University of West Bohemia

Department of Cybernetics

Sections:

- ## Automatic control
  - robotics, predictive control, advanced PID algorithms, PID autotuning, mechatronic models, HW design for embedded control

- ## Information and control systems
  - advanced information systems, energy systems operation, modeling and analysis of biological data

- ## Artificial intelligence
  - audio-visual speech recognition and synthesis, sign language recognition and synthesis, computer vision

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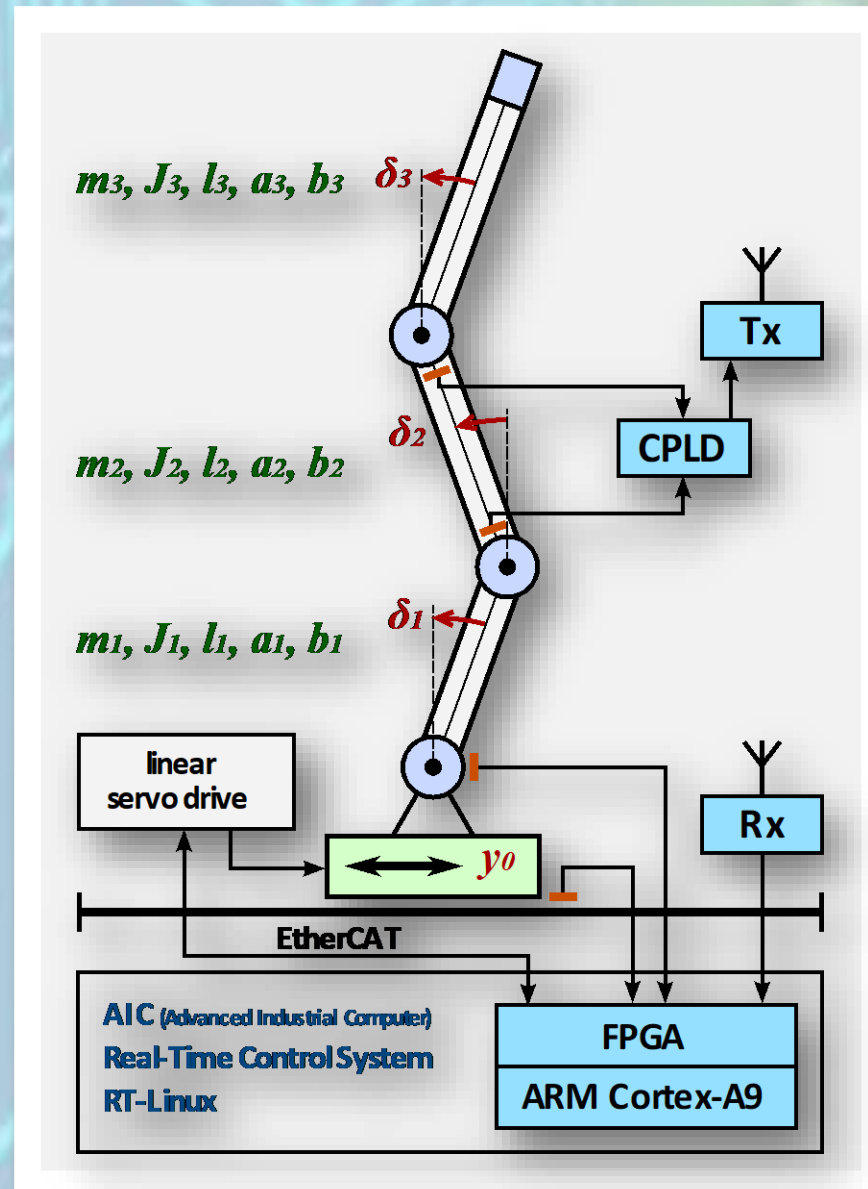OF WEST BOHEMIA

