Computer Aided Measurement of Cardiac Features in Medical Images

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Technology description

Inventions
Semi-automatic algorithm for rapidly and accurately finding edges of one tissue encompassed by another, including partial volume voxel estimation at the edges
Software that executes the algorithm to measure ejection fraction from MR images
Specifically, the improvement allows for faster, more accurate, and more consistent semi-automated measurement of blood at the edge of the ventricle cavity.
Current approaches overestimate the amount of blood because they tend to overestimate voxels that contain both cardiac tissue and blood. This overestimation is a particular problem in patients with low EF, where the missed volume can be a significant percentage of the total. Ejection fraction is relied upon to determine whether a given patient is healthy enough to undergo strenuous treatments, such as surgery or chemotherapy, so the small difference can matter a great deal in treatment planning and outcomes.
MR is an up and coming modality for diagnostic imaging tests of the cardiovascular system. MRA does not submit the patient to radiation, images soft tissue better than any modality, and is about 10 times cheaper than other modalities ($700 for MRA vs $6K for standard angiography).
However, the resolution is not as high as conventional angiography. This low resolution exacerbates the already-difficult issue of handling edges when measuring the amount of blood in the ventricle.
The Cornell algorithm, dubbed LVMETRIC, specifically deals with the problem of resolution by application of a known technique called soft segmentation, which is one of several techniques within the field of image segmentation algorithms. Other segmentation algorithms generate regions with clear boundaries and apply a binary value to a given region - they are "hard"; in soft segmentation regions or classes are allowed to overlap, and are subsequently valued and weighted, avoiding loss of information caused by binary classification.
Ejection fraction, blood volume, myocardial mass and cardiac output are measured for patients with the following conditions, to assess disease and track treatment efficacy:
coronary artery disease
heart valve lesion
myocardial infarction
congestive heart failure

patients who will or have undergone percutaneous transluminal coronary angioplasty, coronary artery bypass graft surgery, open-heart surgery
patients who will or who are undergoing chemotherapy
The algorithm is extendable to other imaging modalities (e.g. ultrasound) and to measuring other tissues that are encompassed (eg solid tumors).

Institution

Cornell University

Inventors

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