"A hybrid algorithm for automatic heart segmentation in CT angiography"
Imen Melki (ESIEE - General Electric):

Volumetric Computed Tomography (CT) angiography has become a standard non-invasive routine procedure for cardiac imaging and coronary arteries pathology detection. However, before the diagnosis process, a preprocessing task is critical for an accurate examination of the vessels. In this work, we present a hybrid algorithm to automatically delineate the heart volume in 3D cardiac CT datasets for the visualization of coronary arteries. Our work eliminates the tedious and time consuming step of manual removing obscuring structures around the heart (ribs, sternum, liver...) and quickly provides a clear and well defined view of the coronaries. So far, works related to heart segmentation have mainly focused on heart cavities delineation, which is not suited for coronaries visualization. In contrast, our algorithm extracts the heart cavities, the myocardium and coronaries as a single object. The proposed approach is based on the fitting of a geometric model of the heart to a set of automatically extracted 3D points lying on the heart shell. A novel two-stage fitting scheme is used to improve the robustness to the outliers. The fitting result is refined using a Random Walker (RW) segmentation approach. Qualitative analysis of results obtained on a 70 exam database shows the efficiency and the accuracy of our approach.

"Medial axis filtering for shapes with features at different scales"
Michal Postolski (ESIEE - Technical University of Lodz):

The medial axis is a very useful representation of the object and plays a major role in shape analysis in numerous applications, for example object recognition, registration or compression. However it can be hard or even impossible to use this tool effectively without first dealing with some problems, especially in discrete spaces and with noisy objects. One of the most important one is that the medial axis is not stable under small perturbations of a shape: modifying a shape slightly can result in substantially different medial axes. This fact, among others, explains why it is usually necessary to add a filtering step (or pruning step) to any method that aims at computing the medial axis and a nonreversible but simplified description of binary objects is of interest. Different criteria can be used to locally threshold and discard spurious medial axis points or branches. In previously proposed methods local information (that is, geometric information extracted from a single medial ball) is compared to a global parameter value to determine the importance of the corresponding medial axis point. However, it is well known that this local filtering can lead to remove small branches which might be important for the shape understanding especially for shapes with features at different scales. In this presentation, we address this issue and propose two new different approaches which put in relation local information and regional information to make an effective medial axis filtering and overcome drawback noticed in previously presented methods. On a number of experiments we evaluate their stability, and compare they with the previously introduced methods.
We consider criteria for sparse image recovery problems, suitable for preserving edges between homogeneous regions. Our studies focus on the optimization of functions expressed as a sum of convex data fidelity term and a prior, which is either a truncated quadratic penalization or a smoothed version. Since the problem is non-convex, it is generally challenging. In this talk, a short review of existing methods is first given, and then we propose two approaches: a combinatorial Graph-Cut based algorithm, which we call Quantized-Convex Split Move and a continuous Majorise-Minimize Memory-Gradient optimization algorithm. We compare both methods in term of convergence properties, quality of the results and time efficiency.