Compensating position-dependent disturbances in mechatronic systems: a new repetitive control framework with applications to a substrate carrier

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Abstract

Mechatronic systems such as printers, wafer scanners and piezo steppers, are often subject to position-dependent disturbances such as cogging, commutation errors or imbalances. Take as an example the substrate carrier as show in Fig. 1, which is one of the pilots within I-MECH [1]. This system consists of a rotating steel belt, that is driven by two rollers. The rotating nature induces disturbances that are repeating in the roller position domain, see Fig. 1. At constant belt velocities, the disturbance is periodic in time and can be effectively attenuated by repetitive control (RC) [2]. However, for arbitrary velocity profiles, position-domain disturbances in general are not periodic, hence RC is ineffective, in fact may lead to severe performance deterioration.

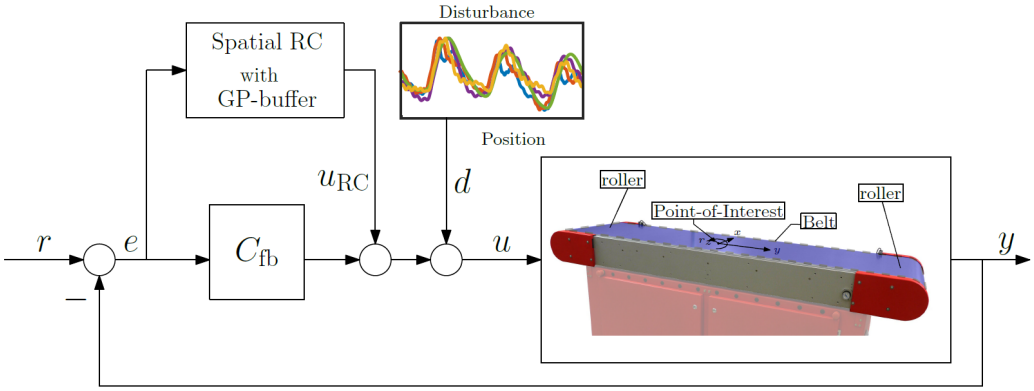

Figure 1: Spatial repetitive control framework for position-domain disturbances in the generic substrate carrier.

A new repetitive control approach with a Gaussian Process (GP) based buffer is presented, that effectively deals with position-domain disturbances. The key idea is to generate a disturbance model by means of a spatial buffer based on a GP, which enables direct incorporation of prior knowledge [3]. The method is successfully applied to the experimental setup.

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