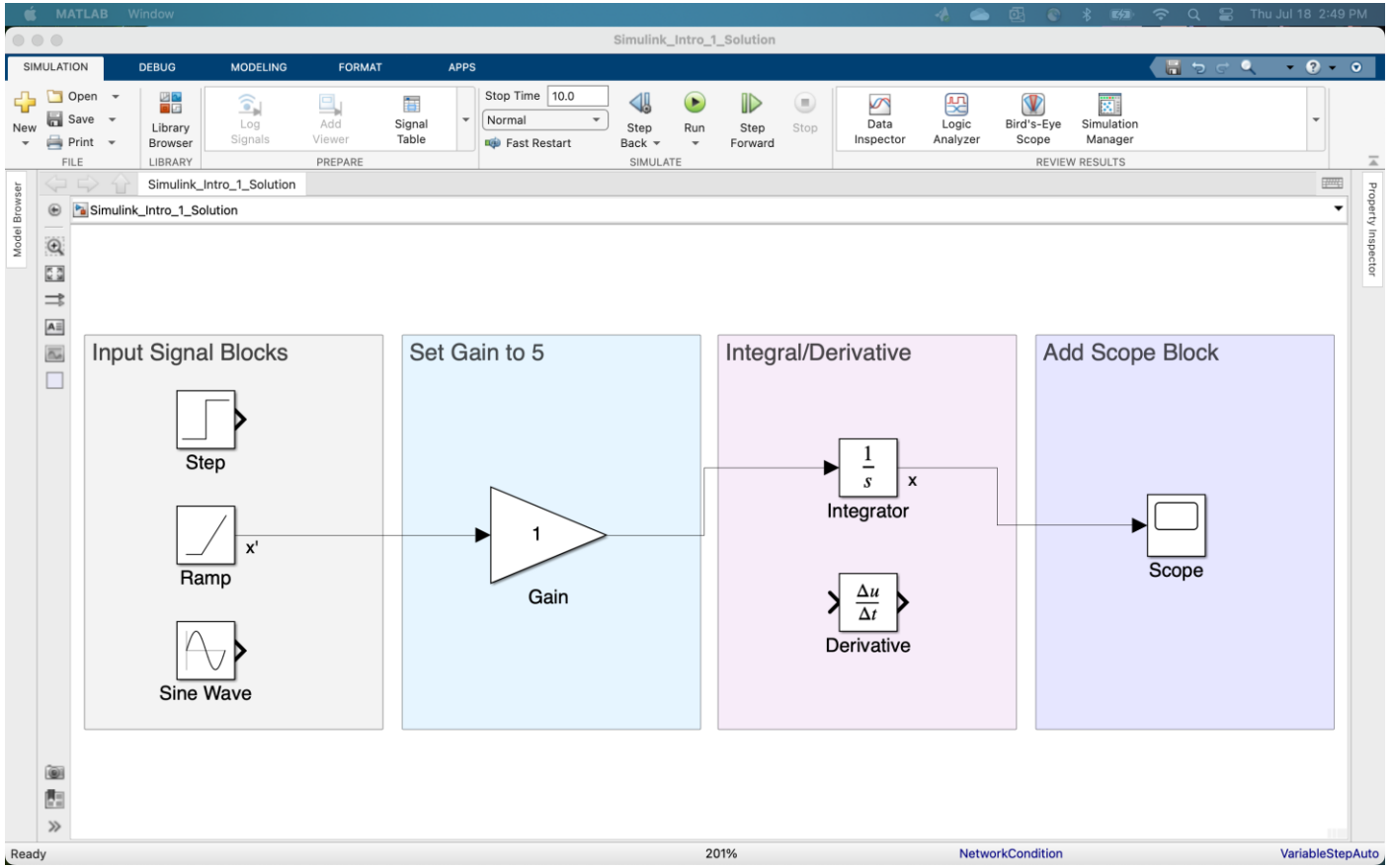
Automatically generate code

- Generate production-quality C and HDL code
- Deploy directly to embedded processors or FPGA's/ASIC's

