



Virtual XCU Calibration with Neural Networks NARX/Sequential Neural Networks for Dynamical Systems

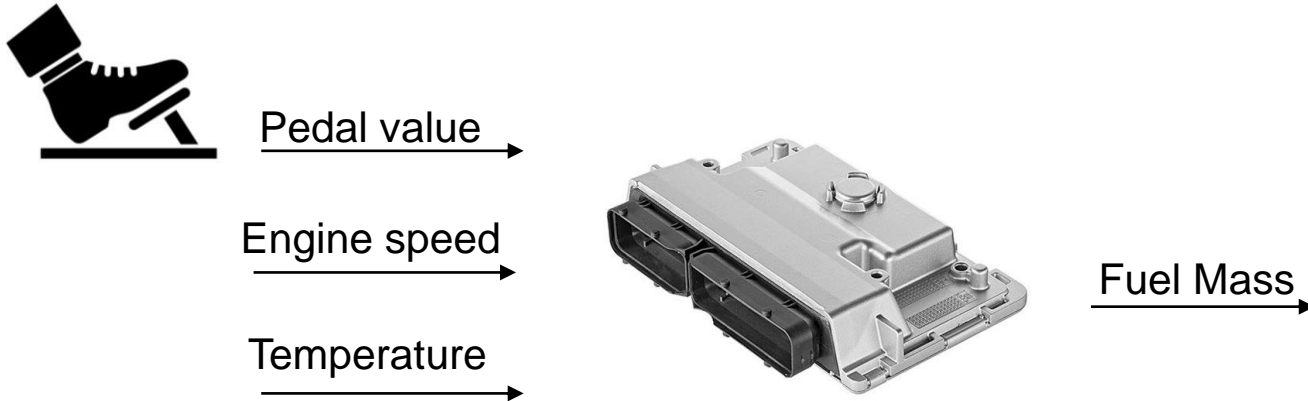
Agenda

- 1 Classical ECU Functions
- 2 Deep Dynamical Systems
- 3 Deploying AI As Virtual Testbench

Classical ECU Functions

What is an ECU Function ?

- › Mapping Input Signals to Output signals

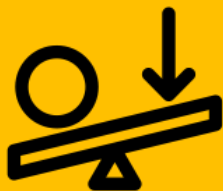


Classical ECU Functions

Advantages/Disadvantages

Advantages

- › Physically motivated
- › High understanding of what's going on (intermediate signals have typically physical units)
- › Enabling “transfer learning” for single HW change



Disadvantage

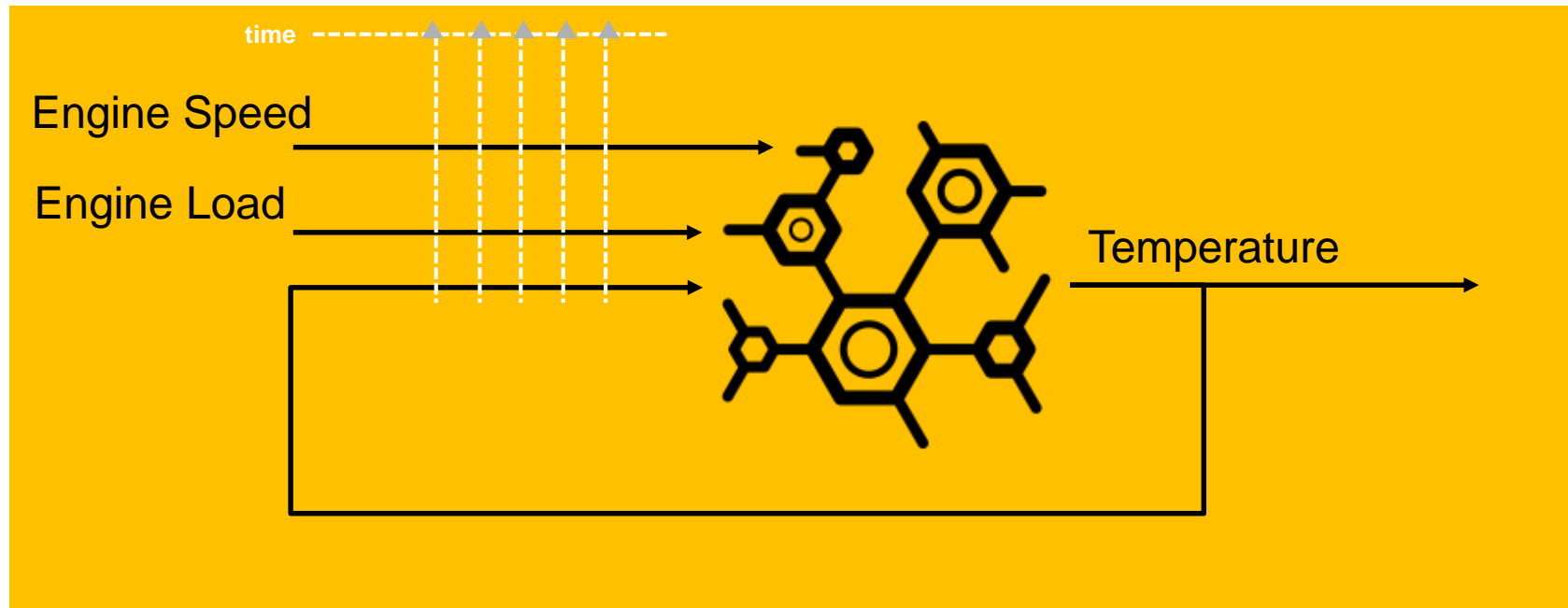
- › Require development (modelling + coding)
- › Require methodology development for calibration = training
- › Require tooling for the training (backpropagation)
- › Require very special measurements from engine test bench



