Real-time control prototyping of driver assistance and autonomous driving technologies at Mobileye

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The EyeQ chip

- Performs interpretations of the visual field
- All object detection algorithms are conduced by a monocular camera, reducing costs and simplifying tooling and packaging of the camera sensor device
- As of today, Mobileye chips are used in over 5.2 million vehicles
- Until end of 2016, the chip will be used in 247 car models from 22 car manufacturers

www.mobileye.com

A Mobileye EyeQ2 chip used with a Hyundai lane guidance camera module

EyeQ3 chip accepting multiple cameras from surround-view systems

Leveraging the EyeQ chip and a real-time computer for autonomous driving

- All vision detection and processing tasks are performed by the EyeQ chip

- A rugged industrial real-time computer for in-vehicle use was required to:

  - ✓ Acquire processed vision data from the EyeQ chip, and speed, steering feedback, yaw rate, and other data from the vehicles buses via CAN
  - ✓ Run real-time controls applications created from Simulink, including the above communication protocol interface
  - ✓ Dynamically monitor and tune the real-time application during real-time runs
  - ✓ Log data during long-term standalone test runs for post execution analysis

Contents of delivery

Speedgoat hardware, drivers, and test models

MathWorks software
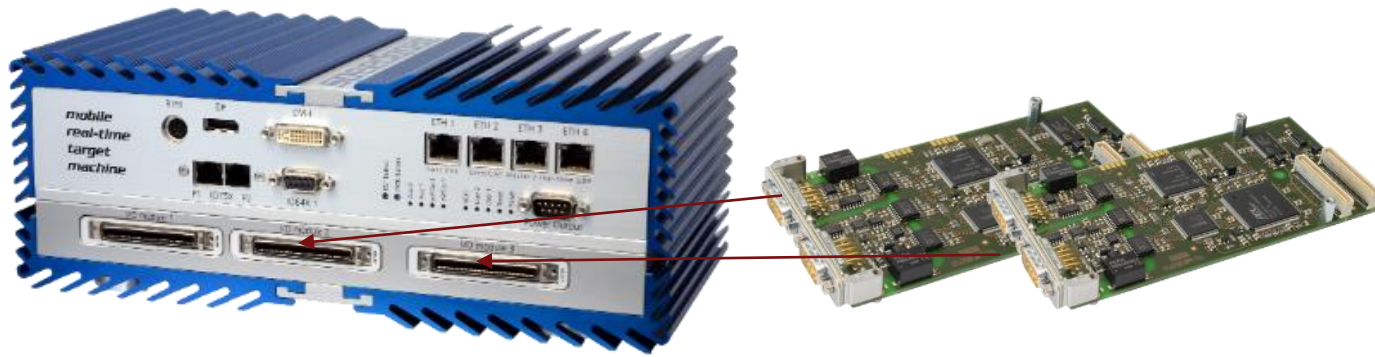
Mobile real-time target machine with 7x24 drive for data logging
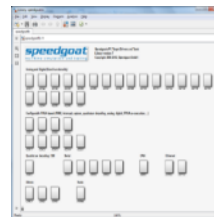
2 x IO601 CAN I/O modules (4 ports)

- ▪ MATLAB
- ▪ Simulink
- ▪ MATLAB Coder
- ▪ Simulink Coder
- ▪ Simulink Real-Time

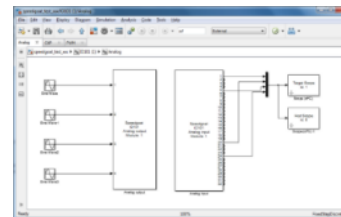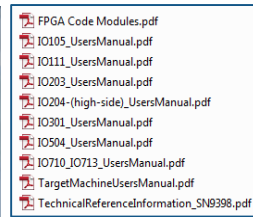**I/O cables** **Terminal boards** **Driver blocks** **Simulink test models** **Documentation**

