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Short Comunaction

Hearh Electrical Activity Reconstruction *via* Electrocardiographic Torso Mapping Through 250 Electrodes

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1. Letter to Editor

Clinical and Medical Images are usually anatomical, like usual radiology, CT scan, tomographies, of functional through oxygen metabolism like functional magnetic resonance. A third category, at least for the 2 main "electric" organs in the body, brain and hearth, also 2D and 3D even dynamic images of the electrical course is possible, and quite used in EEG mapping for instance also for neuro marketing in order to monitor areas activations in different tasks.

A special attention could be devoted to hearth, whose electrical activity seems even more apparently coherent, being ordered to drive contraction and harmonized blood pumping. Some pathologies, like arrhythmia, or fibrillation, deviate from the standard behavior in a way that could be dangerous and has to be cared for. Usually, investigation about if and where to ablate in endocardium is performed through invasive brachial catheters, while it could be of interest to reconstruct epicardial, septal and endocardial electrical activity from torso recording at a proper sampling

The idea resorts to the late cardiologist Bruno Taccardi, formerly in Parma then in Salt Lake City, whose late friend Eilio Gatti, among our great Mentors in Politecnico di Milano, made in 1972 the first device with 250 ECG channels in order to have the proper dynamical surface sampling to reconstruct hearth electrical activity.

Despite almost half a century is past, a satisfactory solution is not yet commercially available, being the inverse problem quite ill-posed because of breathing, anisotropy, in homogeneity of the torso, hosting lungs, liver and other organs besides hearth. CT-scan of the very subject is needed to make a model of the transfer function from hearth to torso, but then the severe ill-poseness of the inversion makes hard to find a sufficiently error-free estimation even by resorting to the standard Phyllips Tichonov regularization techniques quite resolutive in less complicate problems.

Besides refinements in this sense, inspired to the beautiful work a great mathematician, Alfio Quarteroni, is performing on the parallel fluidodynamic estimation also thanks to an ERC grant, probably a regression analysis, more black box based as in my paper in Automatica (2003) together with machine learning could be of some help. A bright start-up within the EPFL basin is devoting energy and money to complement in this sense market offering in such a field.

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