Semantic Segmentation with Scale-Equivariant Networks

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Résumé

Equivariant Neural Networks have produced interesting results in tasks where some kind of symmetry is present on the data.
In many tasks in computer vision, scale symmetry is present in the data, e.g. in a semantic segmentation task of an urban scene, the same class of object can be visible by the camera at different distances, hence the object will appear at different scales. To this end, it is interesting to study the properties of scale-equivariant networks. The scale semigroup equivariant networks are a class of scale-equivariant networks which are based on a scale-space operator, such as the Gaussian scale space or morphological scale-spaces, and scale-cross-correlations, which are scale-equivariant counterparts of the convolution operators.
The U-Net, on the other hand, is a neural network which provides state-of-the-art in semantic segmentation tasks.
In this work, we present a U-Net constructed based on the scale-cross-correlation and different scales-spaces, in particular the Gaussian and quadratic morphological ones, and we test its equivariance in a segmentation task of obtaining the strands of a 3D tissue object based on 2D slices of the object. We find that this change significantly improves the performance of the model in scales unseen during training.

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