- FPGA Code Modules.pdf
- IO105_UsersManual.pdf
- IO111_UsersManual.pdf
- IO203_UsersManual.pdf
- IO204-(high-side)_UsersManual.pdf
- IO301_UsersManual.pdf
- IO504_UsersManual.pdf
- IO710_IO713_UsersManual.pdf
- TargetMachineUsersManual.pdf
- TechnicalReferenceInformation_SN9398.pdf
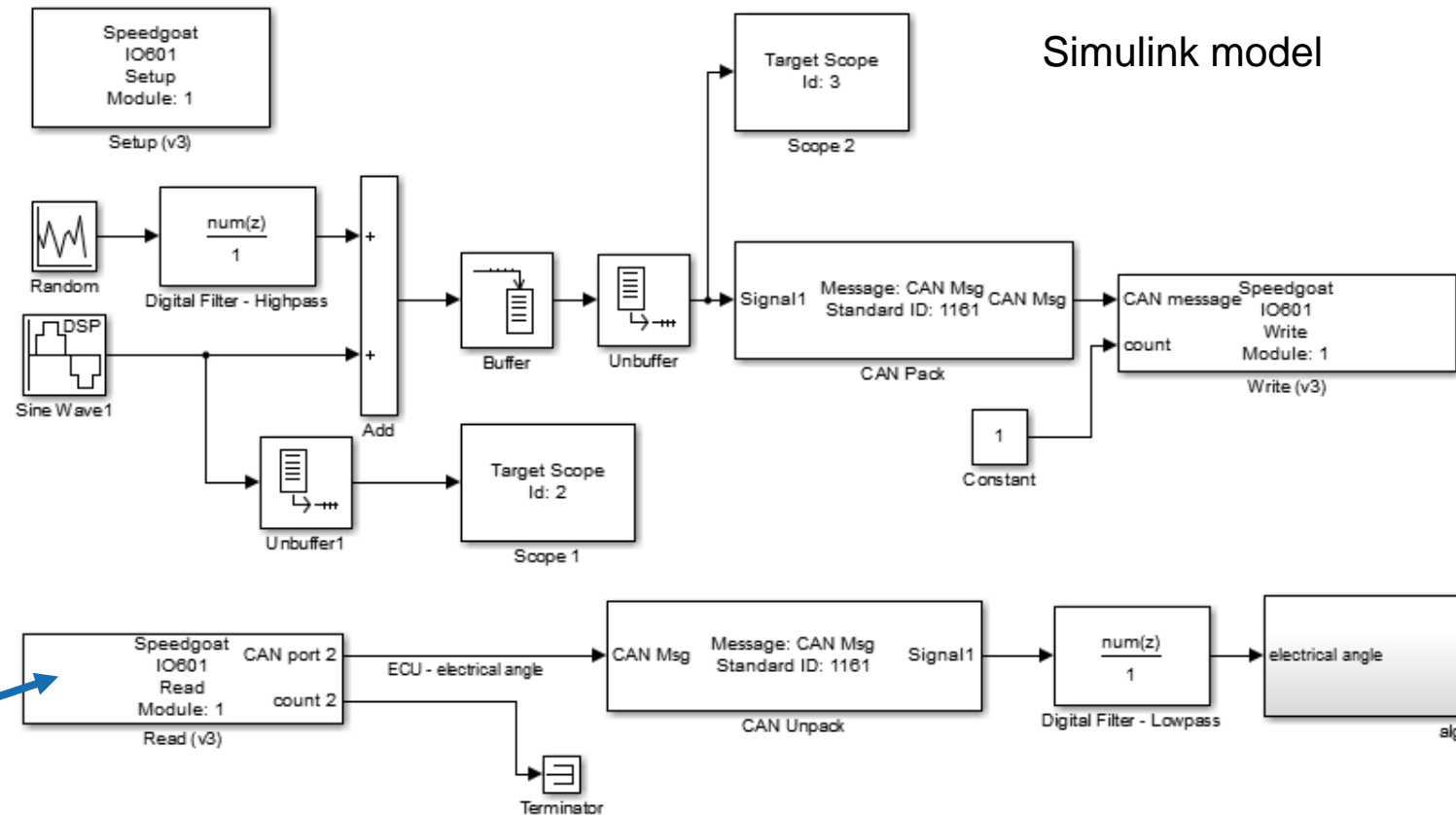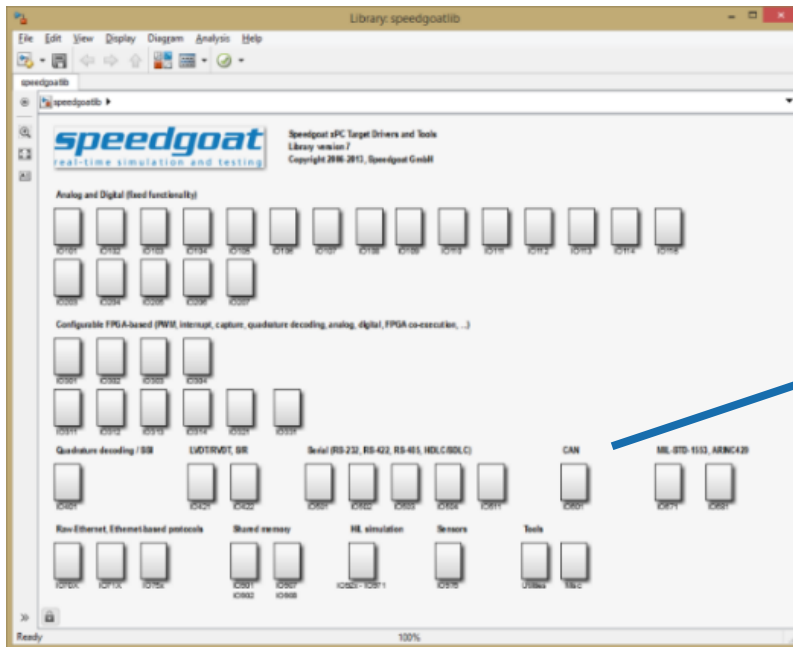
Connection with EyeQ chip, and vehicle buses

