

CBIMMS Invited Seminar

“Precision Control for Micro-Scale Manufacturing”

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ABSTRACT

Established tools for the manufacture of systems with micro-scale features include standard lithography techniques. This talk examines a different method for microscale manufacture called Microscale Robotic Deposition (MRD). This is a solid freeform fabrication technique where by material is deposited to rapidly “build up” complex 3 dimensional structures. We will introduce current systems under construction that focus on the creation of periodic, lattice-like structures for their potential of acting as waveguides. This is a truly interdisciplinary research effort involving Materials Science, Manufacturing, and Controls. Each of these aspects will be highlighted briefly before focusing on the main topic of discussion.

The main topic of this talk centers on the control aspects of the MRD problem, particularly the precision motion control problem. The periodic nature of the systems under construction allow for the use of an Iterative Learning Control (ILC) approach to positioning problem. Iterative Learning Control utilizes information from a previous attempt at a task to update a feedforward signal and better the tracking performance on future attempts at the identical task. Most practical ILC designs incorporate some stabilizing filtering mechanisms to provide robustness to the learning process. In this talk we will extend that approach by introducing an adaptive filtering technique based on Time-Frequency analysis; this leads to an Adaptive ILC design. By identifying where high frequency system dynamics are evident, we are able to adjust a stabilizing filtering mechanism so as to circumvent the standard tradeoff between performance and robustness. In addition to presenting the adaptation algorithm, this talk will briefly discuss stability guarantees associated with the method.

The talk will finish by presenting several open issues associated with MRD as an overall manufacturing system.