

Modeling and Control of SMT Manufacturing Lines Using Hybrid Dynamic Systems[†]

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Abstract. In this paper we show how hybrid control and modeling techniques can be put to work for solving a problem of industrial relevance in Surface Mount Technology (SMT) manufacturing. In particular, by closing the loop over the stencil printing process, we obtain a robust system that can recover from faulty initial settings, adapt to environmental changes and unscheduled interrupts, and remove discrepancies associated with bidirectional printing machines. Moreover, a timed Petri net argument is invoked for bounding the control effort in such a way that the throughput of the system is unaffected by the introduction of the closed-loop controller. The soundness of the approach is verified on a real SMT manufacturing line.

1 Introduction

To close the loop around the Stencil Printing Process (SPP) in Surface Mount Technology (SMT) manufacturing has long been a desirable yet evasive goal in the industry [2, 7, 12, 15, 14]. By closing the loop it is envisioned that the system will recover from faulty initial settings, adapt to environmental changes and unscheduled interrupts, and remove discrepancies associated with bidirectional printing machines. However, the reason why this problem is particularly challenging is threefold. First, as of yet, no detailed process models have been derived [7, 12, 14], which implies that traditional, model-based control algorithms are of limited use. Secondly, the high noise levels in the process, combined with aggressive temporal variations in performance due to environmental factors such as humidity and temperature, make data-driven models unsuitable as a basis for

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