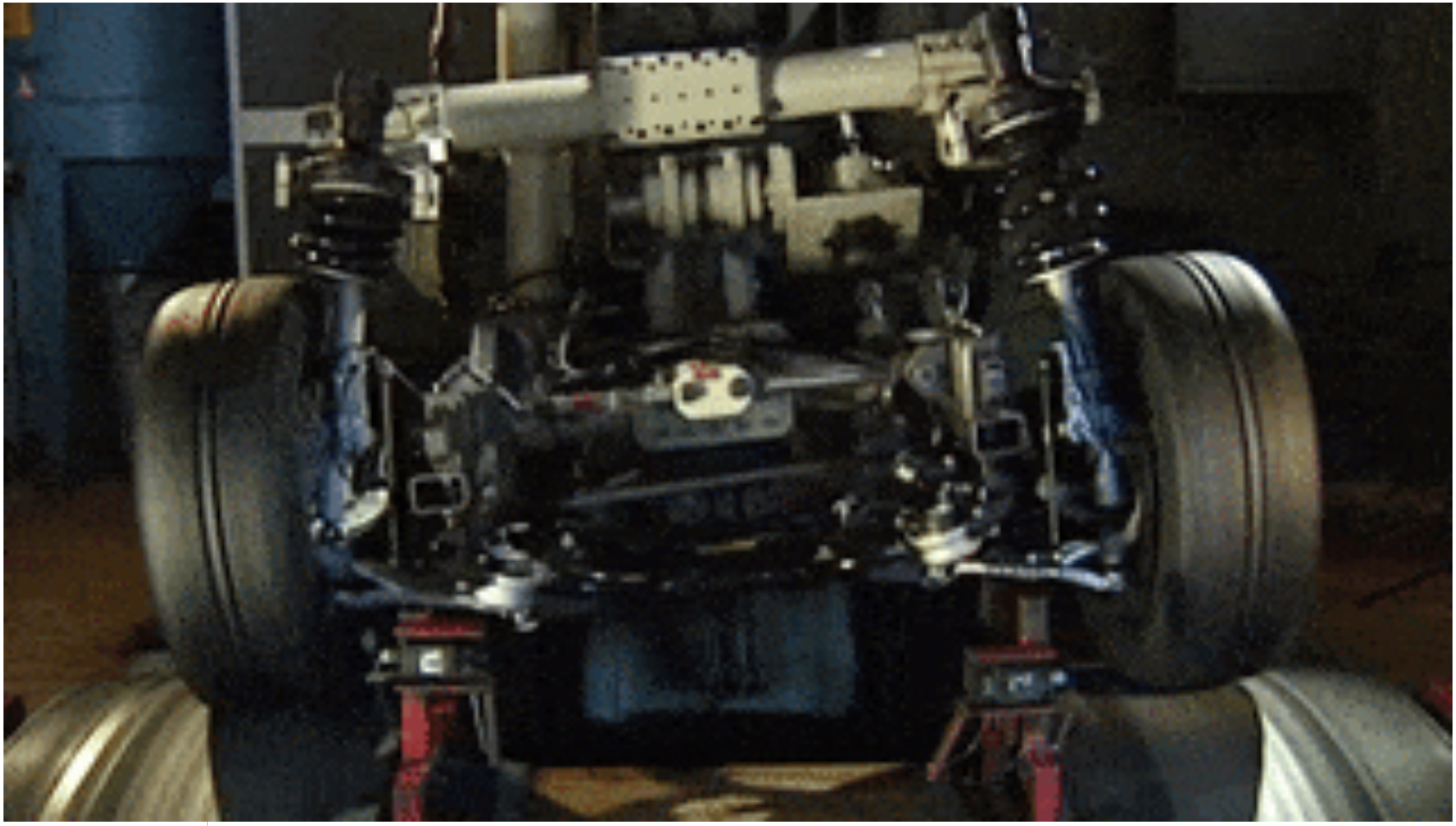


Hardware-in-the-loop Test Setup for Tuning Semi-Active Hydraulic Suspension Systems