✓ Drag & drop driver blocks for I/O modules installed in target machine to your model
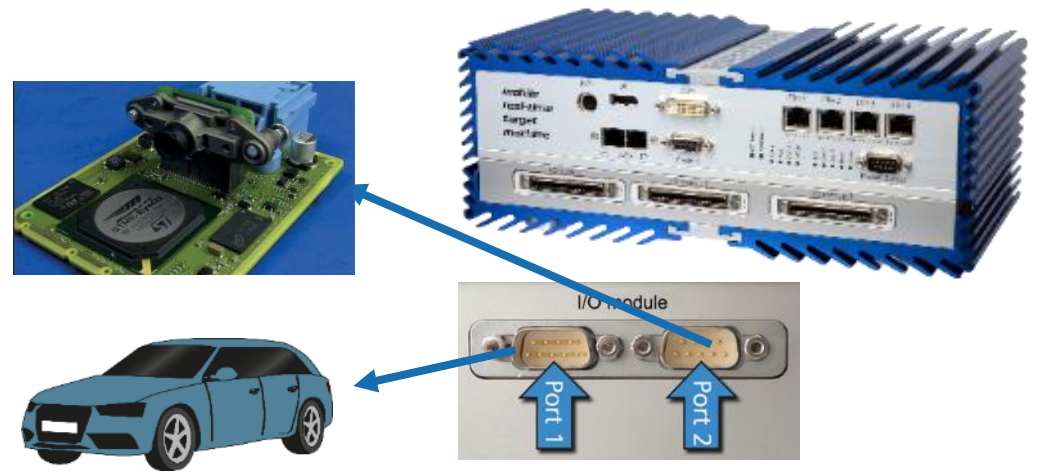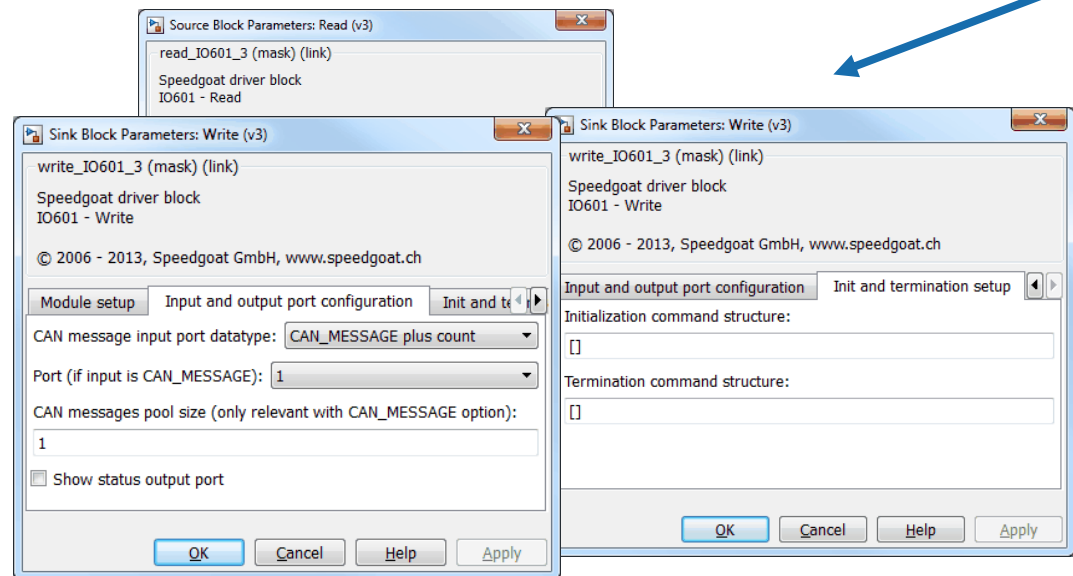
✓ Connect I/O ports of driver blocks with your design

