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Integrating RNN in skip connections for land cover classification of aerial images

Proposal for a master thesis topic (EN)

Classification of land cover is a standard task in remote sensing, in which each image pixel is assigned a class label indicating the physical material of the object surface (e.g. *grass*, *building*). This task is challenging due to the heterogeneous appearance and high intra-class variance of objects. Recent work trying to solve this task has focused on convolutional neural networks (CNN), delivering considerably better results than traditional classifiers such as Random Forests, whereas such classifiers use hand-crafted features as input, CNN provide a framework in which these features (and, thus, a representation of the image) can be learned from training data, which explains much of the success of CNN in classification. Originally, CNN were designed to predict a single class label per image. In the meantime, they have also been expanded to the task of land cover classification, where a class label is to be predicted for each pixel. This is achieved by an encoder-decoder structure, where in the encoder part, the resolution is continuously reduced (as in common CNN), whereas the encoder part up-samples the resultant class scores to obtain per-pixel predictions. Existing methods mainly suffer from a poor representation of object boundaries due to the reduction of resolution in the encoder part of the CNN. Therefore, skip connections, connecting feature maps from low level to high level, are applied to address this issue.

The goal of this master thesis is to integrate recurrent neural network (RNN) in skip connections other than the popular ways, i.e. elementwise additions of feature maps (Add-Skip) or concatenating them first and then fusing via 1x1 convolution (Learn-Skip). Since the feature maps in low level and high level shows hierarchical relationships, the classification could profit from them. The assumption lies on that the most important features would be kept after RNN-skip-connections, so that the final performance (e.g. in term of overall accuracy) would be improved. As RNN module, gated recurrent unit (GRU) or long short-term memory (LSTM) could be the choice, which will be investigated during the work. Overall speaking, the master thesis will answer the followed questions: 1) how can RNN be integrated into neural networks, 2) compared to the Add-Skip, Learn-Skip and without skip connections, would RNN improve classification and why, 3) which RNN module performs better and in what degree.

In this work, a baseline network based on SegNet will be provided to the students, including some prepared dataset. The working language will be English.

This thesis will be supervised by Chun Yang, M.Sc.

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