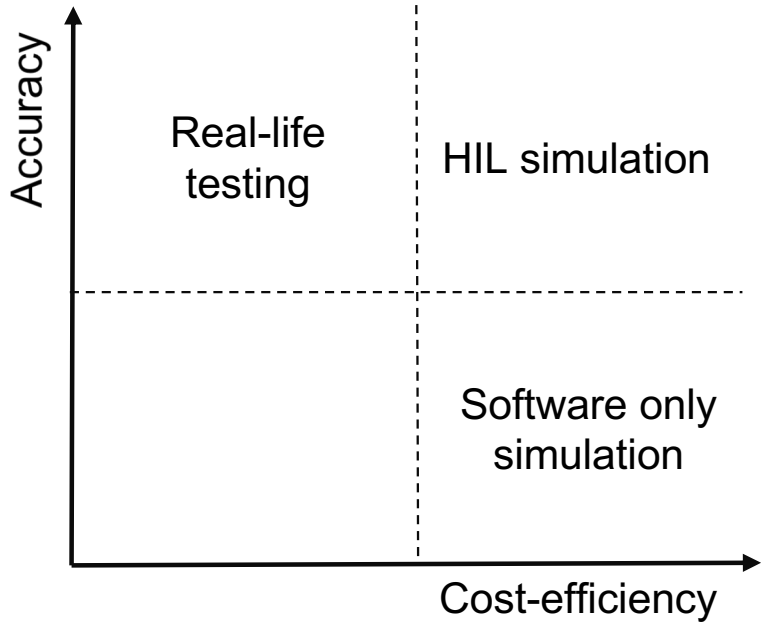
Aalto-yliopisto
Aalto-universitetet
Aalto University

Elisa Alboni, Ville Björklund, Matti Lin, Heikki Lu

01.04.2020

Suspension System Testing

- Real-life testing
- Software only simulation
- Hardware-in-the-loop (HIL) simulation



Challenges

Hardware-in-the-loop suspension systems simulations require:

Equipment

Investment

Experience

Solution

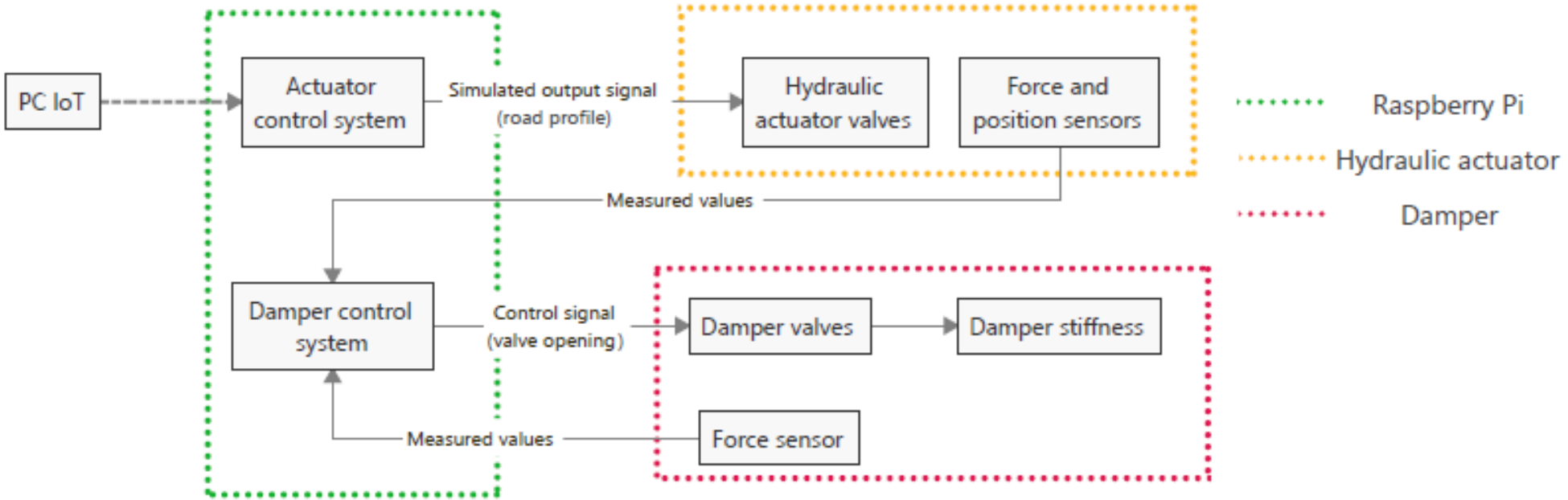
Single board computer controlled hydraulic test bench

- Accessible documentation
- Significantly cheaper than existing solutions
- Enables IoT compatibility

