Decentralized Control of Print Registration in Roll-to-Roll Printing Presses

Article

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Abstract

Roll-to-roll (R2R) manufacturing is a type of continuous manufacturing process extensively used to produce a wide variety of consumer products, such as plastics, paper, films, non-wovens, textile, etc. Recent advances in nanotechnology and material science have enabled the possibility of manufacturing electronics on a flexible substrate using R2R printing techniques. Even though the feasibility of printing electronics on flexible substrates has been extensively studied, continuous printing on a moving substrate using R2R techniques has not been adequately investigated. To facilitate progress towards high precision R2R printing, a systematic investigation of the various aspects that affect print quality and ways in which those can be influenced by different control configurations facilitated by choice and location of various components of the print section is necessary. In this paper we investigate two common control configurations for R2R printing based on the structure of the R2R print section and various components available for control. For these two configurations we develop a state-space model that contains both state and input delays. We propose a decentralized, memoryless, state feedback control law for both control configurations and show the stability of the closed loop systems using frequency domain delay-dependent stability conditions. These control configurations are evaluated and compared using model simulations and discussions on the effectiveness of each strategy are provided.

Link to the Article