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1 Introduction

Iterative Learning Control (ILC) is an efficient method to derive a feedforward signal for systems which follow the same trajectory repeatedly. Two kind of errors occur when following a trajectory; repetitive and non-repetitive errors. The derived feedforward signal only compensates for the repetitive part of the error. The non-repetitive errors deteriorate the performance of ILC [1].

The goal of the research is to develop a wavelet-based filtering method to filter out the non-repetitive part of the error signal and with this improve the tracking performance of ILC.

2 Disturbances in ILC

When ILC is applied to a system P with feedback controller C, the learning filter L is based on a model of the process sensitivity $S_P = P/(1+PC)$. Robustness against modeling errors is obtained by means of a filter Q. The feedforward update f_{k+1} is calculated from the error signal e_k as:

$$f_{k+1} = Q(f_k + Le_k) \tag{1}$$

The tracking error at iteration k for a closed loop system with input disturbance n_k and output disturbance d_k can be formulated, with the sensitivity $S = 1/(1 + PC)$ and the reference trajectory r, as:

$$e_k = Sr - Sd_k - S_P n_k - S_P f_k \tag{2}$$

Using Eqs. 1 and 2, the tracking error of iteration k can be calculated as a function of r, n_k and d_k. The resulting error equation depends on the disturbance signals of the current and the previous iterations. It can be shown that the disturbance signals of the last two iterations have the largest influence on the tracking error.

3 Wavelet filtering

Whereas in [2] the feedforward signal of ILC is filtered using a time-frequency analysis, this research focusses on the tracking error directly using a Discrete Wavelet Transform (DWT). The DWT uses an analysis wavelet filter bank to decompose the error signal into wavelet coefficients at various frequency bands [3].

The wavelet coefficients of the repetitive part of the error are equal for error signals of subsequent experiments, whereas the non-repetitive part results in different wavelet coefficients. The resemblance between the coefficients of various error signals is calculated using an error criterion. The coefficients which not do meet the error criterion are adjusted.

The adjusted wavelet coefficients are used in a synthesis wavelet filter bank to construct a filtered error signal. The reconstructed error signal is used as input for the learning algorithm of ILC (see Fig. 1).

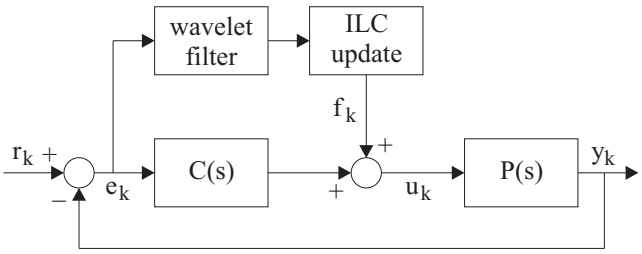

Figure 1: ILC scheme with wavelet filtering

The presentation will discuss the state of affairs in the project.

References

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