Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Mechanics-informed radiology, fluoroscopy, and endoscopy enabled by deep learning techniques[1] SOURAV HALDER, SHASHANK ACHARYA, GUY ELISHA, WENJUN KOU, JOHN E. PANDOLFINO, PETER J. KAHRILAS, NEELESH A. PATANKAR, Northwestern University — The functioning of many organs depends on their mechanical properties, and deducing these properties based on data from routinely used diagnostic techniques can help understand the "mechanical health" of an organ and to predict the future course of a pathology. Here we consider flexible tubular organs that are common in a human body, specifically, the esophagus. We develop a one-dimensional fluid-structure numerical model that predicts the shape of the tube, and the fluid velocity and pressure inside it. Using data from the fluid-structure model, we train a variational autoencoder (VAE) that generates a latent space. The model data gets clustered into different regions of the latent space. We find that the locations of the clusters, relative to each other, represent similarities and differences between the modes of bolus transport through the esophagus. The VAE also consists of a side network that we train to predict the physical parameters of the model. We also show that the trained VAE can be used with clinical data from MRI, Fluoroscopy, EndoFLIP (an endoscopy technique), and thus provide fundamental understanding of the underlying physics of various disorders of any flexible tubular organ.

[1]This work was supported by NIH Grants DK079902 and DK117824, and NSF Grants OAC 1450374 and OAC 1931372. Computational resources were provided by the XSEDE allocation TG-ASC170023 and Quest HPC facility at Northwestern University.

Sourav Halder
Northwestern University

Date submitted: 31 Jul 2020 Electronic form version 1.4