Intelligent feedforward : increasing performance and extrapolation capabilities with iterative learning control

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Motion stages are the key components that often determine the throughput and production accuracy. Examples include robotic arms, printing systems, pick and place machines, electron microscopes, wafer stages, and additive manufacturing machines. To enhance the performance of these systems, the development of *intelligent* control techniques that automatically optimize the performance *per system* is highly promising, [1,2].

The majority of all motion systems have to perform repetitive tasks and can benefit from control techniques such as Iterative Learning Control (ILC). A key assumption in ILC is that the task of the system is invariant under the repetitions. As a consequence, the learned command signal is optimal for the specific task only.

This poster presents a new ILC algorithm that possesses extrapolation capabilities with respect to the task, see [1]. Significantly improved performance with respect to pre-existing techniques is demonstrated for a medium-loading drive of an Océ large format printer [3], see Figures 1 and 2.

Acknowledgments
This PhD research (2011-2015) is in collaboration with Océ Technologies (Venlo, The Netherlands). Printing systems are a prime example where learning control can effectively compensate for repetitive disturbances and tasks.

References

[1] Joost Bolder and Tom Oomen, "Rational Basis Functions in Iterative Learning Control - With Experimental Verification on a Motion System," IEEE Transactions on Control Systems Technology, to appear.

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[3] Bart Moris, Joost Bolder, Sjirk Koekebakker, Tom Oomen, Maarten Steinbuch, "Rational basis functions and Norm Optimal ILC: Applications to industrial setups," TU/e MSc. Thesis CST2013.112, 2013.

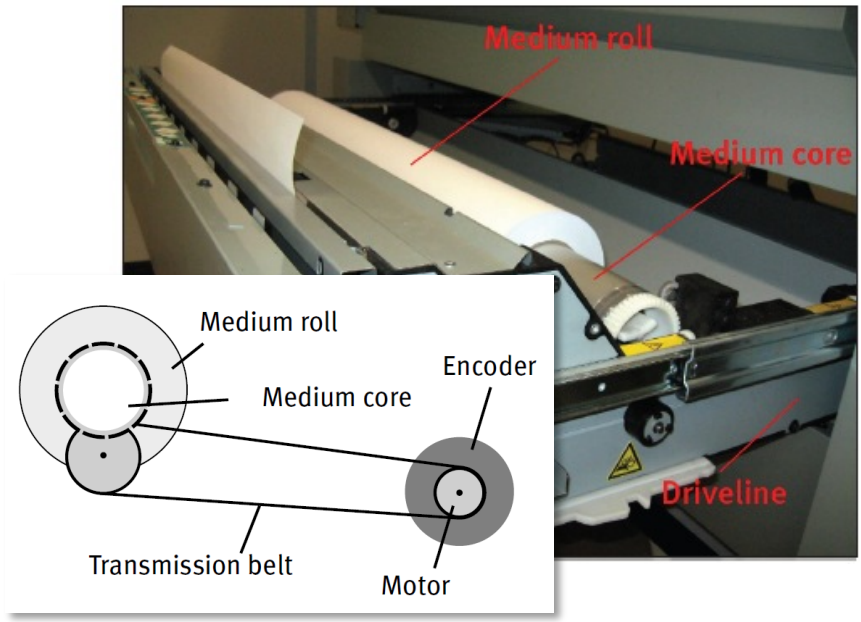

Figure 2: Overview of the medium-loading drive of a large format printer

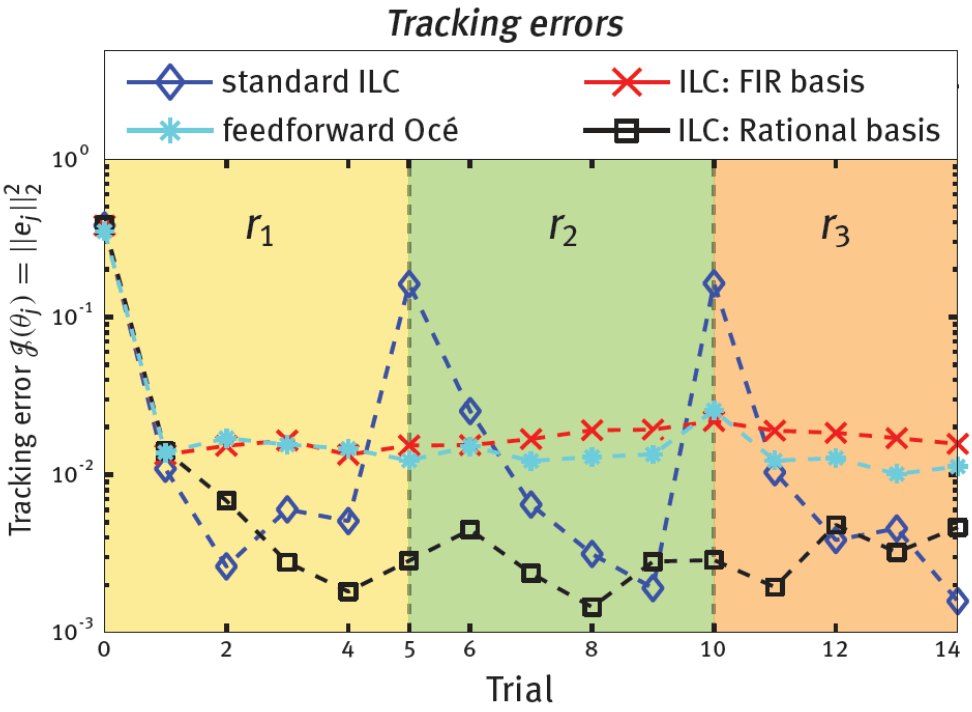

Figure 1: The proposed rational basis in ILC offers superior performance when the reference is changed from r_1 to r_2 and from r_2 to r_3, respectively.