

DIDACTIC RECOMMENDATION COMPLETE FUZZY CONTROL COURSE

The method of fuzzy control is taught in gradual requirements and the learning content is systematically intensified using the units of the series RT 121 to RT 124. The experimental units are mechatronic systems in which the desired positions and angular positions can be reached as

quickly and as exactly as possible. The position or angular position that is reached is held constant against disturbances and any deviations are compensated for.



RT 121 Ball-on-Beam
Level 1 – basics: linear, one-dimensional single-variable model
RT 121 provides an introduction to fuzzy control. The knowledge gained with RT 121 is required for further experiments with the other units of this series.

- Introduction to the basic terms fuzzification, rule base, inference, defuzzification
- Working with the development software FSH-Shell
- Testing of a simple fuzzy control on a slow single-variable system
- Optimisation of parameters and online debugging



RT 122 Inverted Pendulum
Level 2a: non-linear, one-dimensional single-variable model

- Design of a fuzzy control for an unstable single-variable system with two separate rule bases for the outputs
- Two separate outputs with strong coupling
- Mastering of non-linearities on the actuator side
- More stringent system optimisation requirements



RT 123 Ball-on-Plate
Level 2b: linear, two-dimensional multivariable system

- Design of a fuzzy control for a multivariable system without coupling
- Method using two separate fuzzy controls for both directions
- Improved control characteristics by adopting the strategy of coupling both fuzzy control systems



RT 124 Carrier Vehicle with Inverted Pendulum
Level 3: non-linear, one-dimensional multivariable system with a strong coupling

- Design of a fuzzy control for an unstable multivariable system with a strong coupling
- Superposition of pendulum stabilisation and position of the vehicle
- Very high real-time demands
- Develop a strategy to decide what to do in case of conflicting requirements

Increasing problem complexity

FUZZY CONTROL: SOFTWARE

The individual processing steps of the fuzzy controller are shown using the fuzzy control for the ball-beam system (RT 121) as an example.

Fuzzification

The crisp input values for the position and velocity of the ball are assigned to linguistic terms. Mathematical models such as triangular and trapezoidal functions are used for this purpose.

Inference

The fuzzy input quantities are linked using a rule base and a result is determined.

Defuzzification

Finally, a triangular function is used to transform a fuzzy result back into a crisp output value. This output value is the manipulating variable for the actuator. In the case of an RT 121, the crisp output value is the speed for the motor. This motor changes the inclination of the beam.