Deep Dynamical Systems

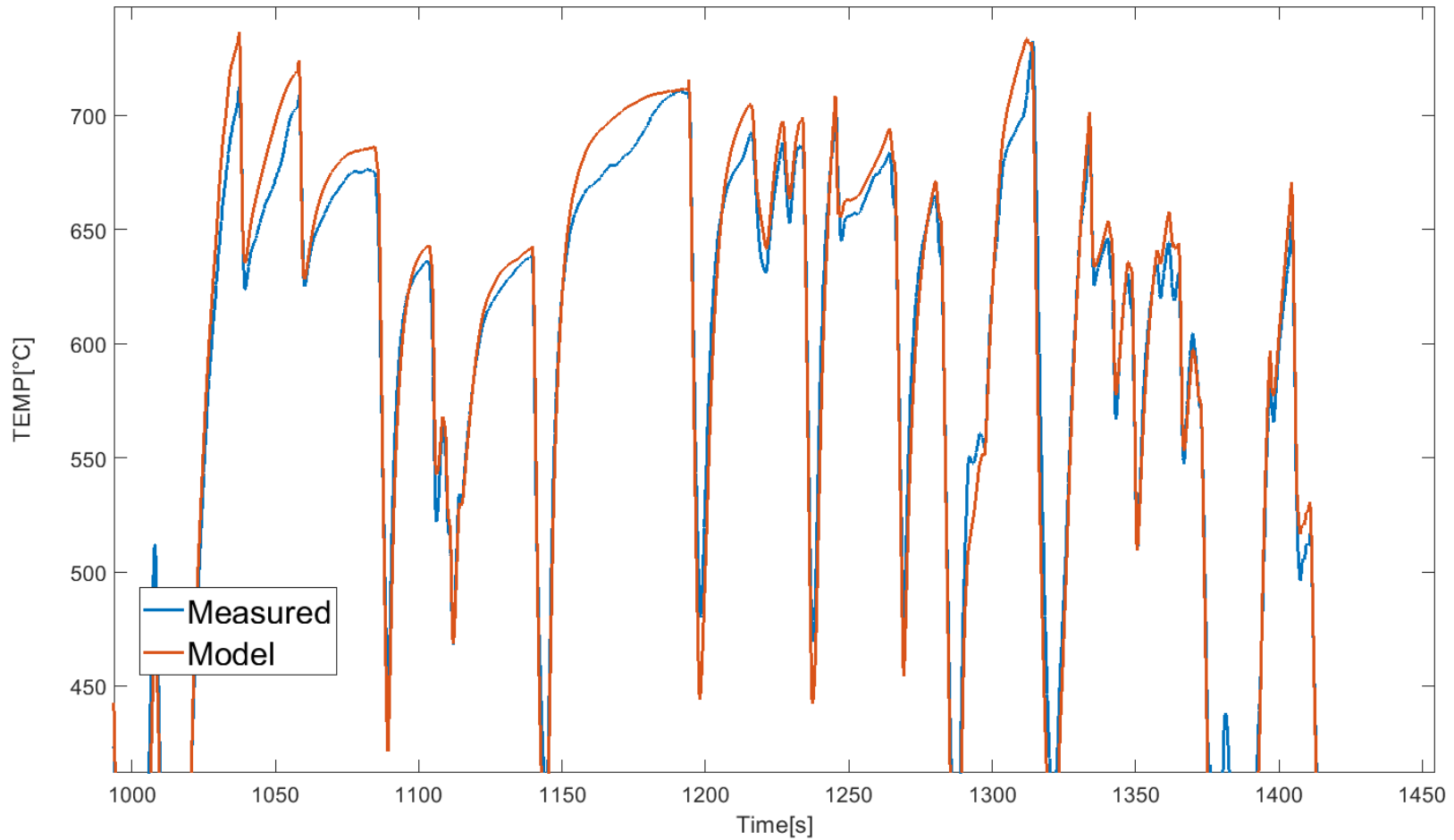
Network overview

- › No LSTM (Long Short-Term Model)
- › NARX (Nonlinear autoregressive neural network)

