Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Providing biomimetic passive pumping on an implantable biosensor ALEC DRYDEN, MATTHEW BALLARD, Saint Martin's University — Microfluidic technologies have opened doors to rapid, inexpensive and compact medical diagnostic testing, with one important example being the glucose meter. Technology continues to evolve to continuous monitoring through mounting microfluidic devices onto the patient. A major hurdle in the development of on-body sensors is that they typically require flow of bodily fluids such as interstitial fluid or blood through the device. As a result, on-body sensors are typically bulky, requiring a pump and power source. We propose a solution for passive pumping on an implantable biosensor by mimicking nature's elegant solution to the problem – lymphatic valves. The lymphatic system pumps fluid using unidirectional flexible valves which open and close with fluctuations in fluid pressure, driven by contraction and expansion of surrounding muscle and of the lymphatic vessels. The ability of easily manufacturable bioinspired microfluidic valves to provide passive pumping in a low Reynolds number environment is explored through use of a fully coupled three-dimensional fluid-solid solver. High-aspect-ratio polydimethylsiloxane (PDMS) bioinspired valves, anchored to the microchannel floor, mimic lymphatic valves, opening and closing to allow forward flow and prevent backflow, respectively. The design's size scale, biocompatible materials, and reliance on biologically driven pressure gradients allow implantability and defeat the need for active pumping from an external source.

Alec Dryden
Saint Martin's University

Date submitted: 30 Jul 2019 Electronic form version 1.4