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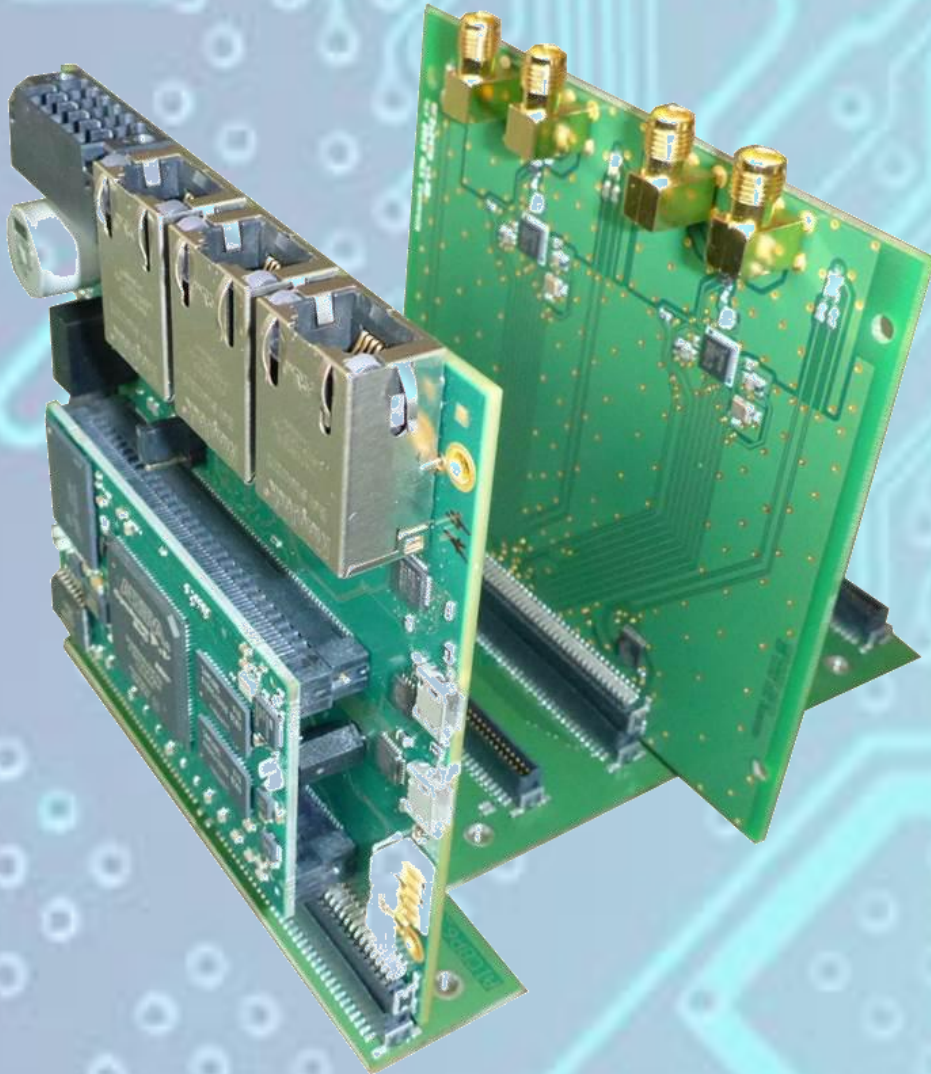# Triple inverse pendulum
