

Unlocking the Power of Pixels with AI

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Abstract

Routinely acquired medical images contain far more information than is currently used in clinical practice. This talk presents a series of studies that leverage deep learning and AI foundation models to extract this latent signal from computed tomography (CT) and chest radiography for disease diagnosis and cardiovascular risk prediction. We first focus on low-dose CT from lung cancer screening, where many participants also face elevated cardiovascular disease (CVD) risk. Using NLST data, we developed Tri2D-Net, a deep learning framework that integrates multi-view CT representations with clinical factors to predict CVD presence and CVD mortality. Tri2D-Net outperforms CAC-based and prior deep learning approaches, and its attention maps highlight cardiac structures and calcifications that align with clinical expectations, demonstrating the potential of opportunistic CVD risk assessment from existing CT scans. We then turn to chest X-ray, the most widely used imaging exam worldwide. I will describe large-scale CXR pretraining and the development of a chest X-ray foundation model that supports disease classification, CVD risk estimation, and mortality prediction, with interpretable saliency patterns. I will close by briefly highlighting emerging work on 3D-aware “world models” that infer CT-like structure from routine radiographs, and by discussing key technical, clinical, and ethical challenges for deployment.