Multi-layer phase field model for selective object extraction

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Selective object segmentation is a common problem of image processing. This is one of the first steps of most image analysis applications, therefore its accuracy is crutial for the later calculations. The criteria of selection varies from the simplest ones such as the intensity or texture properties of objects to more complex ones like object shape descriptors. Earlier methods use object templates as reference shapes. This approach has limited flexibility and not efficient for unknown number of instances. Variational models commonly used to describe shapes without model templates. A special type of these models called higher-order active contours, are based on contour representation of regions and use interactions between contour points to describe regular shapes [1]. Numerous applications in biology (e.g. cell nuclei detection on fluorescent microscopy images) and physical sciences (e.g. nanoparticle delineation in transmission electron microscopy) objects can touch or even overlap with each other [2].
In this work, we present a multi-layer phase field segmentational model that can extract a family of shapes with predefined size and shape charactestics such as ratio of area and perimeter. With multiple phase-field layers we can represent overlapping objects. Using a common phenomenon in microscopy that is the measured intensities are additive if objects located on the top of eachother. We combine the size and shape selective prior model with this additive data model which can handle overlapping parts if they have the above properties. We tested the model on synthetic and on real microscopy images.

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References

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