

Model-based Adaptation of Nonlinear Control by using Intelligent Indices in Detecting Operating Conditions

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Abstract: Fuzzy controllers can be converted to linguistic equation (LE) form by replacing the symmetric parts of the rules with linguistic equations where linguistic levels for error, error derivative and change of control are represented by linguistic values. The first direct LE controller was implemented in 1996 for a solar thermal power plant, and later the multilevel LE controller was installed for an industrial lime kiln and for a water treatment plant. A genetic tuning method has been improved by using the constraint handling method and the advanced nonlinear scaling. Intelligent indices, which provide information about changing conditions, are increasingly important in the LE control as they can be tuned recursively with generalised norms and moments. In the solar thermal plant, the control algorithm uses the minimum of three setpoint values defined by: (1) the operator, (2) the chosen working point and (3) the adapted working point. In this case, the working point is defined by the difference of the scaled values of the temperature increase over the collector field and the effective irradiation. Automatically detected cloudy periods reduce the need of manual control actions even in drastic changes of operating conditions by reducing temporarily the acceptable working point and the setpoint through it. The control system operates well even when the cloudiness is fluctuating heavily.

Keywords: adaptive control, nonlinear control, intelligent control, model-based control, fuzzy set systems, multivariable systems.