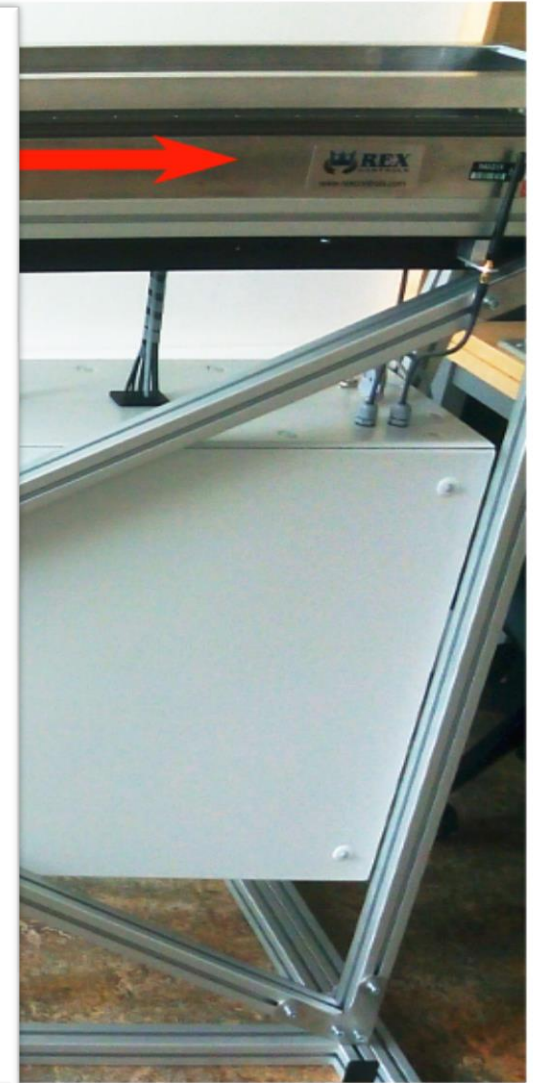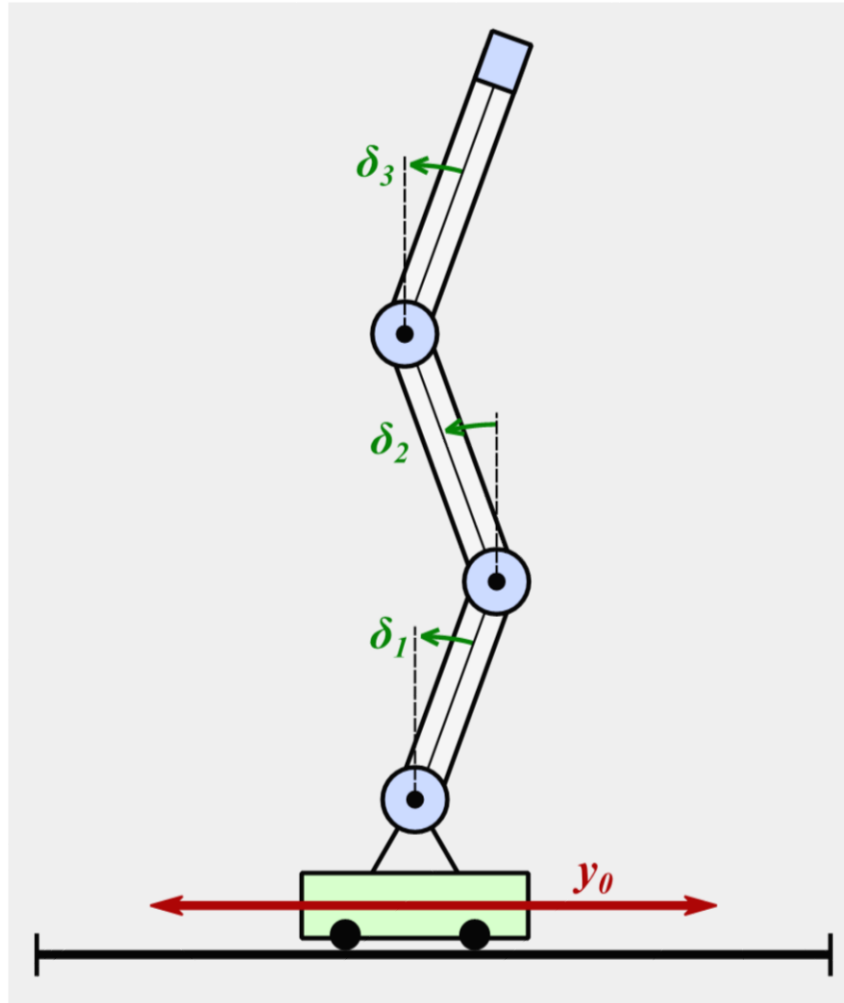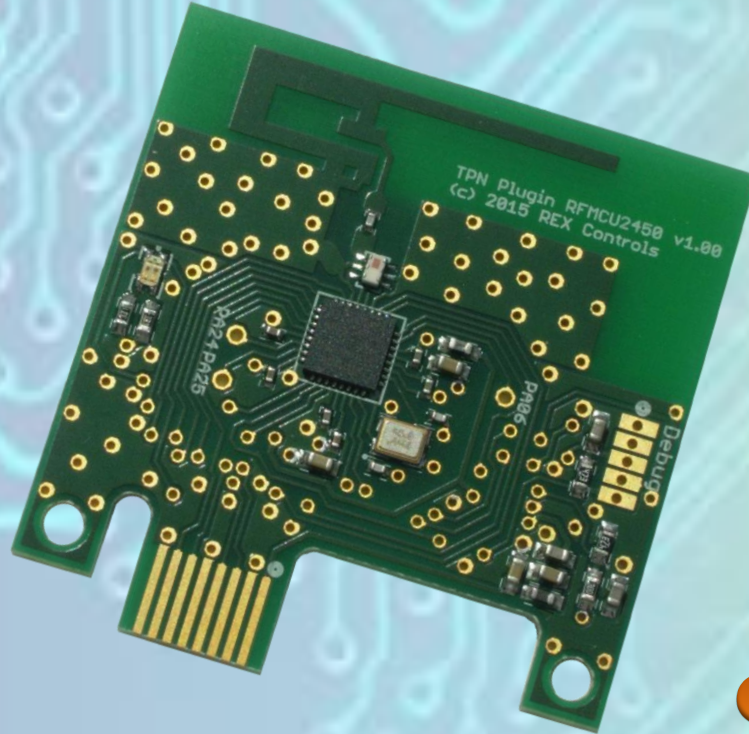
Pendulum in action

