**A COMPARISON AND COMBINATION OF METHODS FOR CO-REGISTRATION OF MULTI-MODAL IMAGES**

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**ABSTRACT:** The RAPIDMAP project aims at integrating Remote Sensing (RS) and Geographic Information Systems (GIS) for resilience against disasters. In case of disasters and hazard monitoring, rapid mapping of the affected areas using RS and GIS is of great importance. Moreover, the continuous increase of the number of imaging satellite sensors has enhanced the necessity of combined usage and analysis of such sensor data, including the task of image co-registration. Co-registration requests the automated finding of corresponding image features and becomes very difficult when the images differ a lot. Perhaps the most difficult case is that of co-registering optical and SAR images, while also multispectral images can vary a lot, e.g. when they cover the visible, SWIR and TIR range of the spectrum. In difficult co-registration cases, the putative point correspondences are mostly wrong. Thus, an additional problem is to find and automatically eliminate matching errors. In this paper, we present and compare various matching methods. The comparison includes not only the results, but also the quality values for each individual feature point match. In our own previous work, Least Squares Matching (LSM) in the gradient domain was used to find correspondences, and blunders were excluded based on a combination of several quality criteria. A second approach, developed at DLR, uses Mutual Information (MI) to find correspondences. Here, the matches and quality values of the LSM and MI methods are compared. Furthermore, we also test another method, also based on MI. We extend that method to also estimate the matching quality, and combine the more robust MI with the more precise LSM to eliminate gross errors. Finally, we use a Discrete Fourier Transform method to obtain upsampled cross-correlation values around the peak in the frequency domain to find correspondences. Our dataset includes different pairs of SAR and optical images, including data from the Tohoku Earthquake and Tsunami, 2011. Since none of these images come with ground truth, the results had to be checked visually. Thus, as a second test dataset we use very different AVHRR multispectral images, which are already co-registered. By introducing known geometric distortions we can perform quantitative evaluations on this data.

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