Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Selective pumping in a network: A novel bioinspired flow transport paradigm YASSER ABOELKASSEM, ANNE STAPLES, Virginia Tech — We present a new paradigm for selectively pumping and controlling fluids at the microscale in a complex network of channels, which we call "selective pumping in a network." The approach is inspired by internal flow distributions induced by rhythmic wall contraction phenomena in insect tracheal networks. The selective pumping concept presented enables fluids to be transported, controlled and directed into specific branches in networks while avoiding other possible branching routes, without the use of any mechanical valves. The results presented here might help guide efforts to fabricate novel microfluidic devices with improved efficiency for mixing purposes and targeted drug delivery applications. In this study, both theoretical analysis and Stokeslets-meshfree computational methods are used to solve for the 2D viscous flow transport in an insect-like tracheal network of channels with prescribed moving wall contractions. The derived theoretical analysis is based on both lubrication theory and quasi-steady approximations at low Reynolds numbers. The meshfree numerical method is based on the method of fundamental solutions (MFS) that uses a set of singularized force elements "Stokeslets" to induce the flow motions. Moreover, the passive particle tracking simulation

Yasser Aboelkassem
Virginia Tech

Date submitted: 03 Aug 2012 Electronic form version 1.4