Triple inverse pendulum

AIC – Advanced Industrial Controller

- **Modular system – backbone bus board with slots for plug-in cards**

- **Processor card – Altera Cyclone V (FPGA + 2x ARM Cortex A9)**

- **RF card – 2x 802.15.4. transceiver based on Atmel AT86RF233**

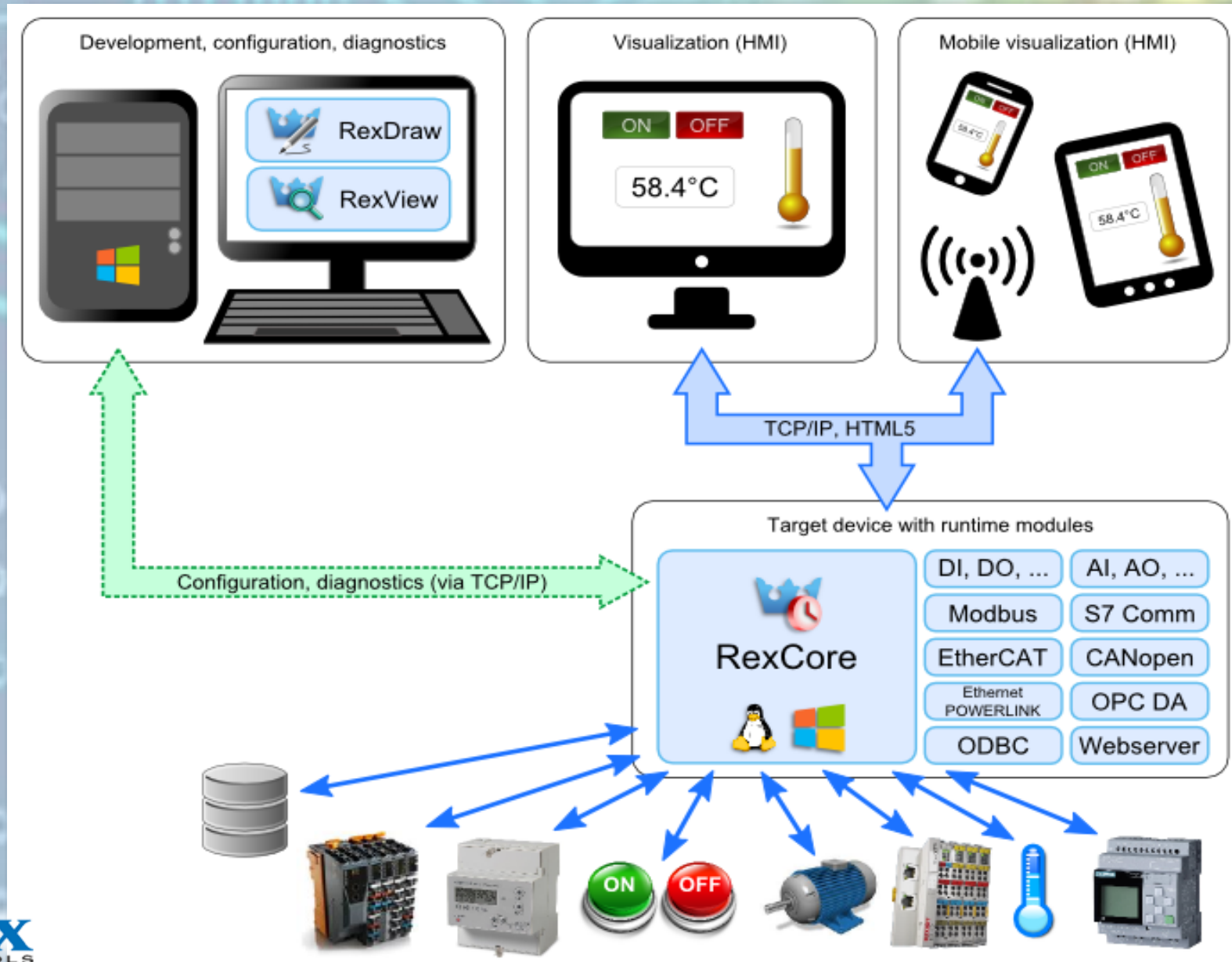- **Many other IO plug-in cards**

Pendulum RF node

HW

- Based on Atmel SAM R 21 (ARM Cortex M0 MCU + 2.4 GHz 802.15.4 RF transceiver)
- PCB antenna

SW

- Unidirectional transmission: retrieves position data from the incremental sensors and periodically transmits them
- Transmission period 800 µs

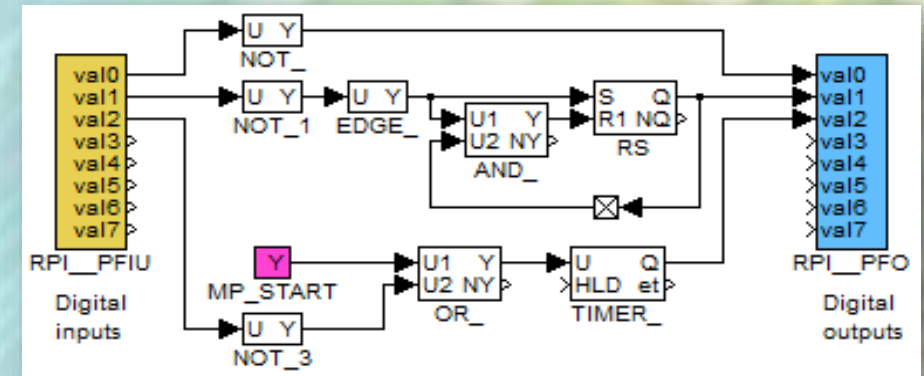# REX real-time control system

REXDraw

- **Graphical design of the control algorithm**

- **Linked with Matlab**

- **Lots of sophisticated blocks:**

  o **PID regulators, autotuners**

  o **Motion control (inverse kinematics)**

  o **Custom scripting**

Computer Vision in Automatic Control

- **Sophisticated systems for visual sensing, visual control and visual servoing**

