Generative Electrical Impedance Tomography from Multichannel Stethoscope Sounds

Iyer, Meera (School: James Logan High School)

Electrical Impedance Tomography (EIT) reveals lung function and helps diagnose many diseases. However, commercial EIT systems are expensive and bulky. Two-thirds of the world's population, especially in combat zones, do not have access to basic radiology services such as X-rays or EIT. However, stethoscopes are ubiquitous, cheap, and portable. This work proposed creating an AI method to generate EIT images from stethoscope sounds from multiple chest positions. A Variational Autoencoder (VAE) was created to map an EIT image to an embedding. Several convolutional neural networks (CNNs) and loss functions were tested to map Mel Spectrogram images of stethoscope sounds from multiple positions on the chest to EIT image embeddings, which were then passed through the VAE's decoder to generate EIT images. To evaluate the accuracy of generated images, a CNN was trained to detect diseases from real EIT images. The accuracy of the generated EIT images using the disease classification CNN was compared to that from real EIT images. Not only was the generated data visually similar to real EIT images, but they also produced similar disease classifications as real images. The highest relative accuracy was 87.5% and average accuracy was 81.6% across five data splits. This is the first work to propose EIT image generation from stethoscope sounds. Future work includes improvements in networks and training, building an affordable stethoscope vest with synchronized capturing of sounds from multiple positions on the chest, and training a network to generate EIT images from the sounds.