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Non-smooth structured control design with application to PID loop-shaping of a process.

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Summary: Feedback controllers with specific structure arise frequently in applications because they are easily apprehended by design engineers and facilitate on-board implementations and re-tuning. This work is dedicated to H_∞ synthesis with structured controllers. In this context, straightforward application of traditional synthesis techniques fails, which explains why only a few ad hoc methods have been developed over the years. In response, we propose a more systematic way to design H_∞ optimal controllers with fixed structure using local optimization techniques. Our approach addresses in principle all those controller structures which can be built into mathematical programming constraints. We apply non-smooth optimization techniques to compute locally optimal solutions, and provide practical tests for descent and optimality. In the experimental part we apply our technique to H_∞ loop-shaping proportional integral derivative (PID) controllers for MIMO systems and demonstrate its use for PID control of a chemical process.

MSC:

93B51 Design techniques (robust design, computer-aided design, etc.)
93B36 H^∞-control
93B50 Synthesis problems
93C99 Model systems in control theory

Keywords:

non-smooth optimization; H_∞ synthesis; structured controllers; PID NP-hard problems

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