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Laboratory Furuta Pendulum Model FPM-211/210

General description

Laboratory Furuta pendulum model (rotary inverted pendulum) is intended for education and training in automatic control as well as for demonstration purposes. The model illustrates common tasks in automation and feedback control and provides hands-on experience. The kinematic system is underactuated, full-revolving motor-driven arm can be used to generate or suppress motion of the freely swinging and rotating pendulum.

The model is based on the REX control system, which processes the signals from sensors, implements control algorithms and commands the motor. The control algorithm is created by interconnecting individual function blocks in a graphical environment. The available function blocks are organized in libraries which cover not only all common areas of automation and feedback control, but also offer a variety of elements for developing advanced control algorithms. Special and unique algorithms can be implemented by utilizing a user-programmable block.

In case the Matlab®-Simulink® license is available, it is possible to benefit from its compatibility with the REX control system and simulate the developed control algorithm. In this way the algorithm can be tested and verified prior to deployment in real-time control system of the physical pendulum.

FPM-211

Control unit with a touchscreen LCD panel

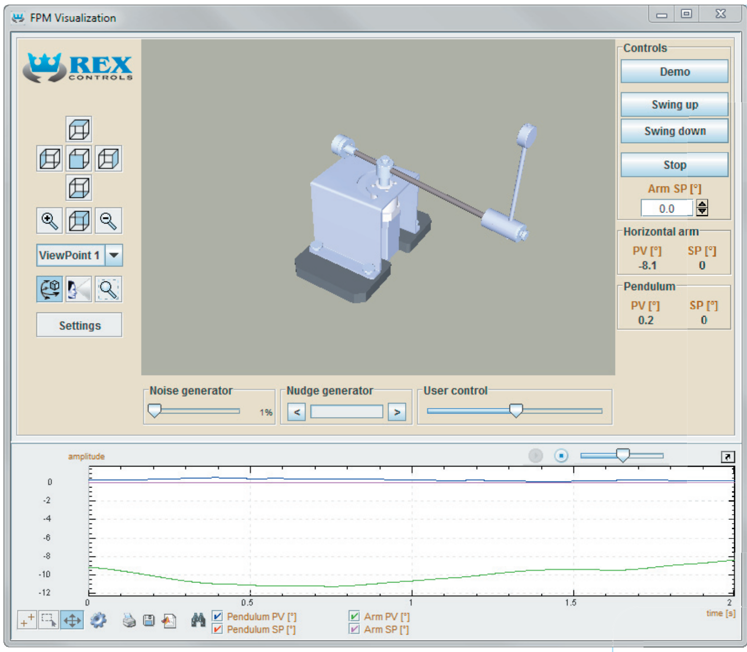
Laboratory Furuta Pendulum Model

FPM-210

Control unit for use with remote operator interface

Automatic control tasks

- Mathematic modelling of electromechanical systems
- Stabilization of an unstable system by PID or state feedback law (balancing the pendulum in the upper equilibrium)
- Damping of residual vibration using feedback control or input shaping filters (suppressing pendulum swinging)
- Design of state observer
- Velocity and position control
- Switching of control strategies
- Nonlinear control algorithms
- Practical examples: swing-reducing crane control, active vibration damping in structures, stabilization of a rocket during launch, jerk-free motor control, etc.

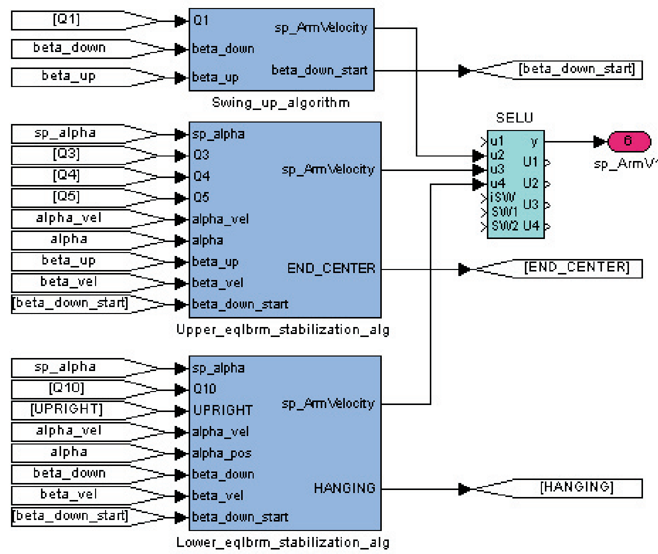


Visualization and control

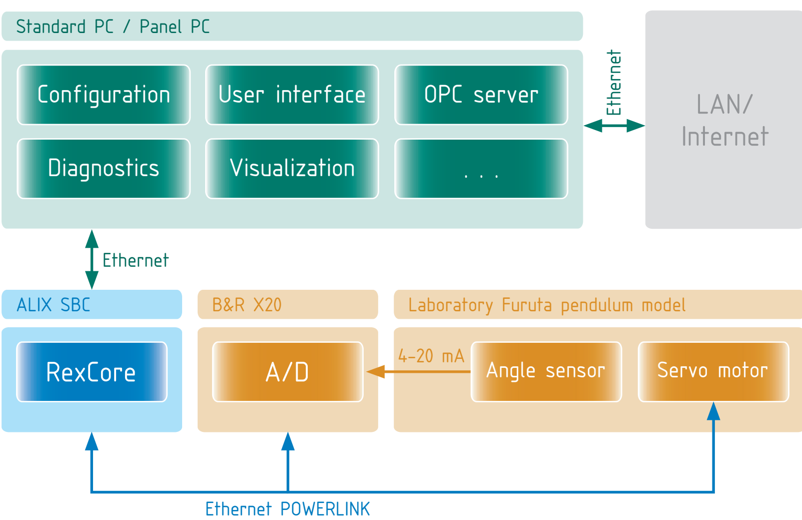
- Visualization using animated 3D model which follows the physical model in real-time
- Arbitrary viewing angle
- Developed in Java, based on open-source Java3D library, platform independent
- Adjusting the position of the arm in the horizontal plane
- Exporting the measured signals to CSV file

Programming

- Graphical programming of the control algorithms
- Function block libraries
- Control algorithm decomposition (pendulum swing-up, pendulum stabilization, anti-sway control, error state handling, etc.)
- On-line signal monitoring



Schematics of the model



Contents

- Rotary inverted pendulum model (including motor and cables)
- Control unit based on ALIX single board computer, powered by standard 230 V or 110 V AC
- Panel PC with touchscreen LCD (only for FPM-211)
- CD with software, demonstration algorithms and user manual including the Furuta pendulum mathematical model