Speedgoat and Simulink Real-Time drivers

Connection with EyeQ chip, and vehicle buses

✓ Configure I/O and protocols settings through dialog fields

✓ <u>Automatically</u> create and run a real-time application from your Simulink model on the target machine
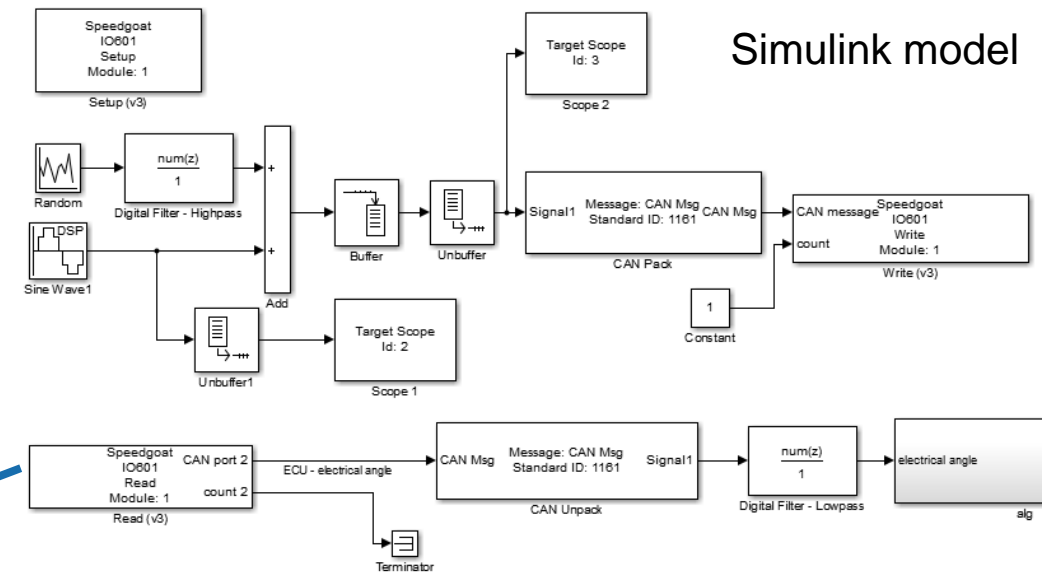
Simulink model

