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Insights into efficient laminar mixing from studies on the gastrointestinal tract SETH DILLARD, SREEDEVI KRISHNAN, H.S. UDAYKUMAR, University of Iowa — Many biological and engineered systems are dependent upon the efficacy of fluid mixing in the laminar flow regime. The physiological processes responsible for nutrient absorption and transport in the GI tract are prime examples of natural design optimization from which much can be learned and applied to designs of engineering interest. We have analyzed individual aspects of the GI tract, with particular focus on the junction between the stomach and intestine to quantify the effect of the anatomy and physiology of this segment on the mixing of nutrients with enzymes. An Eulerian levelset-based flow solver with Lagrangian particle tracking is used to computationally analyze fluid flow through several representative 2-D components of the antral-duodenal junction. Stretch rate maps and scalar species distributions illustrate how each individual anatomical feature and peristaltic contraction patterns contribute to mixing through vortex formation and shedding in the presence of pulsatile flow. It is shown that geometric irregularities and asymmetries, such as those found in biological systems, can lead to enhanced fluid mixing.

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