What does learning control have to offer for your machine?

A lot! We will demonstrate it on industrial printers.

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Introduction

Improvements in motion control are a key step towards meeting tightening requirements on throughput and accuracy in future industrial machines. Typically, a combination of traditional feedback and feedforward controllers is employed, which remain fixed throughout the life-cycle of the system.

Learning control enables a significant performance increase over feedback and feedforward control by learning from past data, to anticipate and compensate for repeating components of the error. These disturbances include known setpoint signals and unknown disturbances, such as friction and hysteresis.

Although important progress has been made in theory and design of learning controllers, its full potential for industrial mechatronic applications is largely unexploited [1]. This is partly due to several former shortcomings of learning control. The aim of this work is to provide a concise overview of recent advances in learning control that are particularly tailored towards successful industrial implementation, and reveal to the interested reader what learning control has to offer for his/her particular problem at hand.

Recent advances in learning control

To guarantee successful implementation of learning control in various industrial environments, and to enable performance up to the limits of reproducibility, recent advances address the following key aspects:

- *Multivariable (MIMO) systems:* A new design framework for MIMO iterative learning control (ILC) and repetitive control (RC), see [2], allows motion control engineers to intuitively tune these MIMO controllers for robust stability and interaction through manual loopshaping control design, see [3].
- *Flexibility:* Breaking the trade-off between performance and flexibility (robustness) to non-repeating tasks in ILC [4], enabling optimal performance for, e.g., varying setpoints.
- *Modeling requirements:* Removing the requirements on models in learning control [5], [6], enables high- and robust performance through learning without having to estimate costly system models.

Demonstrations of recent developments

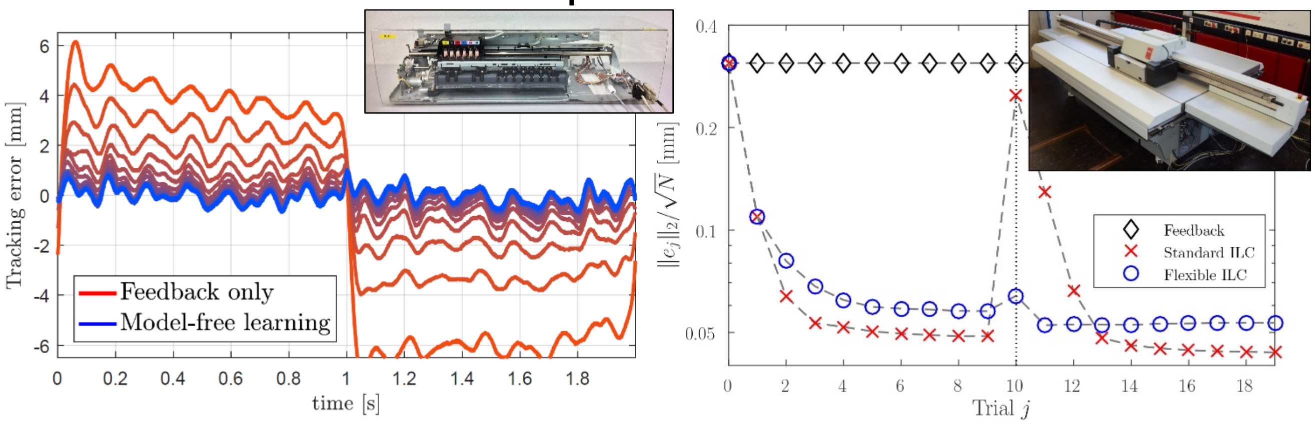

Figure 1: Experimental results using learning control: high performance can be achieved without using models (left), and robustness to non-repeating disturbances (in trial 10) is obtained using flexible ILC. (right).

References

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