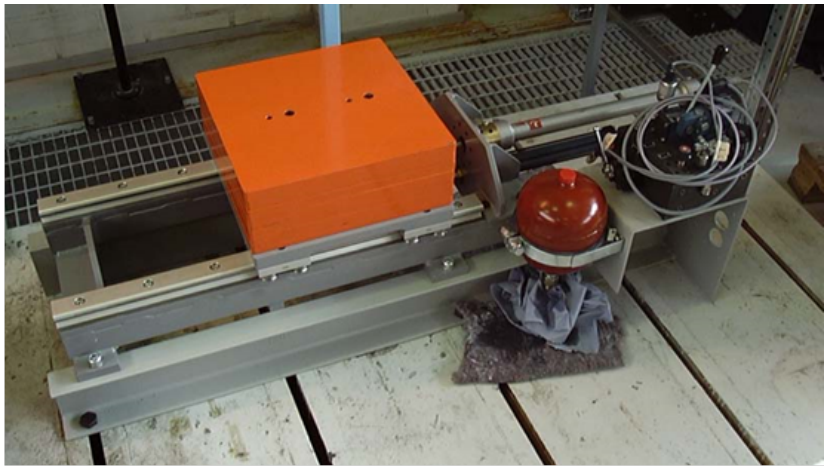
Simulations based on *Matlab* and *Simulink*