- **Tight integration of computer vision and automatic real-time control**

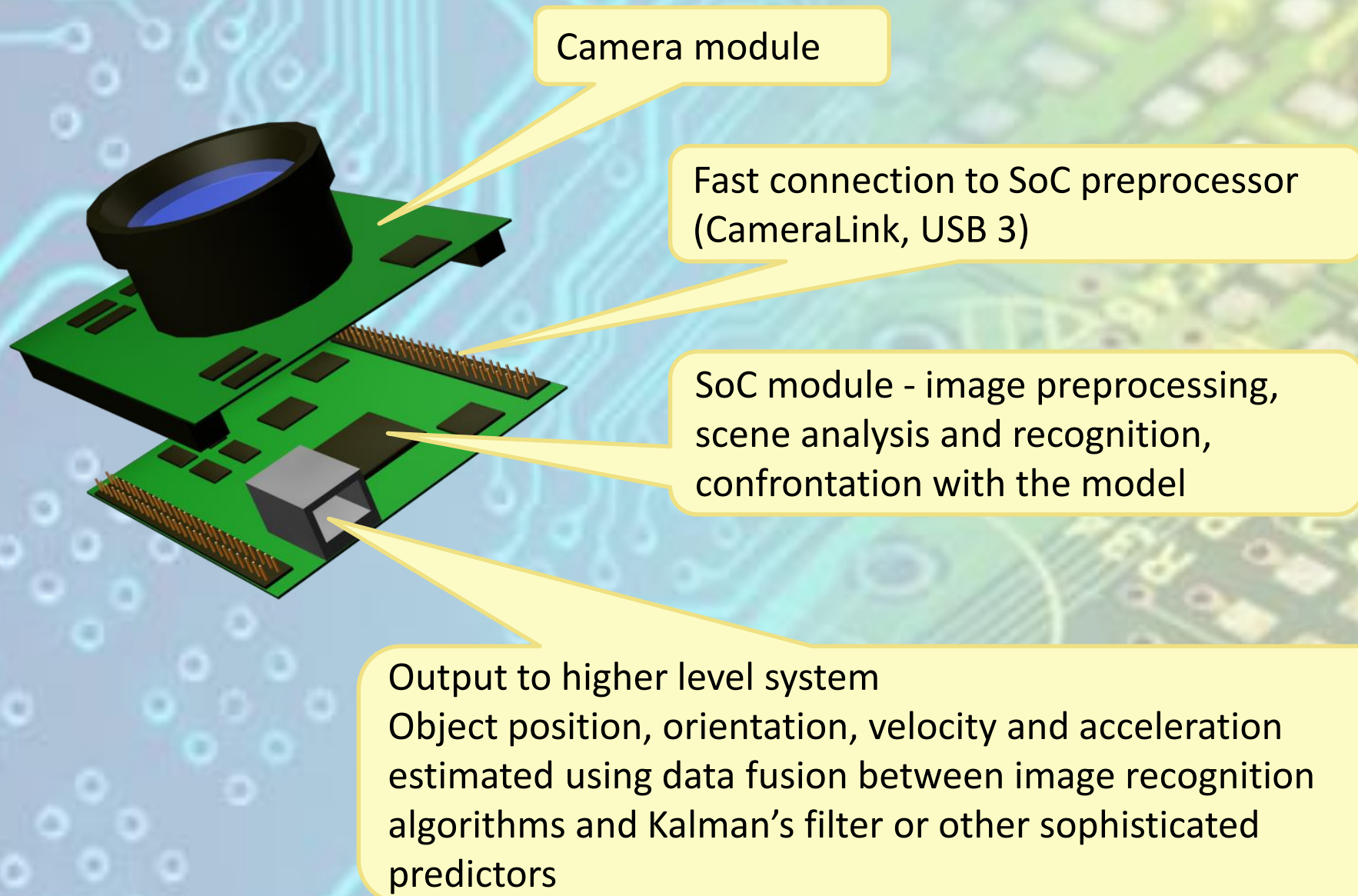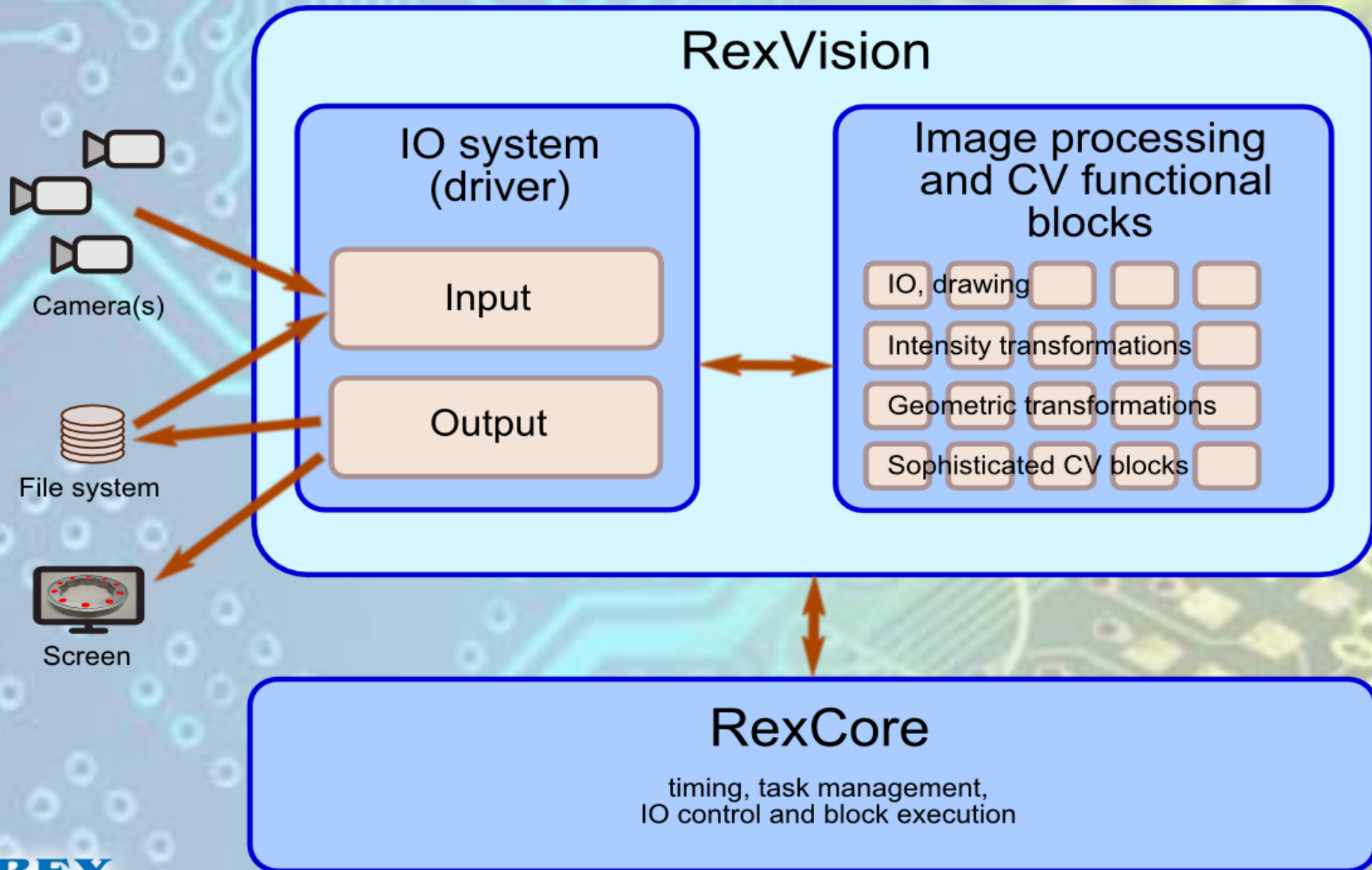- **Both single camera systems (2D, pseudo-3D) and stereo/multiple camera systems (3D)**
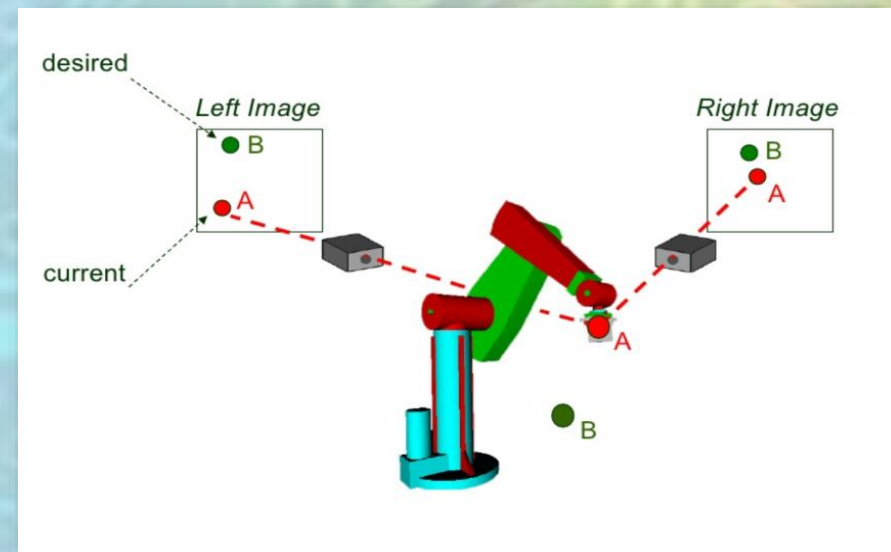
Goals

- ## Smart Camera Sensor
  - image acquisition and processing device with integrated intelligence focused on object tracing and motion control
  - simple output comprising location, orientation and speed of the observed object

- ## RexVision
  - flexible and highly configurable platform for automatic control with native support of computer vision
  - tight integration of computer vision and control algorithms
  - plug-in component for real-time control system REX
  - control design configurable using block schemas (Simulink)

SCS structure

Camera module

Fast connection to SoC preprocessor (CameraLink, USB 3)

SoC module - image preprocessing, scene analysis and recognition, confrontation with the model

Output to higher level system
Object position, orientation, velocity and acceleration estimated using data fusion between image recognition algorithms and Kalman's filter or other sophisticated predictors

REXVision structure

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Thank you

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