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TeraSoft

ELECTRO-MECHANICAL

ENGINEERING CONTROL SYSTEM (EMECS)

EMECS is a set of electro-mechanical devices for control engineering research and education. EMECS consists of modular mechanical and electrical hardware such that a variety of control experiments can be easily constructed and are suitable for all level of instruction. It is also sophisticated enough to provide a platform for investigating a variety of control related problems such as system modeling, system identification, linear control, nonlinear control, optimal control, haptic control, intelligent control, and switching control to name just a few. In addition to hardware, Simulink blocks for the experiments are provided to help users in control design and simulation. Furthermore, in Simulink environment, xPC Target™ provides a high performance host-target environment that enables you to connect your Simulink® and Stateflow® models to physical systems and execute them in real time on Micro-Box 2000/2000C. xPC Target includes proven capabilities for rapid prototyping, hardware-in-the-loop testing, and application deployment in an open hardware architecture. The required hardware and software are given below.

Hardware Requirement:

- Micro-Box 2000/2000C with proper support of I/O boards (ADC/DAC/GPIO/Encoder)
- EMECS (Inverted/Double-Link Pendulum, Speed, Position & Force-Feedback control)
- DAC driver circuit
- Switching power supply
- RJ-45 crossover Ethernet cable

Inertial Load Control Tuner :

- Φ 60mm, Weight 75g
- Supports position/speed/haptic control mode

System Software Requirement:

- MATLAB (R2009a or latest version)
- Simulink
- Simulink Coder (Formerly known as Real-Time Workshop)
- xPC Target
- Stateflow and Stateflow Coder (recommended)

3rd Party - Software Requirement:

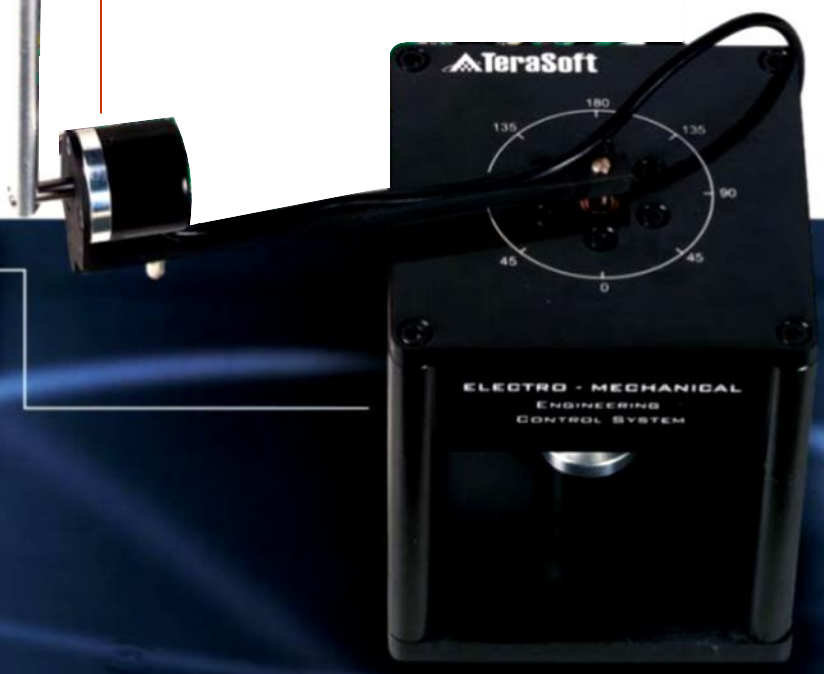
Choose one supported and compatible compilers for your system

- Microsoft Visual C/C++ V6.0 Prof. Edition
- Microsoft Visual C/C++ .NET 2003 V7.1 Prof. Edition
- Microsoft Visual C/C++ 2005 SP1 V8.0 Prof. Edition
- Microsoft Visual C/C++ 2008 V9.0 Express Edition
- Microsoft Visual C/C++ 2008 SP1 V9.0 Prof. Edition
- Open Watcom V1.7 (supported for use in C/C++ only)

Servo-Motor Module Link

Including both M5068-24V-6K motor and 500 Pulse/Rev Encoder.

• Link 1 : Rotary inverted Pendulum
  → Arm : length 16cm, Weight 60± 5g
  → Pendulum : length 16cm, Weight 25± 3g
  → Encoder : 500 Pulses/Rev. Weight 58± 3g



Servo-Motor Module

Weight: 3± 0.1kg

• Includes Servo-Motor and Encoder:
  → Encoder : 500 Pulses/Rev.
  → Servo-Motor (M5068-24V-6K)
    - Highest Efficiency : 5800rpm/1.6A/0.4Kgf-cm
    - Export Power : 31.5 Watt
    - Starting Injector : 1.8 Kgf-cm
• Flexible Control System:
  → Can also connect with other controllers

Distributed by:

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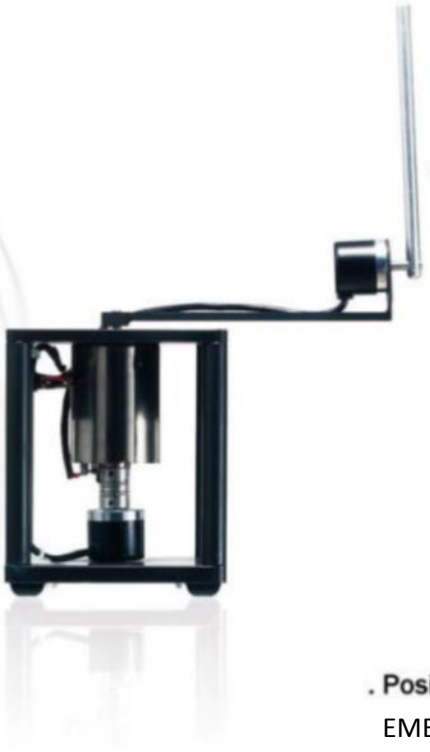


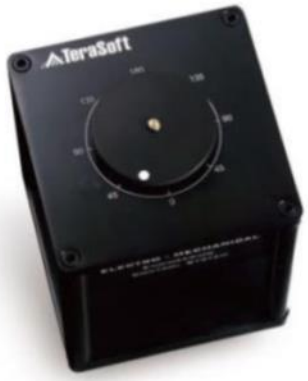
FUNCTIONS OF EMECS

. Swing up and balancing control of rotary inverted pendulum

A laboratory exercise is to configure EMECS as a rotary inverted pendulum. The rotary inverted pendulum is a highly nonlinear system. The control purpose of this experiment is to de-sign a hybrid controller for swing up and balancing control

. Position Control

EMECS can be configured to control a DC servo motor with an attached inertial load. A position control system is designed such that the output angle tracks a commanded position.



. Speed Control

EMECS can be configured to control the speed of a DC servo motor. The configuration is the same as that of position control above. A feedback controller is designed to regulate the speed of the output shaft and reduce the closed-loop steady state error.

. Haptic Control

The objective of this experiment is to establish the detent-action models for haptic control. Two Simulink models are provided and implemented on the servo motor module with the inertial load disc. The inertial load disc serves as a haptic knob. By turning the haptic knob, the user can feel the effects of the force-feedback of haptic detents.

STRUCTURES OF EMECS

Multi-Function Model Experiments

Experiment / Hardware	Servo-Motor Module	DSP-Target Controller	Link 1	Link 2	Inertial load Control Tuner
Swing up and balancing control of rotary inverted pendulum	√	√	√		
Position Control	√	√			√
Speed Control Mode	√	√			√
Haptic Control	√	√			√

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