Application instrumentation with Simulink Real-Time

Simulink Real-Time Explorer

- Manage and control Real-time target machines and applications

- Rapidly build instrument panels (GUIs)

- Leverage panels to tune parameters in real-time

External mode

- Dynamically tune parameters directly in your Simulink model using external mode

Scopes

- Monitor signals on a screen attached to your target machine with target scopes

- Monitor signals using host scopes

- Log data on the target machine, for post real-time execution analysis, using file scopes

Stand-Alone Operation

- **Embed real-time applications**
  Simple: Simply select standalone mode

  Normal mode: Target machine is connected to development computer with Ethernet cable, application parameters are dynamically tunable during real-time runs
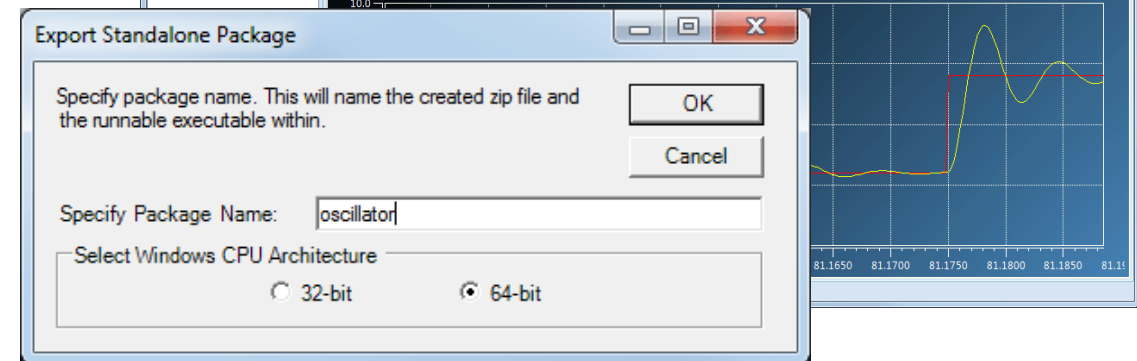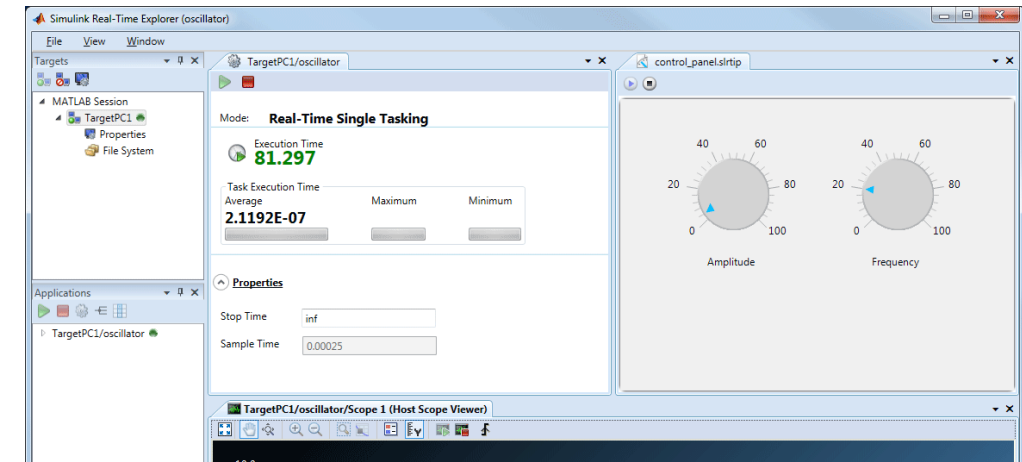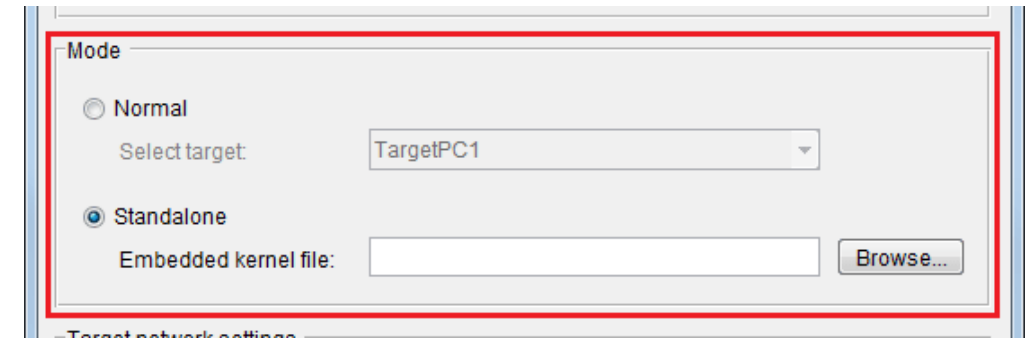
  Standalone mode: Real-time application and real-time kernel are combined to a single executable. Applications starts at power-up of target machine

