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A biomimetic model for internal fluid transport based on physiological systems in insects YASSER ABOELKASSEM, ANNE STAPLES, Virginia Tech — Biomimetics is an increasingly important field in applied science that seeks to imitate systems and processes in nature to design improved engineering devices. In this study, we are inspired by insect respiratory systems, and model, analytically and numerically, the air transport within a single model insect tracheal tube. The tube wall undergoes localized, non- propagative rhythmic contractions. A theoretical analysis based on lubrication theory is used to model the problem at low Reynolds number. Results are then validated by performing meshfree computations based on the method of fundamental solutions (MFS). This meshfree numerical approach is then used to investigate the airflow in more complex geometries: a channel with multiple branching segments and various wall contraction regimes. This study presents a new biomimetic mechanism for valveless pumping that might guide efforts to fabricate novel microfluidic devices with improved efficiency that mimic features of physiological systems in insects.

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