JOURNAL OF PURDUE UNDERGRADUATE RESEARCH

STEM

## Performance Characterization of Microfluidic Peristaltic Pump Using Micro-Particle Image Velocimetry (μPIV)

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Lab-on-Chip (LoC) devices are on the verge of revolutionizing clinical diagnostics and point-of-care applications. These devices can integrate miniaturized laboratory functions (such as separation and analysis of components of a mixture) on a single chip using extremely small fluid volumes. For example, in the health care industry, an electrophoresis chip is fabricated for monitoring lithium in the blood of manic depressive patients, and a similar chip platform can also be used to measure sodium in urine, which is relevant for kidney patients. Microperistaltic pumps, as a LoC component, have received a fairly high attention, because they are responsible for routing the fluids in a complex network of microchannels. Microperistaltic pumps have many advantages—they are inexpensive to fabricate, simple in design, and robust in many applications, and they have provided an efficient means for sanitary fluid transport—and thus they are exploited in industrial peristaltic pumping.

This research investigated the performance of a microfluidic peristaltic pump in order to design a more efficient and optimized pump. A popular flow measurement technique called Micro-Particle Image Velocimetry (μPIV) was used as a methodological approach in this research to quantify the flow generated by the peristaltic pump. The EDPIV Software, a (μPIV) analysis tool, was used to analyze the flow of micro-channel inside the microperistaltic pump by generating synthetic images. The two critical parameters from EDPIV results, namely, time averaged flow rate and wall shear stresses, will be assessed in order to quantify the pump performance and optimality. In addition to the mentioned parameters, a shape of velocity profile and maximum velocity of the fluid will be obtained. A number of important parameters will be explored. The most important of these are valve sequence, control pressure, and pump frequency. These results will suggest important and thus far missing design rules for microperistaltic pumps so that an optimal (or nearly so) pump can be designed a priori rather than by trial and error.

*Research advisor Steven Wereley writes, "Hamid Zamenian has investigated the parameters that influence how fluids can be moved in microscopic devices (specifically called peristaltic pumping) with an eye toward optimizing these devices so that they can be used more efficiently or longer in handheld applications."*

Zamenian, H. (2015). Performance characterization of microfluidic peristaltic pump using micro-particle image velocimetry (μPIV). *Journal of Purdue Undergraduate Research, 5,* 97–98. http://dx.doi.org/10.5703/1288284315677