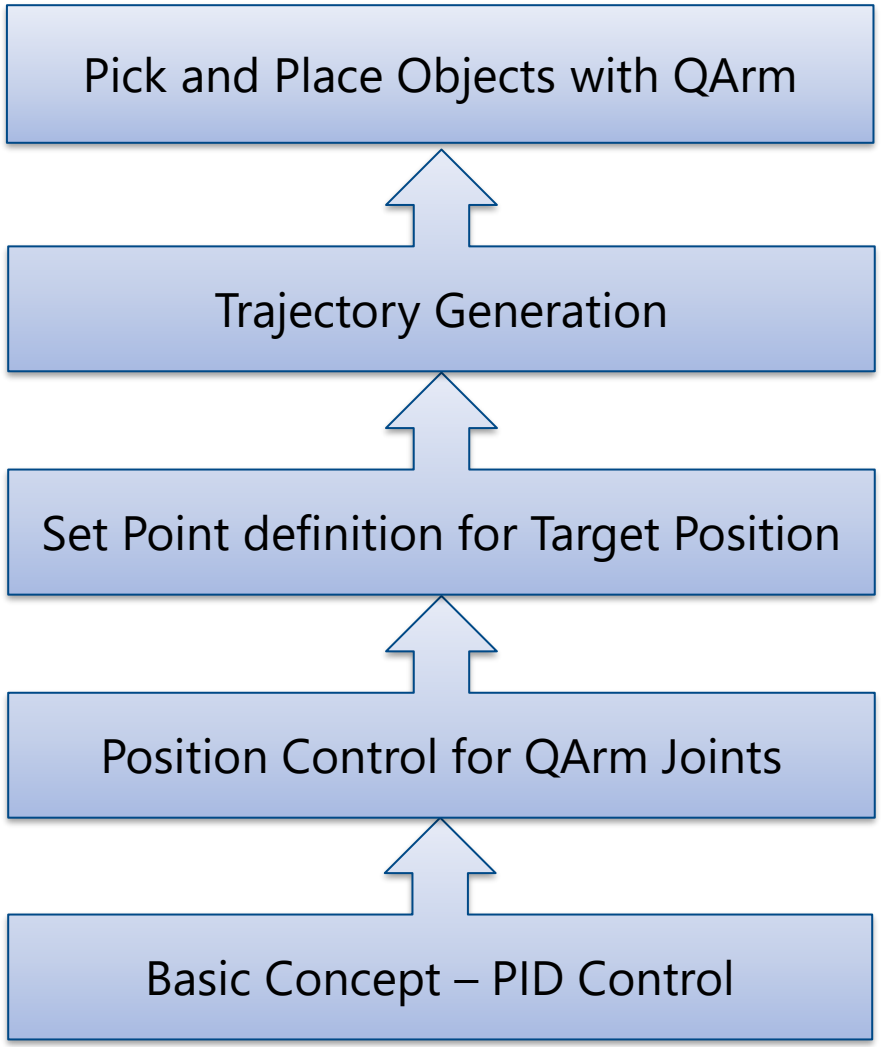


Exercise 1: Getting our feet wet with Simulink (10 mins)

- Go to …….. Folder and open the file named: *Simulink_Intro_1_24a.slx*
- Connect any one of the 'Input Signal Blocks' to the Gain.
- Decide if you want to integrate or differentiate and connect to the corresponding block
- Add a scope block and connect. You can also connect the input block to see both signals



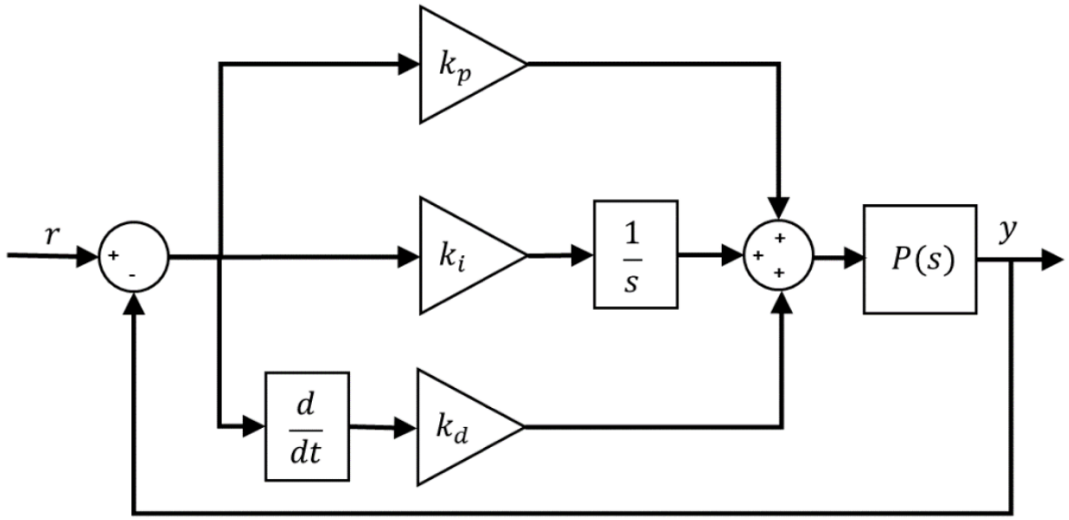
From Concepts to Practice



PID Controller – Proportional, Integral, Differential Controller

$$u(t) = k_p\, e(t) \;+\; k_i \int_0^t e(\tau)d\tau \;+\; k_d \frac{d\, e(t)}{dt}$$

$$U(s) = \left(k_p + \frac{k_i}{s} + k_d s\right) E(s)$$



A PID controller continuously adjusts a system's output to minimize the error between a desired setpoint and a measured variable using proportional, integral, and derivative actions.

[What is a PID Controller?]

Exercise 2: Build a PID controller in Simulink (10 mins)

- Go to …….. Folder and open the file named: *Simulink_Intro_2_24a.slx*
- Add a desired value block as input
- Decide the P, I, D values
- Edit the plant parameters by adding a transfer function
- Add a scope block