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Delayed and Fractional-Order PI(D) Controllers for TDS Systems Tuned by Modern Parameter Optimization Methods

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Abstract:

Time-delay systems (TDSs) represent a family of systems with very complex dynamics characterized by an infinite spectrum, specific responses, and characteristics in time and frequency domains. The use of standard PI(D) controllers does not guarantee a sufficient control response in most cases.

The core idea of this PhD thesis is to extend the standard PI(D) structure with delays and/or fractional (i.e., non-integer) order of derivatives when controlling the TDSs. This can preserve the advantage of the PIDs having a relatively simple structure yet bring significantly broader possibilities for affecting the feedback control system dynamics compared to the standard scheme. Various optimization problems can be assembled when tuning the controller parameters. Despite a low dimension of the parameter space, the complexity of the TDSs dynamics brings about several constraints, multimodal fitness functions, or multiobjective specifications. These research tasks might be sufficiently solved via modern parameter-optimization methods, such as metaheuristics, etc.

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