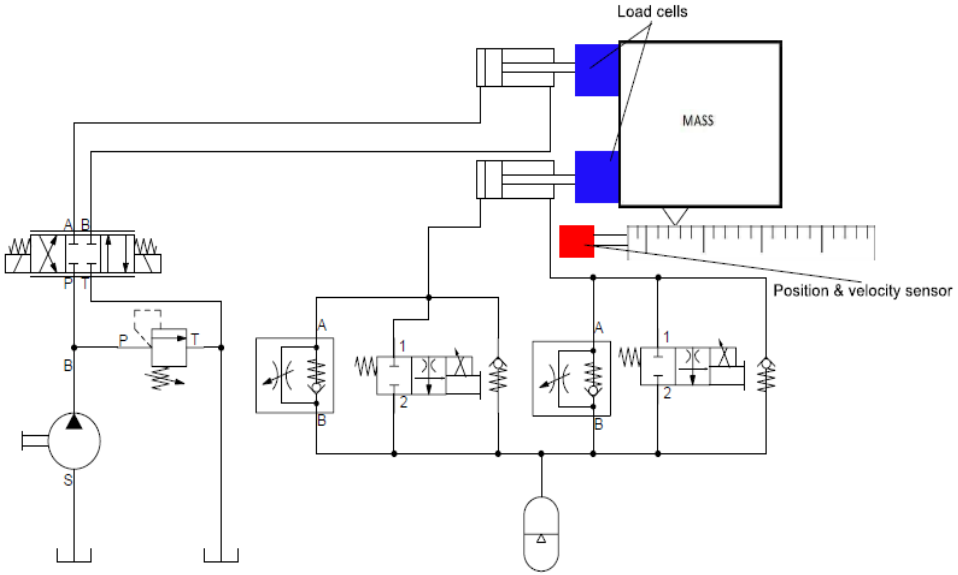
- Universal software

Details of Our Solution

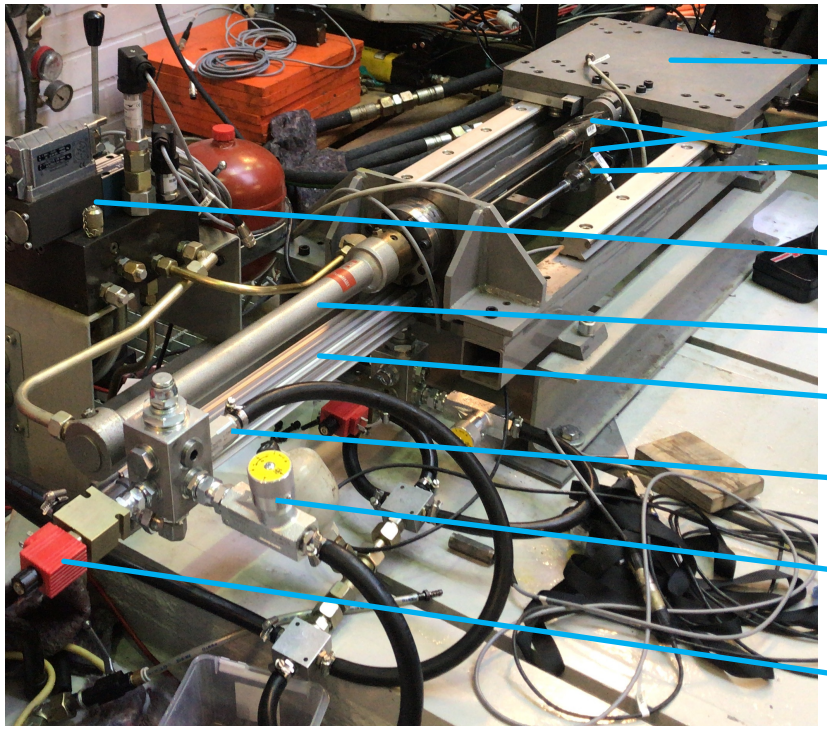


The Hydraulic Test Bench





The Hydraulic Test Bench



Mass

Position sensor

Load cells

Servo solenoid directional control valve

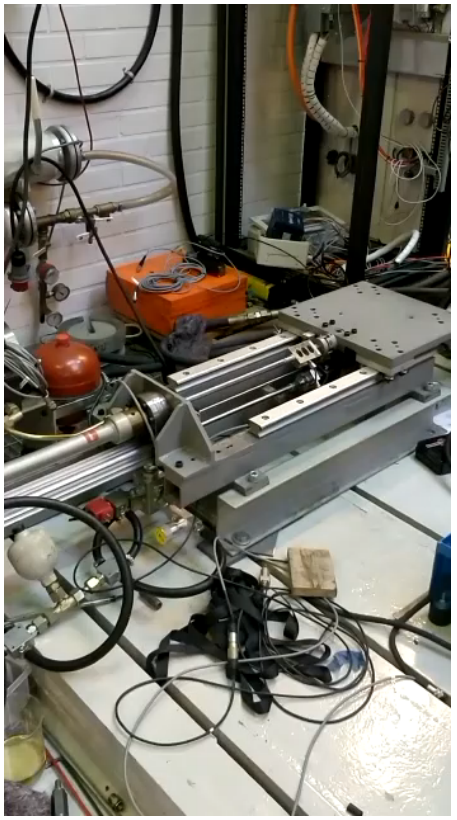
Actuator

Damper

Check valve

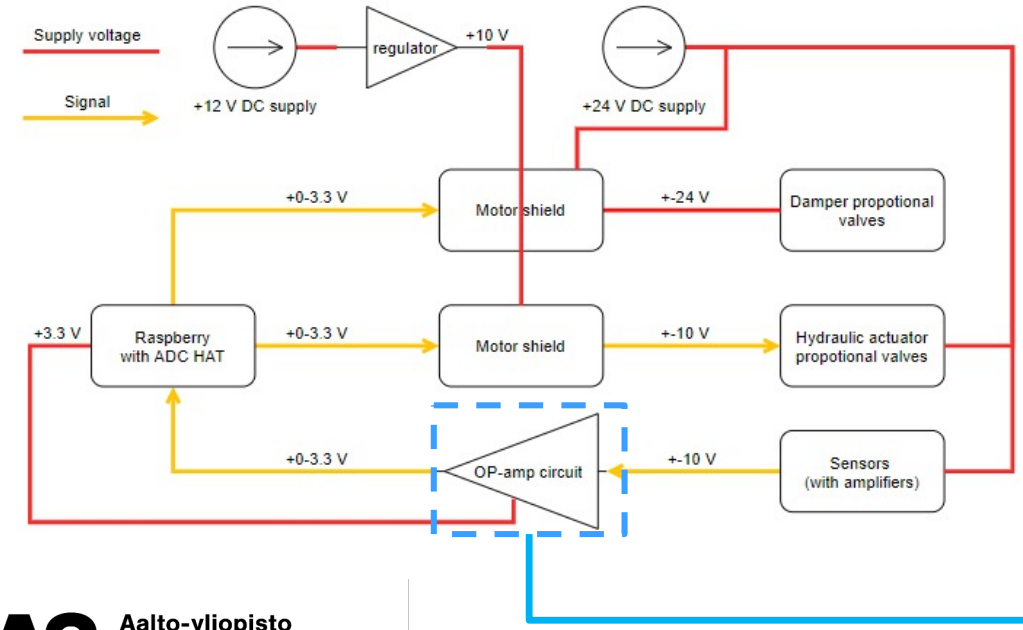
Manual flow control valve

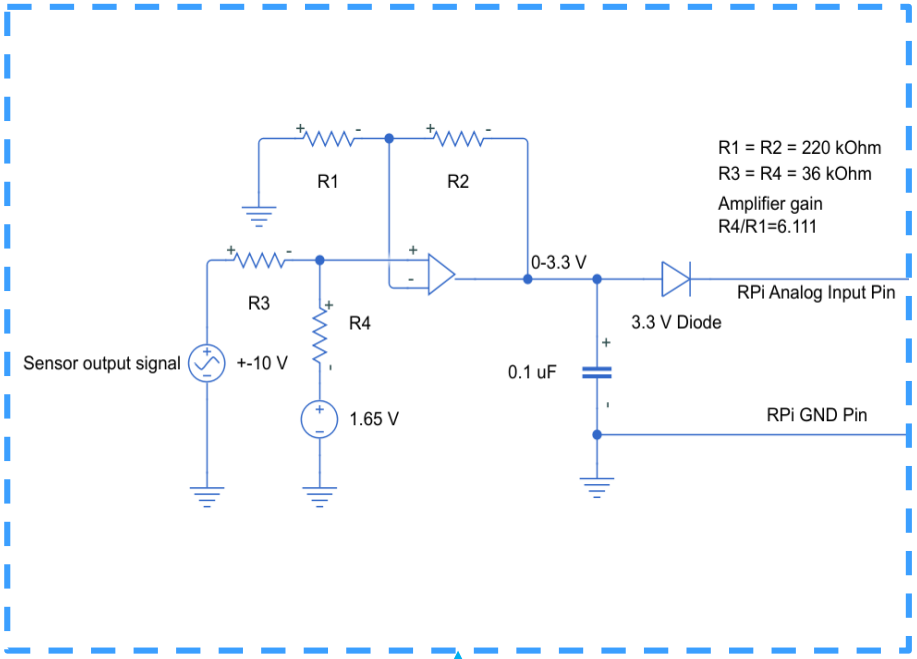
Electro-proportional valve



The Control System Hardware

- Voltages needed for the control system: -10...+10 V and 24 V