- **Standalone User Interfaces**
  Run Simulink Real-Time Explorer in standalone mode, or leverage C or .NET APIs

- **Royalty Free**
  One license, many target machines

Value Contribution

"With the Speedgoat system, changing parameters and tuning the system is very easy and straightforward. It saves us a lot of time."

"There is no need to re-compile and burn each new version of the control algorithm."

Eyal Bagon
Senior Director Autonomous Vehicle
Mobileye

Eyal Bagon while **not driving** the car

# User Story Examples - Developing Complex Products meeting Future Demands

Proterra, Greenville, SC, USA
Zero-Emmission Battery Electric Bus
Hardware-in-the-Loop simulation

Levant Power, Woburn MA, USA
Energy neutral active suspension system
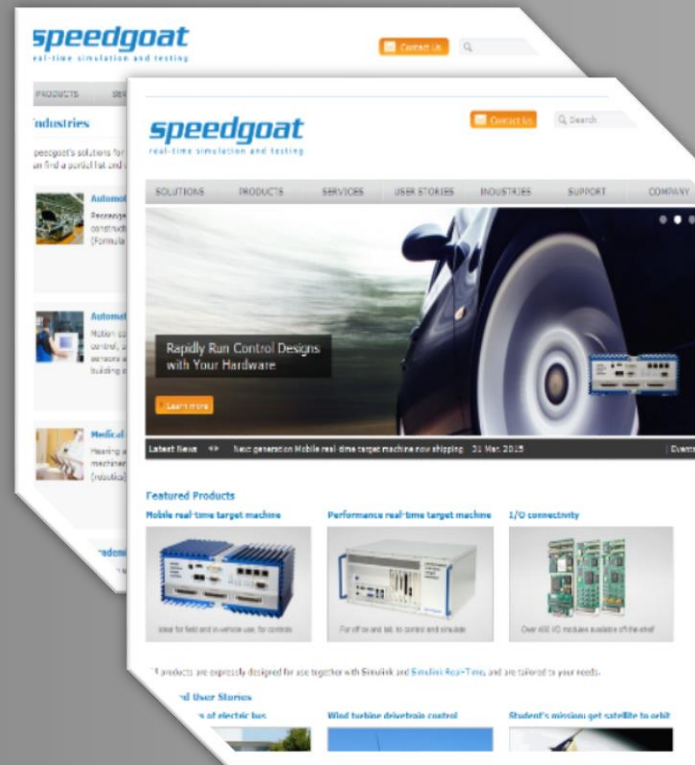In-vehicle Rapid Controller Prototyping

