Iterative Learning Control with Rational Basis Functions

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1 Introduction

Many high precision motion systems must perform repeating tasks that slightly vary. Feed forward techniques are often used to improve performance. Classical feed forward is a static calibration to compensate for known process dynamics and disturbances. Iterative learning control (ILC) is a technique which eliminates all repetitive disturbances by adapting the feed forward each repetition of the task. Classical feed forward works for any task, yet it does not take advantage of the repetitive character. Altough ILC does take this advantage, the tasks must be strictly identical, if not, transients in the feed forward may hinder practical usability. In order further to increase performance a control strategy is required that allows variations in the task and concurrently exploit the repetitive behavior.

2 ILC with rational basis functions

The block diagram in Fig. 1 shows the controller structure. The control loop consists of a standard linear feedback controller C that drives plant P with input u_j. The learning controller updates the parameters θ_j at the end of each trial j. The feedforward f_j is generated by filtering the reference r with $F(\theta_j)$, of which the structure has yet to be chosen.

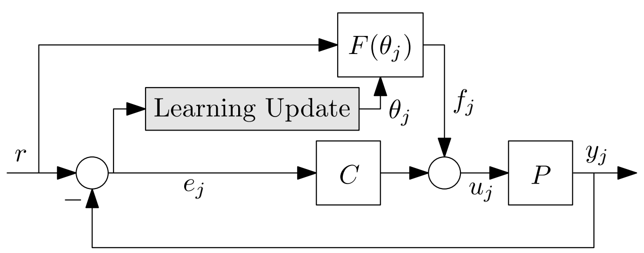

Figure 1: Block diagram of the controlled system.

In [1] a FIR basis for F is used, which fits in the ILC framework of [2]. In [3] a rational structure for F is proposed where the parameters are solved by a linearized optimization program, this introduces an undesired a priori unknown weighting on the tracking error. In this work we show that this changes the objective function and may lead to undesirable results. We propose a new approach by connecting the ILC problem to a class of identification algorithms [4, 5], leading to a first solution of the unweighted problem.

3 Application

The different strategies are applied to medium positioning in an industrial scanning inkjet printer, the system is depicted in Fig. 2. The drive has to perform a repeating task in which tracking performance is important.

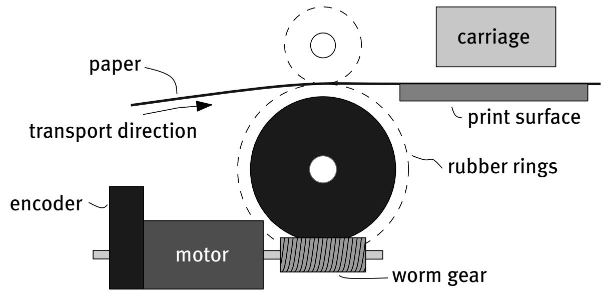

Figure 2: Medium positioning drive.

4 Simulation results and conclusion

Simulation results of the converged tracking errors are shown in Fig. 3. It shows that using PLR can yield smaller tracking error than when using the FIR basis or the linearized aproach.

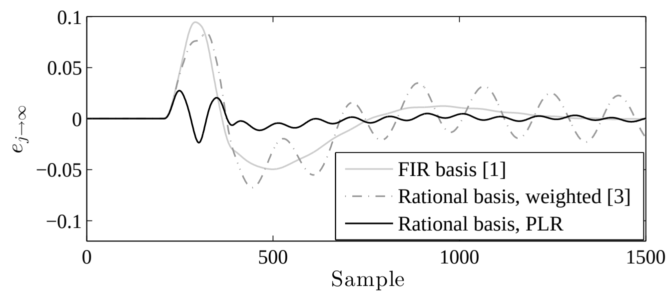

Figure 3: Converged tracking errors

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