- RPi voltage range 0...3.3 V

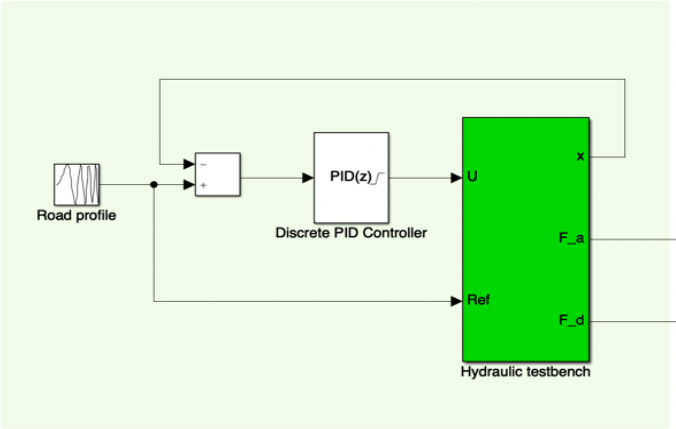


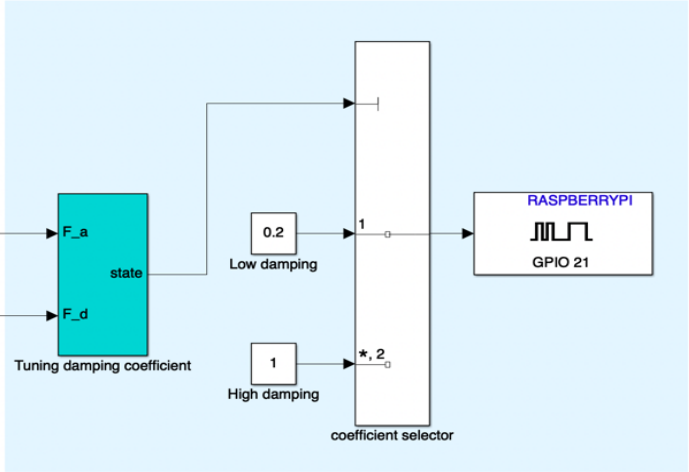


The Simulation

- Road profile generation
- Collection of sensor data

- Skyhook control strategy
- Tuning damping coefficient





Results

- Framework for an HIL simulation setup to test suspension systems
  - Hardware
  - Signal processing circuits
  - Simulink model

Needs further research:

- Building the presented framework to validate the real time capabilities (step time)
- Use of industrial RPis in creating HIL simulating systems