

PHD PROPOSAL

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Title: **Graph cut techniques for image segmentation**

Keywords: Graph cut, Image segmentation, Level lines, Watershed

Summary: Graph Cut techniques have been successfully proposed to solve some specific problems of optimisation under certain conditions on the functional to be minimized. We have recently proposed a new graph cut approach that minimizes a functional addressing configurations of geometrical objects through a marked point process modelling. Currently the only prior between objects consists of repulsive potentials that prevent objects overlap. The goal of this PhD proposal is to extend this framework.

In a first step, we will generalize the approach to embed attractive interactions to favour for example clustering or alignment effects. Based on this extended framework we will propose a generic framework for multi-scale image segmentation. From this general scheme several segmentation algorithms will be derived and compared. The main idea is to generate several over segmentation maps of the scene. The proposed graph cut approach will provide the best set of regions within the proposed over segmentation maps in the sense of a global criterion mixing data and prior information.

Using this general framework several segmentation algorithms can be proposed. For example one can consider some previous segmentation maps obtained by the watershed algorithm or the different level lines in the native dataset. In this step, we will propose and compare several of such algorithms.

Finally, the proposed algorithms will be evaluated on real biological images obtained by several microscopy probes. We will focus on several cell populations.

Work plan:

- 1) Extension of the repulsive graph cut framework to attractive interactions
- 2) Multi-level segmentation algorithm based on the defined graph cut framework
- 3) Proposition of different segmentation algorithms and comparison
- 4) Application to cells segmentation
- 5) Application to neurons segmentation

Bibliography:

Stochastic geometry for image analysis, Xavier Descombes. Wiley-ISTE, pp. 384, 2011, 978-1-84821-240-4.

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