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Iterative Learning Control

Robustness and Monotonic Convergence for Interval Systems

Series: Communications and Control Engineering

- Shows the reader how to use robust iterative learning control in the face of model uncertainty
- Helps to improve the performance of repetitive electromechanical tasks, widespread in industry
- Provides a rounded and self-contained approach to the subject of iterative learning control not available elsewhere

This monograph studies the design of robust, monotonically-convergent iterative learning controllers for discrete-time systems. Iterative learning control (ILC) is well-recognized as an efficient method that offers significant performance improvement for systems that operate in an iterative or repetitive fashion (e. g. , robot arms in manufacturing or batch processes in an industrial setting). Though the fundamentals of ILC design have been well-addressed in the literature, two key problems have been the subject of continuing search activity. First, many ILC design strategies assume nominal knowledge of the system to be controlled. Only recently has a comprehensive approach to robust ILC analysis and design been established to handle the situation where the plant model is uncertain. Second, it is well-known that many ILC algorithms do not produce monotonic convergence, though in applications monotonic convergence can be essential. This monograph addresses these two key problems by providing a unified analysis and design framework for robust, monotonically-convergent ILC. The particular approach used throughout is to consider ILC design in the iteration domain, rather than in the time domain. Using a lifting technique, the two-dimensional ILC system, which has dynamics in both the time and iteration domains, is transformed into a one-dimensional system, with dynamics only in the iteration domain. The so-called super-vector framework resulting from this transformation is used to analyze both robustness and monotonic convergence for typical uncertainty models, including parametric interval uncertainties, frequency-like uncertainty in the iteration domain, and iteration domain stochastic uncertainty.

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