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A Method for Automatic Echocardiogram Segmentation

Lightweight algorithm for real-time LV boundary mapping without training datasets.

Researchers at Purdue University have developed a method (an algorithm/software) to perform robust and accurate unsupervised echocardiogram segmentation. B-mode echocardiography is used to image the left ventricle (LV) of the heart. The measurements of LV shape and function obtained in echocardiography require an accurate segmentation of the LV boundary. Shape prior and deep-learning methods have been used to establish the boundary; however, the methods have high computational costs and need large training datasets. The computational time associated with these methods limits the segmentation capabilities to specific parts of the cardiac cycle. The Purdue researchers' software does not require any datasets to train the model for accurate predictions. The software detects the image features from each image, identifies a connected path of the features using user-defined feature points, and consolidates the connected paths into a resulting set of coordinates. Due to the low computational costs of this method, it allows segmentation throughout the cardiac cycle and assessment of time-varying trends. The method is also capable of analyzing both B-mode and color doppler echocardiograms, both common images obtained in transthoracic echocardiography. Along with the LV, the software can be used for segmentation of the pupil.

Publication: M. C. Brindise, B. A. Meyers, S. Kutty and P. P. Vlachos, "Automated Peak Prominence-Based Iterative Dijkstra's Algorithm for Segmentation of B-Mode Echocardiograms," in IEEE Transactions on Biomedical Engineering, vol. 69, no. 5, pp. 1595-1607, May 2022, doi: 10.1109/TBME.2021.3123612.

Technology Validation: Validation testing with real patient data has shown that this method accurately detects pathological changes in patients with Hypertrophy Cardiomyopathy and Dilated Myopathy.

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Category
Medtech & Digital Health/Medical Image Processing
Medtech & Digital Health/AI in Medical Imaging

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Advantages:

- Automatic

- Low computational costs

- Provides segmentation of desired feature across time

- No training of software required

- Works with different imaging systems and vendors

Applications:

- Segmentation of LV or pupil for flow analysis or to manufacture an in vitro model for experimental testing

- Segmentation for detection of congenital heart defects in children, cerebral or aortic aneurysms, stenotic arteries, and more

TRL: 3

Intellectual Property:

Provisional-Patent, 2020-03-11, United States

Utility Patent, 2021-03-11, United States

Keywords: Biomedical Engineering, Cardiac Imaging, Cardiovascular Disease, Computational Fluid Dynamics (CFD), Diagnostics, Image Processing, Imaging, Segmentation