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Deep Learning based Active Contour Algorithms for Diabetic Retinopathy Segmentation

Segmentation is one of the important steps of image processing which can separate or segregate meaningful regions from images and has been useful in various applications including lane recognition in self-driving vehicles, face recognition and detection and many such others. Active contour is one of successful image segmentation techniques, which has been implemented in a wide range of medical imaging problems from microscopic cell image detection to brain tumour detection from CT and MRI. Active contour minimizes an energy functional in an unsupervised manner, which offers the required force to converge the user defined initial contour at the boundary of the target objects. However, active contour based approaches lack a way to work with labelled images in a supervised machine learning framework. Furthermore, they are unsupervised approaches and success of these methods strongly depend on many parameters, which is selected by empirical results and as a result fail in many real world applications.

Inspired from breakthrough successes deep for solving a variety of imaging problems, this research investigates the implementation of active contour models into deep learning framework to increase the segmentation accuracy of the active contour models. Segmentation accuracy of active contour models have been measured in terms of Jaccard Score, Dice Coefficient, and Pratt's Figure of Merit (PFOM). Proposed deep learning based active contour algorithms have been successfully implemented on detecting diabetic macular edema, which causes blocking of tiny blood vessels located at the back inner wall of the eye or retina because of high blood sugar content in the blood. Experimental results demonstrate the consistency with the result of the human segmenters, and thus help to reduce tiresome manual labour. In future, we would like to deploy the proposed algorithms in other medical imaging problems.

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