AGCO, France/Germany/USA
Agricultural vehicles with most energy
efficient gearboxes
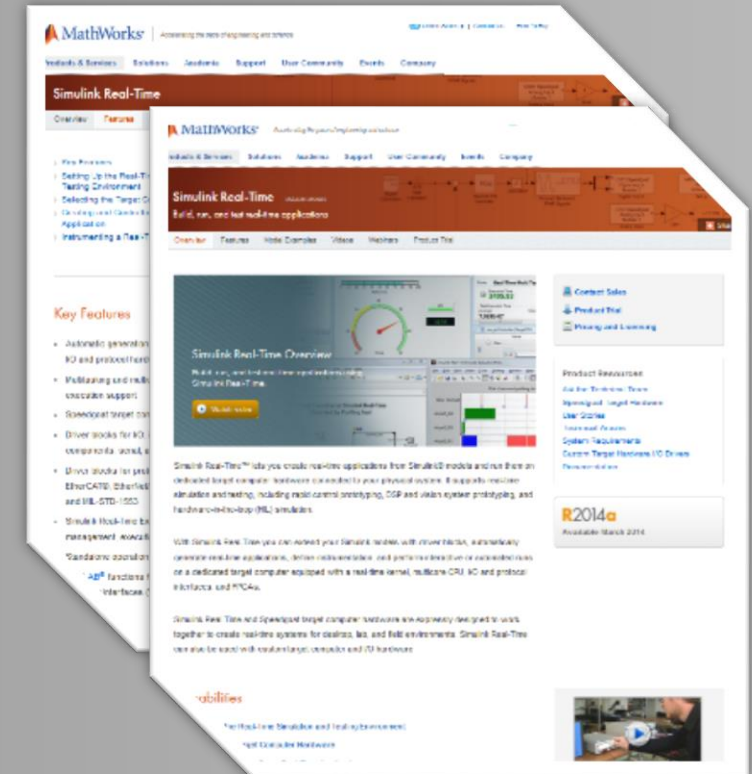Hardware-in-the-loop simulation

www.speedgoat.ch/userstories
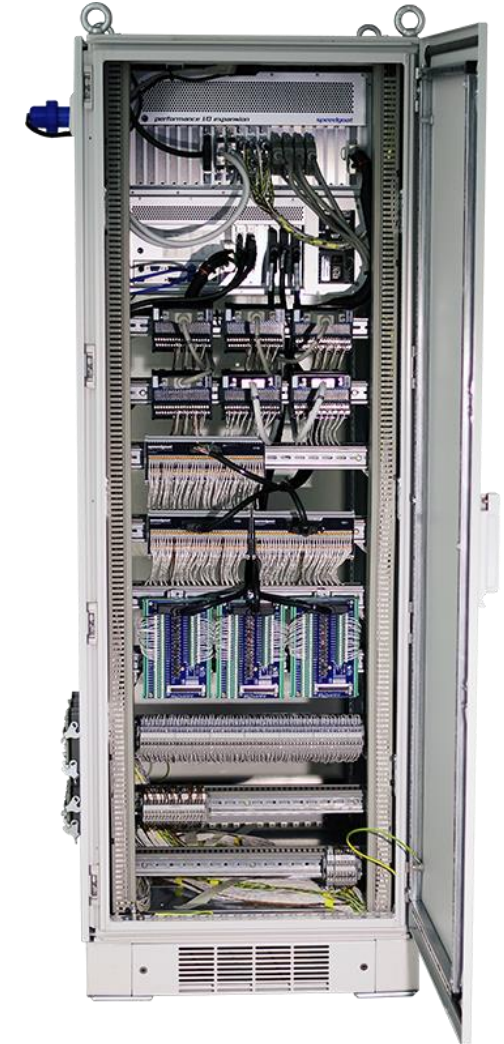
Resources and Contact Information

Meet us at our booth

www.speedgoat.ch

www.mathworks.com

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