# DeepValve: the first automatic detection pipeline for the mitral valve in cardiac magnetic resonance imaging

Giulia Monopoli, Daniel Haas, Nickolas Forsch, Vajira Thambawita, Gabriel Balaban, Mary M Maleckar

Simula Research Laboratory
Oslo, Norway

**Background**: Cardiac magnetic resonance (CMR) imaging is a pivotal tool for non-invasive diagnosis of MV diseases. Despite significant progress in deep learning (DL)-based segmentation, application for automated MV detection is a key opportunity for enhanced MV disease diagnostics. **Objective**: The objective was to develop a DL-based pipeline for the precise detection of MV from CMR. **Methods**: Our dataset comprises 82 CMR patient scans with confirmed MV disease, totaling 120 annotated images. Our automatic detection pipeline for the MV, which we named DeepValve, employs established U-Net architectures for regression and segmentation analysis; and proposes a novel hybrid model, adapting the Differentiable Spatial to Numerical Transform (DSNT) module within a U-Net framework to CMR. Performance is assessed using root mean squared error, Dice score, intersection over union, and Procrustes-based metrics, for comprehensive evaluation of position and shape of detected MV structures. **Results**: DeepValve effectively captures MV anatomy in CMR images. The custom loss function in the hybrid DSNT model yields improved detection sensitivity. **Conclusion**: DeepValve marks the first use of DL for MV detection in CMR, introducing a hybrid strategy integrating segmentation and regression, enhancing prediction quality and presenting a significant step towards automated MV assessment using DL in CMR.