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Supervised Change Detection in VHR Images Using Support Vector Machines and Contextual Information

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One of the recent challenges in environmental studies is how to include and exploit multitemporal information from multispectral very high resolution (VHR) images. This problem is also known as change detection (CD). Nowadays, many approaches, both supervised and unsupervised, are known and the selection of the method depends strongly on the application, the scope of the study and on available time.
In the present research an accurate multiclass supervised method based on Support Vector Machines (SVM) for multitemporal remotely sensed image classification is proposed. SVM is a method issued from the statistical learning theory, known for its good generalization abilities and its performance when dealing with high dimensional spaces. Moreover, its sparse solution provides a final model depending only on a few patterns with an associated nonzero weights (support vectors), and resulting in an optimal regularized complexity. The final decision is obtained with a linear separation of data in an induced kernel feature space, corresponding to a nonlinear classification in the input space.
When dealing with CD in VHR imagery, misclassified patterns are often caused by the high variance of the information at pixel level, caused by noise and by the influence of the high spatial resolution. Considering a precise coregistration, the variance at object level is high both in space and in time. The usefulness of adding such information is in smoothing, following an object based or a texture based criteria, the interclass variance and increasing the intraclass variance. By adding such information the classifier can better perform when predicting the class of pixels, because of the neighborhood information that was intrinsically extrapolated by the filtering. In the proposed approach, the behavior of mathematical morphology and morphological profiles obtained with different parameters are studied in a CD setting. The series of features are extracted both on the multispectral images and on the panchromatic images covering the scene at different time.
Finally, the model is developed by directly applying multitemporal classification on the multitemporal image, looking for both stable and changed classes. Accurate multiclass CD with VHR optical imagery is a very powerful tool when analyzing city sprawl evolution and urbanization regimes, or when the resolution of the images allows a fine analysis of a multitemporal phenomenon (natural hazards, post catastrophe assessment, risk maps...). The real case study deals with a multitemporal image issued from two QuickBird scenes of the city of Zurich, Switzerland.
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