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Investigations on supervised domain adaptation for the training of fully convolutional neural networks in aerial image classification

Proposal for a Master thesis topic (DE/EN)

The pixel-wise classification of remotely sensed images and derived data (e.g. digital surface models) is an important step in the process of generating or updating maps. For the last years, Deep Neural Networks (DNN) have been adapted to that task, surpassing the results of classical machine learning approaches in nearly all scenarios. However, DNN for classification, usually in form of Fully Convolutional Neural Networks (FCNN), often require a large amount of training data in order to learn the complex mapping required to solve this task. Training on few data often leads to a weak generalization of the model, especially when applied to domains that differ from the training domain in terms of the mapping function. In the context of this work, domains refer to aerial imagery of different cities, possibly taken in different seasons and lightning conditions.

One approach to counteract this problem is supervised domain adaptation (SDA). In this setting only few training samples are available for a specific task in the domain of interest (target domain), but plenty of samples are available in a different but related domain (source domain). In SDA, a DNN is first trained on the source domain before being fine-tuned on the actual domain of interest, called the target domain. In recent publications it was shown, that such an approach can lead to a large improvement of the performance in the target domain compared to directly applying the model which was only trained on the source domain.

The main goal of this thesis is a systematic investigation of different variants for SDA for the classification of aerial images. One aspect to investigate is the choice of the training strategy in the source domain. Particularly, the influence of the model initialization, the strategy for data augmentation and the optimization. The second aspect is related to the fine-tuning stage. On the one side, it should be investigated, how the hyper-parameters of the respective training affect the final performance. On the other side, the amount and the choice of labelled samples in the target domain should be investigated w.r.t. the resulting performance in the target domain. Based on the results of the analysis, the student should develop an approach to predict which samples should be labelled with a limited amount of labelling capacity, using the labelled data in the source domain and the unlabelled data in the target domain.

This thesis will be supervised by Dennis Wittich, M.Sc.

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