

**Borut Kirn**

**Model-Based linear decomposition of myocardial strains:  
activation time and contractility mapping**

**Abstract**

Patients with severe conduction disorders and heart failure are treated with cardiac resynchronization therapy (CRT), in order to improve systolic left ventricular (LV) function. However, a considerable part of these patients does not respond to the therapy. Standard selection criteria are based upon indices of mechanical asynchrony, e.g., septum-to-posterior wall motion delay, and interventricular and intraventricular mechanical asynchrony. They are all aiming to quantify asynchrony of activation within the LV wall. However, systolic function of the left ventricle deteriorates not only due to asynchronous activation but due to a combination of asynchronous activation and regionally decreased contractility. Therefore, accounting for regionally decreased contractility in the criteria as well may improve the selection of responders.

As an initial step towards assessing the influence of incorporating contractility in the patient selection, we developed a model based technique to reveal simultaneously the maps of both asynchrony and regional decreased contractility from measured strain signals.

We found that the measured strain signals in asynchronous contracting left ventricle can be described with the extended one fibre model. In this model, the representative contractile fibre has been replaced by a series of fibre segments, each having its own activation time and contractility. Applying the model in reverse, the measured maps of regional circumferential strain as a function of time were converted to maps of activation time and contractility using linear decomposition with two representative components. Obtained maps of activation time and contractility were in agreement with clinical diagnosis of left bundle branch block and ischemia in model animals and patients. Presented technique is more robust and generates less noise than conventional also non-invasive techniques for mapping activation time.