

Geometric modeling and motion analysis of the epicardial surface of the heart

Bernhard Quatember^{a,*}, Martin Mayr^a, Wolfgang Recheis^a, Stefanos Demertzis^b,
Giampietro Allasia^c, Alessandra De Rossi^c, Roberto Cavoretto^c, Ezio Venturino^c

^a Innsbruck Medical University (Radiology), Anichstrasse 35, 6020 Innsbruck, Austria

^b Cardiocentro Ticino, Via Tesserete 48, 6900 Lugano, Switzerland

^c Università degli Studi di Torino (Matematica), Via Carlo Alberto 10, 10123 Torino, Italy

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Abstract

Pathological processes cause abnormal regional motions of the heart. Regional wall motion analyses are important to evaluate the success of therapy, especially of cell therapy, since the recovery of the heart in cell therapy proceeds slowly and results in only small changes of ventricular wall motility. The usual ultrasound imaging of heart motion is too inaccurate to be considered as an appropriate method. MRI studies are more accurate, but insufficient to reliably detect small changes in regional ventricular wall motility. We thus aim at a more accurate method of motion analysis. Our approach is based on two imaging modalities, viz. cardiac CT and biplane cineangiography. The epicardial surface represented in the CT data set at the end of the diastole is registered to the three-dimensionally reconstructed epicardial artery tree from the angiograms in end-diastolic position. The motion tracking procedures are carried out by applying thin-plate spline transformations between the epicardial artery trees belonging to consecutive frames of our cineangiographic imagery.

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1. Introduction

In all industrialised countries, coronary artery disease is one of the most serious public health problems. At present, the quality of medical care in the field of heart diseases is at a higher level than ever before. Cardiac images are taken from about four percent of the population every year. A large proportion of these individuals who undergo these examinations are suspected of having coronary artery disease. Thanks to the widespread availability of multi-slice CT scanners [12,13,18], it has become usual clinical practice to first refer these individuals to cardiac CT [10,12]. If the presence of coronary artery disease cannot be excluded with this less invasive imaging modality, conventional X-ray angiograms, which are significantly more invasive, are indicated as a second line of investigation. Coronary angiography is decisive for the final diagnosis and the planning of therapy [12]. Thus, in many cases images of both modalities, viz. three-dimensional CT data sets and biplane angiograms are at the disposal of the cardiologist. In

* Corresponding author.

E-mail address: Bernhard.Quatember@uibk.ac.at (B. Quatember).