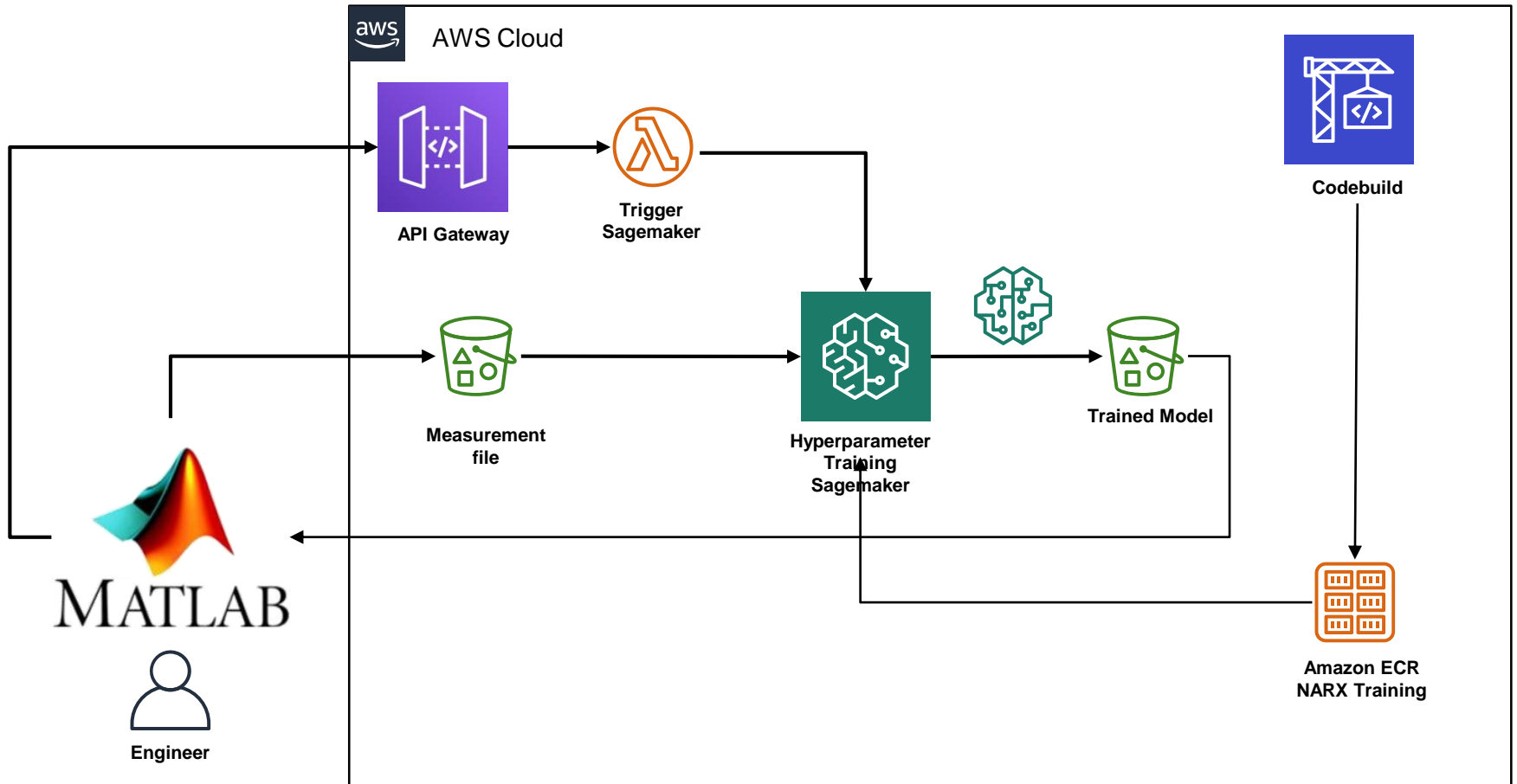


Deep Dynamical Systems

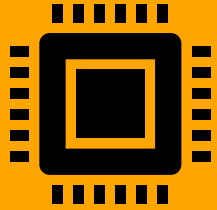
Temperature example 40min of driving (validation)



