Combining Image Detection and ML to Determine Defect Formation in Gravure Printing

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Gravure printing is a high-throughput, precision process drawing renewed interest for the production of low-cost, large-area, flexible electronics systems. It is compatible with a wide range of materials, including colloidal inks and low-molecular-weight polymers, and capable of sub-5 μm features at speeds greater than 1 m/s. Like most coating and printing methods, defects may manifest in various forms, such as particle aggregation, pinholes, ribbing, etc., that must be overcome with process understanding and informed tuning of the ink/substrate properties and process parameters. This study deploys established machine learning algorithms on a database of thirty-one process parameters and measured variables over 1600 print trials. In addition, we use micron-scale, high-speed flow visualization to help understand the underpinning physics of defect formation in gravure printing. The significance of various properties and parameters yields insight into the ink, substrate, and printing parameter combinations that yield defects. In combination with in-situ visualization, the results provide a connection between the complex capillary-hydrodynamics at play and the root-causes of printing process defects.