# *Quantitative spatial cardiac localization of premature ventricular contractions using the cardiac isochrone positioning system*

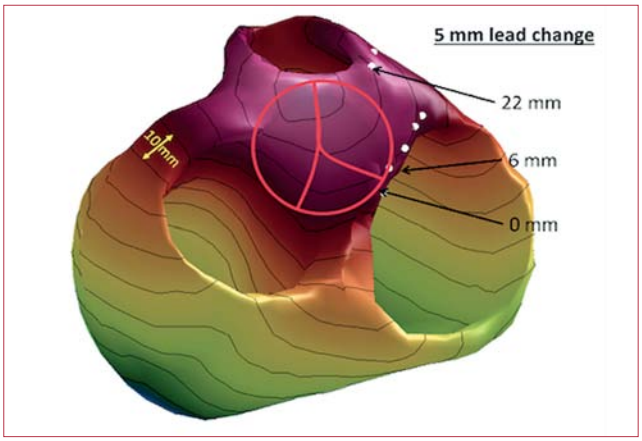
**Peter van Dam***

*University of Nijmegen, Nijmegen, The Netherlands*

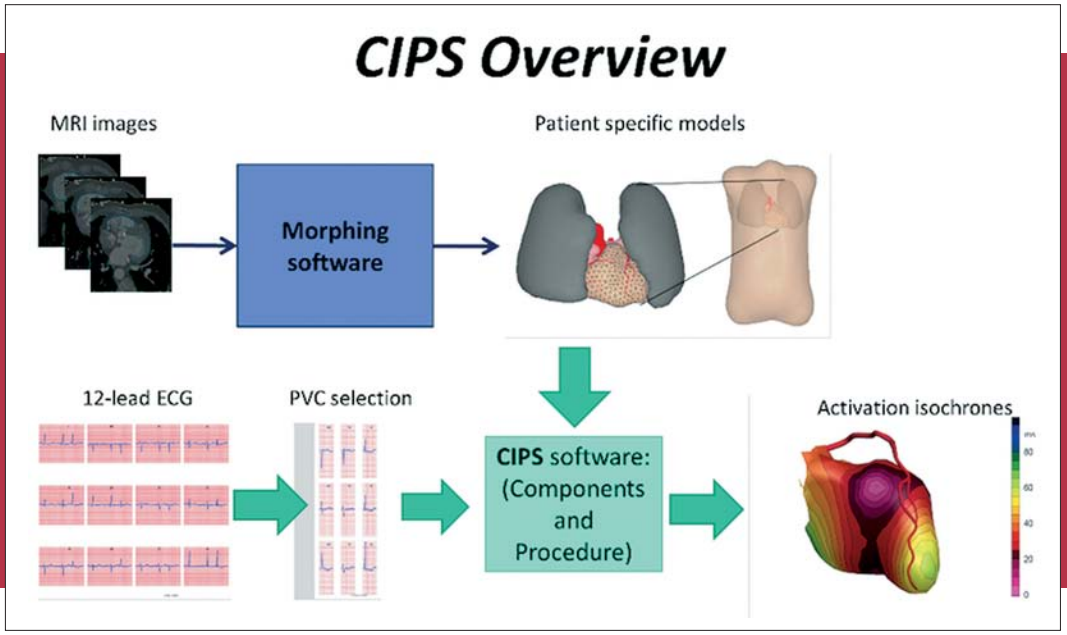
**Introduction:** The precise localization of the site of origin of a premature ventricular contraction (PVC ) or ventricular tachycardia (VT) prior to ablation would facilitate the planning and execution of the electrophysiological procedure[1]. Current electrocardiographic imaging (ECGI) techniques uses body surface mapping that is costly, complex, and requires as many as 256 leads to localize the PVC origin. We have developed and tested the novel cardiac isochrone positioning system (CIPS) utilizing the readily available 12 lead ECG to localize the PVC origin.

**Methods:** The myocardial activation based ECGI requires a patient specific model of the heart and thorax. For the PVC or VT origin localization, the fastest route algorithm[2,3] is used on patient specific models created by the newly developed morphing software[4].

For this study population the electrodes were not recorded accurately. The influence of electrode misplacement was tested on one of the cases by moving the precordial electrodes up and down. The amount of electrode misplacement alters significantly the PVC location determined by CIPS, shown with white dotes. An electrode misplacement of 5 mm resulted in a range of 0-22 mm PVC location.




Consequently we developed and tested new Kinect camera software to document and determine the ECG electrode locations on the chest wall[5]. This software fuses the recorded 3D Kinect camera image with the MRI derived thorax model[4].




**Results:** Ten patients that underwent electrophysiological mapping and ablation of PVCs were studied. The PVCs origins were localized on the endocardium of the mid left later-

al wall, the anterior right ventricular outflow tract (RVOT), the left ventricular superior septum, septal RVOT and mid wall of the RVOT. In one patient the PVC origin was located on the epicardial RVOT. PVC localization by the 12-lead ECGI was correlated to the site of successful ablation. All patients (10/10) had accurate prediction of the PVC origin. However, in two patients without patient specific models the localization was reversed between the RV free wall and septum of the RVOT. With patient specific models and accurately reconstructed electrode positions, these latter two cases would likely be localized correctly.

**Conclusion:** This feasibility study of CIPS shows its ability to localize the PVC origin based on only the standard 12 lead ECG. This ECGI method yields activation estimates of isochrones on both ventricles from which the PVC origin location is derived. This new ECGI technique can localize the PVC from any part of the ventricular endocardium, intramyocardium or epicardium. Accurate localization of the precordial ECG electrodes, however, is still required. The Kinect camera offers the functionality to quickly and reliably localize these electrodes on the chest wall, potentially increasing the accuracy of CIPS. We are currently in the process of designing a prospective study using CIPS with the Kinect camera to localize PVCs and VT origins.

**KEYWORDS:** cardiac isochrone positioning system, inverse problem, Kinect, non-invasive premature ventricular contraction localization.

**CITATION:** Cardiol Croat. 2014;9(3-4):96-97.

Received: 15th Feb 2014
*Address for correspondence: University of Nijmegen, 126 Dept. of Cognitive Neuroscience, Geert Grooteplein 21, 6525 EZ Nijmegen, The Netherlands..

Phone: +31-622198396

Email: peter.van.dam@peacs.nl

## Literature

1. Adams J, Srivathsan K, Shen W. Advances in management of premature ventricular contractions. J Interv Card Electrophysiol. 2012;35(2):137-49.

2. van Dam PM, Oostendorp TF, Linnenbank AC, van Oosterom A. Non-invasive imaging of cardiac activation and recovery. Annals Biomedical Engeneering. 2009;37(9):1739-56.

3. van Dam PM, Oostendorp TF, van Oosterom A. Application of the fastest route algorithm in the interactive simulation of the effect of local ischemia on the ECG. Med Biol Eng Comput. 2009;47(1):11-20.

4. van Dam PM, van Der Graaf AWM, Gotte MJW, editors. A new 3D patient specific morphing tool enabling clinical application of non-invasive cardiac activation imaging. ESC; 2012; Munich.

5. van Dam PM, Maan AC, van der Putten NHJJ, Bruining N, Dijk WA, Laks M. New Computer Program for detecting 12 Lead ECG Misplacement using a 3D Kinect Camera. In: Murray A, editor. Computing in cardiology; Zaragoza 2013. p. 1175-8.