University of Pavia

Ph.D. School of Electrical and Electronics Engineering and Computer Science

Seminar

Strategies for Deep Domain Adaptation in Remote Sensing Applications

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Abstract: The classification of images and other remote sensing data is a fundamental task to derive semantic information about the objects in the depicted scene automatically. For several years, research on image classification in remote sensing has been dominated by deep learning, mainly in the form of variants of convolutional neural networks (CNN). However, CNN are data hungry, i.e. they require a large amount of representative training samples, the generation of which is a time-consuming and costly process. Consequently, strategies for reducing these requirements have been investigated. One such strategy is domain adaptation (DA), where labelled training data available from other projects (referred to as source domains) are used to train a classifier for new image data (constituting the target domain) where no or only a small set of training labels are available. The problem related to this setting is that in general the target domain data will follow another statistical distribution than the source domain data, leading to a domain gap. Thus, DA can be understood as a process that adapts a classifier trained on source domain samples to the distribution of the target domain data without or with only a small number of labelled training samples in the latter.

This presentation will give an overview over strategies for deep DA, i.e., DA for classifiers based on deep learning, in remote sensing applications. The focus will be on semi-supervised methods, i.e., methods developed for the scenario described above, in which labelled data are only available in the source domains. The three main strategies discussed here are representation transfer, instance transfer and appearance transfer. In the first case, the goal is to train the CNN such that the representation obtained in the intermediate layers of the network is as independent from the domain from which a data

sample is drawn as possible, so that the classifier trained using labelled source domain data only can be applied to the high-level feature representation of target samples without changes. In the second case, a classifier trained using source domain samples is iteratively adapted to the distribution of the target domain data by using target domain samples which receive their class labels (semi-labels) automatically from the classifier in its current state. The third strategy tries to change the appearance of the data before presenting them to the CNN so that the distribution of the features in the transformed images from the two domains becomes similar. This presentation will contain examples for all three strategies from the author's own work.

Biography: **Franz Rottensteiner** received a Dipl.-Ing. degree in surveying, a Ph.D. degree and a *venia docendi* in Photogrammetry from Vienna University of Technology, Vienna, Austria (TUW). Currently, he is an Associate Professor and leader of the research group "Photogrammetric Image Analysis" at the Institute of Photogrammetry and GeoInformation at the University of Hannover, Germany (LUH). His research interests include all aspects of image orientation, image classification, automated object detection and reconstruction from images and point clouds and change detection from remote sensing data. Before joining LUH in 2008, he worked as a postdoctoral researcher at TUW and the Universities of New South Wales and Melbourne, both in Australia. He has authored or co-authored more than 100 scientific papers, more than 35 of which have appeared in peer-reviewed international journals. He received the Karl Rinner Award of the Austrian Geodetic Commission in 2004 and the Carl Pulfrich Award for Photogrammetry, sponsored by Leica Geosystems, in 2017. Between 2011 and 2021, he was the Associate Editor of the ISI-listed journal "Photogrammetrie Fernerkundung Geoinformation" of the German Society of Photogrammetry, Remote Sensing and Geoinformation. Being the Chairman of the working group II/4 of the International Society of Photogrammetry and Remote Sensing (ISPRS), he has initiated and conducted the ISPRS benchmark on urban object detection and 3D building reconstruction.

Please note the room has a limited capacity and priority will be given to students of the Satellite Data Analysis course. The seminar will also be broadcast through the following Zoom room:

https://us02web.zoom.us/j/82612832202?pwd=S3ArTG5zMVhFV3AzMVhkZW5tUGJCZz09

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Seminar in English
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