# MRI-Based Quantification of Myocardial Perfusion at Rest and Stress using Automated Frame-by-Frame Segmentation and Non-Rigid Registration

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The quantification of myocardial perfusion relies on manual tracing of myocardial regions of interest (ROIs) and repositioning the ROIs frame-by-frame throughout the contrast-enhanced image sequence. This tedious and potentially inaccurate methodology hinders widespread clinical use of imaging-based quantification of myocardial perfusion. Accordingly, we developed a technique for automated identification and registration of myocardial ROIs from cardiac magnetic resonance (CMR) images as a basis for perfusion quantification. Our approach uses region-based and edge-based level set techniques for endocardial and epicardial border detection combined with non-rigid registration, which is achieved by a 2D multi-scale cross-correlation and contour adaptation (fig., left). This approach was tested on 66 short-axis image sequences (Philips 1.5T) obtained in 11 patients at rest and during regadenoson stress at 3 levels of the left ventricle during first pass of a Gadolinium-DTPA bolus. Standard myocardial ROIs were automatically defined and registered to generate contrast enhancement curves throughout the image sequence. Analysis of one sequence required $<$1 min and resulted in endo- and epicardial boundaries that were judged accurate in all image sequences. Time-curves showed the typical pattern of first-pass perfusion with SNR of $15\pm5$ at rest and $19\pm4$ during stress. During stress, contrast inflow rate ($0.031\pm0.013$ vs $0.014\pm0.004$ sec-1, $p<0.05$) and peak-to-peak amplitude ($0.20\pm0.05$ vs $0.14\pm0.03$, $p<0.05$) were both increased compared to rest (fig., right). Despite the extreme dynamic nature of contrast enhanced image sequences and respiratory motion, fast automated detection of myocardial segments and quantification of tissue contrast results in curves with excellent noise levels, which reflect the expected effects of stress.