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Fluid Flow in Cell Printing MAZIYAR JALAAL, Department of Mechanical Engineering, The University of British Columbia, Vancouver, BC, Canada, ERIC CHENG, ALI AHMADI, KAREN CHEUNG, BORIS STOEBER, Department of Electrical and Computer Engineering, The University of British Columbia, Vancouver, BC, Canada — Inkjet drop-on-demand (DOD) dispensing of cells has numerous applications including cell-based assays and tissue engineering. In our experiments, using a transparent inkjet nozzle, high speed camera, and a shadowgraphy technique, we have observed three different characteristic cell behaviors during droplet ejection: 1) traveling toward the nozzle tip, 2) ejection from the nozzle, and 3) reflection away from the nozzle tip, where the reflection is an unwanted effect which contributes to the unpredictability of current cell printing systems. To understand the reflection mechanisms, we use numerical simulation to resolve the fluid motion inside the nozzle in presence of a cell during drop formation. For this purpose an adaptive finite volume method is employed. To track the interfaces (cell-liquid, gas-liquid) a volume of fluid (VOF) method is used, where the cell is modeled as an immiscible fluid droplet with different physical properties from the suspending fluid. It is shown that after a short period of time, a recirculation zone close to the nozzle tip is generated due to droplet pinch-off. This causes a reverse flow (velocity away from the nozzle) in the center of the nozzle. This dynamic flow field inside the nozzle causes a cell to show one of the three behaviors described above depending on its initial position. Moreover, it is shown that, depending on the size, deformability, and location of the cell, the drop formation process may be influenced.

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