Deep Dynamical Systems Training at AWS



Deep Dynamical Systems Applications



Deploy to ECU



Virtual Testbench



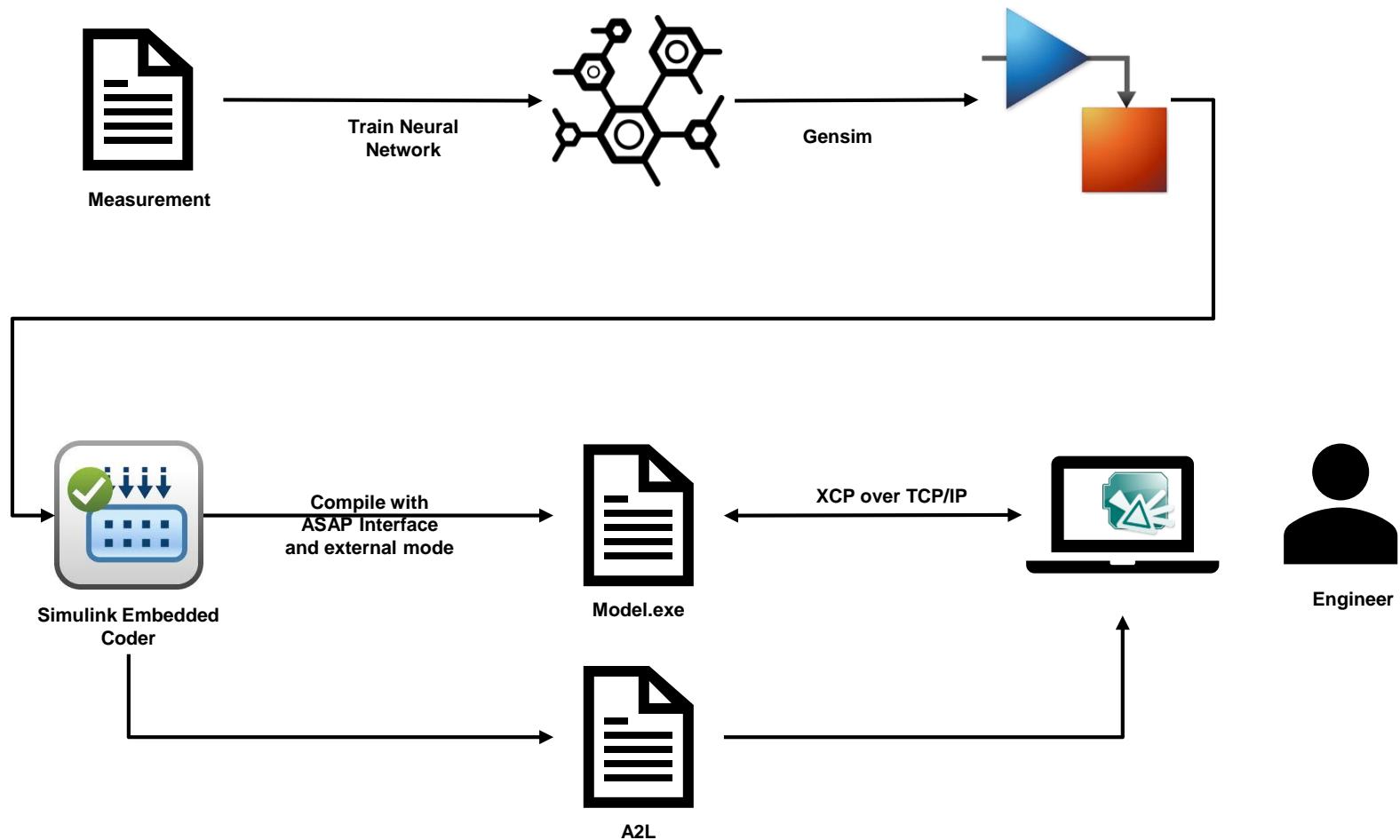
Calibrate Controller for
Dynamical System



