Beyond Time-Domain Iterative Learning Control

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1 Background: Iterative Learning Control

Iterative learning control (ILC) can significantly improve the performance in control applications by learning from past experiments. A mature framework has been developed in the past decades [1] for disturbances that are iteration-invariant acting on LTI dynamical systems [2].

2 Problem Formulation

Increasing requirements in applications, including precision mechatronics, lead to a situation where learning control is very promising, yet base assumptions in ILC are violated. Relevant examples that are fully addressed in this research include piezo-stepper actuators that subject to disturbances are reproducible in the position domain instead of the time-domain [3], and exploiting time-stamped data from incremental encoders leading to non-equidistant signals instead of quantization errors [4].

To address this, a new ILC framework is being developed where both theoretical and design aspects are fully commenced, in addition to its application on state-of-the-art applications

3 Initial Results

The developed ILC framework guarantees monotonic convergence towards a bounded set, an explicit characterization of this set can be computed. Initial results of this ILC framework that exploits time-stamped measurement data from incremental encoders is presented in Figure 1. In this figure it can be observed that the available error is nonequidistant in time. Moreover, each iteration the time instances of the available data are varying. Nonetheless the ILC algorithm is capable of reducing the error significantly, and monotonic convergence of the input signal u_j towards a bounded set is guaranteed.

4 Ongoing research

Future research focuses on extending the ILC framework to feedback control leading to a 2D system, modelling and synthesis aspects, and its application to a range of systems.

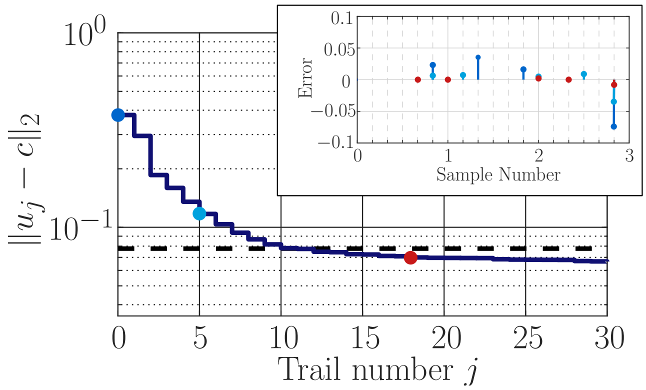

Figure 1: Norm of the input signal u_j when applying time-stamped ILC (—) and corresponding bounded set to which monotonic-convergence is guaranteed (- -). Error data obtained from trail 0 (●), 5(●), and 18 (●)

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References

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