CoCo Seminar Series
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3D Printing As a Complex System

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Engineering Building H-9 (Knoll-MacDonald Commons / Watson Commons)

Nowadays, 3D printing systems are used across a large number of industries for manufacture of a wide spectrum of products. For example, the printed-electronics industry – uniting two worlds of "printing" and "electronics" – has offered fabrication of electronic devices, components, and systems (such as batteries, sensors, antennae, photovoltaics, and flexible displays) with the utilization of 3D printing. Particularly, the additive deposition (printing) of functional materials on flexible substrates has enabled low-cost, large-scale fabrication of conformable and conformal products. In this regard, there are various printing methods, which allow us to selectively deposit and shape electronics with a desired level of resolution and integration.

In this talk, we review and discuss three main 3D printing systems used at Binghamton University as platforms for research on printed electronics, i.e., aerosol jet printing (AJP), inkjet printing, and dispenser printing. We primarily focus on aerosol jet printing, which has recently emerged as the process of choice for printing electronics in critical applications. This is, to a great extent, due to the fact that AJP allows for high-resolution, on-demand device fabrication with relatively-high reliability and integration. However, there are intrinsic process-material-machine interactions, which make AJP an unstable and complex process, prone to shifts in machine behavior and deposited material. We demonstrate how complex phenomena, such as ink temperature instability, solvent evaporation, and pressure buildup, lead to deterioration of print quality. Finally, we review novel methods proposed to mitigate the challenges of complexity in AJP process.

Roozbeh Salary is a Ph.D. candidate in the Industrial and Systems Engineering program at Binghamton University. His research interests include transport phenomena, computational modeling, and process control with a focus on advanced electronics manufacturing and energy systems.

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