Abstract

Microfluidic chips are being used to create cell cultures through controlled cell deposition. Because microfluidics manipulates small fluid volumes, it is challenging to identify the behavior of the particles in the flow. One method for identifying the flow dynamics in the system is known as micro particle image velocimetry (Micro-PIV). This method uses microscopic imaging components to view a fluid that is seeded with fluorescent particles. It is critical to have proper orientation between the microscopic camera, the microfluidic chip, and the laser which produces light for particle excitation and emission. Originally, the microfluidic chip was in a vertical orientation that prevented the objective lens from focusing on the flow field region of interest. A holder was designed that allowed the microfluidic chip to be in a horizontal position while preventing leaks. By obtaining the flow field velocity profile through this experimental setup, the flow can then be manipulated by introducing turbulence into the system. This allows manipulation of the path the particle takes as it moves through the microfluidic chip. The purpose of tracking the particles within the microfluidic chip is to determine whether the particles are depositing in the wells located at the bottom. Once the cells are deposited in the wells, the cells clump together to form 3D spheres. After the cell spheres are established, a chemical will be introduced within the media. Through **splicing** of the 3D spheres, the degree of how far the chemical had penetrated would be determined. Reasoning for using 3D cell spheroids and determining the depth of penetration for the chemical, mimics the reaction and process of what is happening in the human body. The goal of this research to design a prototype to create a 3D array of cancer cell spheroids based on cell deposition simulations and individual cell tracking and to determine if a chemotherapeutic can penetrate into the center of the spheroid to kill even the most resistant cells. This could aid with drug deliverance to help reduce negative effects on the rest of the human body.