## Features

- Non-linear, one-dimensional single-variable system with two actuators
- Inverted pendulum with one input and two outputs
- Fast, real-time control using microcontroller
- Implementing fuzzy algorithms
- Microcontroller-based development process for process control systems

The unstable "inverted pendulum" system acts as a mechanical single-variable system. The upright position of the pendulum is adjusted by two independent propeller drives and should be achieved quickly and if possible without overshooting. A fuzzy control will be developed and optimized for this purpose.

The inclination of the pendulum is measured by a potentiometer. The sensor supplies a crisp signal to the fuzzy controller, where the signal is transformed into a fuzzy input value and inferenced before being transformed back into a crisp output value. This output value controls the actuators, two propeller drives.

The learning contents of the experimental unit are extended by 'Controller Unit' that is more complex because of its two independent drives. Conducting the experiment makes high demands on the system optimization, as the two independent drives have to be tuned.

The control algorithms are initially written and simulated in the user-friendly development software FSH-Shell and then compiled to generate microcontroller code. The control strategy can be optimized at a later date.

Control algorithms are created, simulated and translated into microcontroller code in the user-friendly developer program.

## Specifications

- Non geared rotary platform/plant that constructed with servo motor as the main driver, and an encoder and link arm attached to the pendulum.
- Platform size 150 mm x 150 mm x 180 mm (L x W x H).
- Minimum speed of the drive motor is 5777 rpm.
- Minimum encoder resolution is 487 pulse/rev.
- Inverted pendulum as mechanical single-variable system, Single Input – Multiple Outputs
- 2 Independent motors for propeller drive as actuators
- DSP target controller consists of motor driver, ADC, serial communication interfaces, serial peripheral interfaces, digital I/O and PWM channels. It links the data from hardware to the programming software as well as creating the relevant library and codes for the software.
- System compatible and works on Labview software.
- Rotary potentiometer as pendulum inclination sensor

## Technical Specifications

- Inverted pendulum
- Length: 160mm
- Counterweight: 0.60 kg
- 2 drive motors
- 3,2V / 8A
- Microcontroller
- 8bit microcontroller
- 12-fold ADC 8bit
- Rotary potentiometer resistance value 5kΩ ±20%

## Experiment Possibilities

- Design of a fuzzy control for the unstable single-variable system: inverted pendulum
- Working with the development software
- Activating of two independent actuators that are coupled via the system
- Mastering of non-linearities in the system: inverted pendulum
- Mastering of non-linearities in the propeller drive
- Optimization of
  - Fuzzification
  - Rule base
  - Defuzzification with respect to stability
  - Velocity
  - Control quality

Note: Specifications are subject to change.

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