Reinforcement
Learning

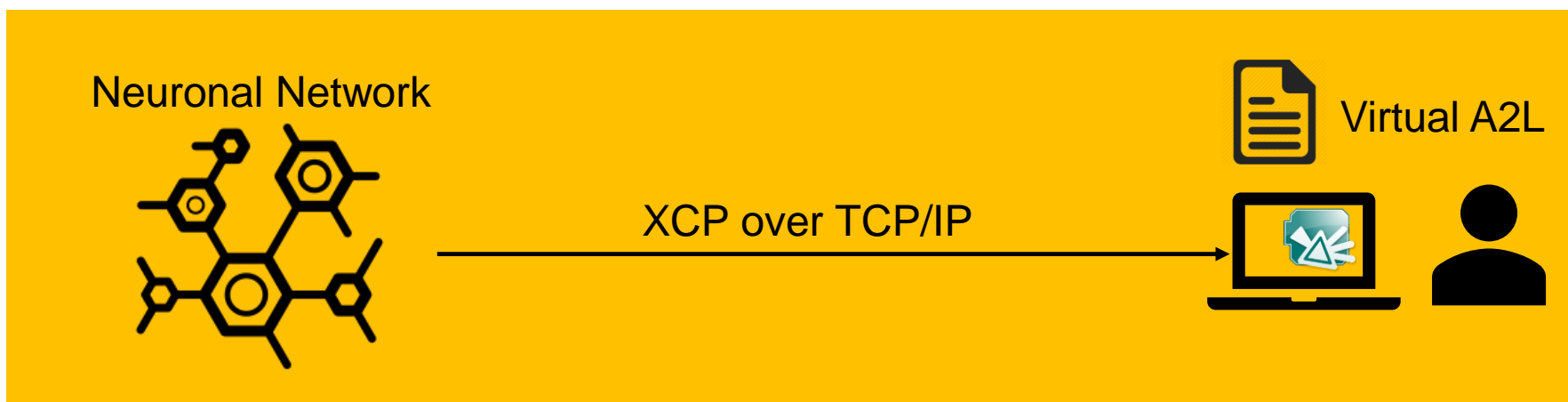
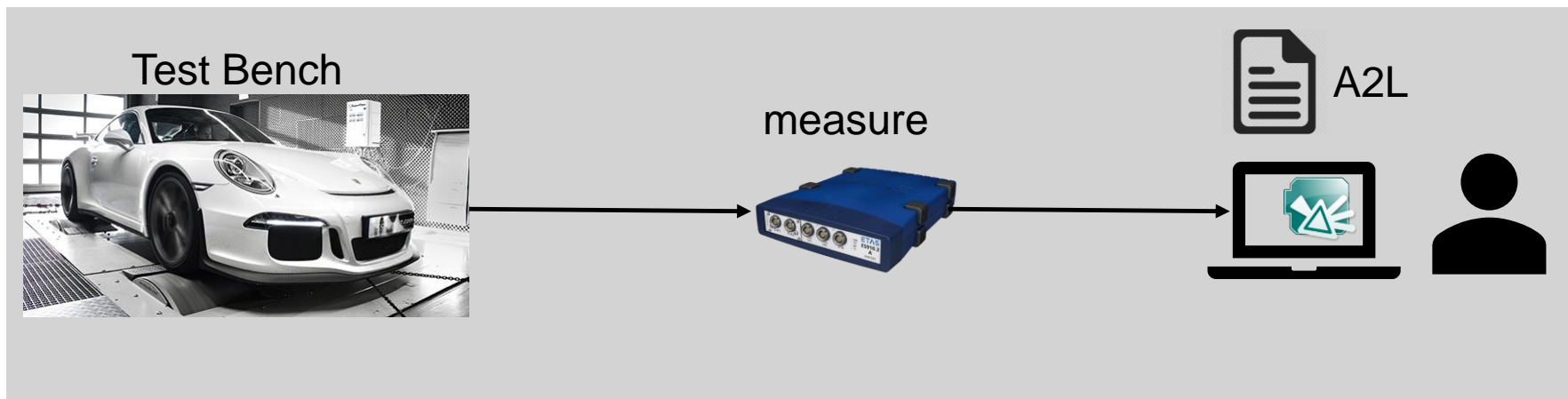
Deploying Artificial Intelligence As Virtual Testbench

Matlab/Simulink Workflow



Deploying Artificial Intelligence As Virtual Testbench

Measure Neural Network with INCA



Q & A

