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Unsupervised Detection of Burned Area from Remote Sensing Images Using Spatial Correlation and Fuzzy Clustering

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Abstract : Land-cover and land-use change information are important because of their practical uses in various applications, including deforestation, damage assessment, disasters monitoring, urban expansion, planning, and land management. Therefore, developing change detection methods for remote sensing images is an important ongoing research agenda. However, detection of change through optical remote sensing images is not a trivial task due to many factors including the vagueness between the boundaries of changed and unchanged regions and spatial dependence of the pixels to its neighborhood. In this paper, we propose a binary change detection technique for bi-temporal optical remote sensing images. As in most of the optical remote sensing images, the transition between the two clusters (change and no change) is overlapping and the existing methods are incapable of providing the accurate cluster boundaries. In this regard, a methodology has been proposed which uses the fuzzy c-means clustering to tackle the problem of vagueness in the changed and unchanged class by formulating the soft boundaries between them. Furthermore, in order to exploit the neighborhood information of the pixels, the input patterns are generated corresponding to each pixel from bi-temporal images using 3×3, 5×5 and 7×7 window. The between images and within image spatial dependence of the pixels to its neighborhood is quantified by using Pearson product moment correlation and Moran's I statistics, respectively. The proposed technique consists of two phases. At first, between images and within image spatial correlation is calculated to utilize the information that the pixels at different locations may not be independent. Second, fuzzy c-means technique is used to produce two clusters from input feature by not only taking care of vagueness between the changed and unchanged class but also by exploiting the spatial correlation of the pixels. To show the effectiveness of the proposed technique, experiments are conducted on multispectral and bi-temporal remote sensing images. A subset (2100×1212 pixels) of a pan-sharpened, bi-temporal Landsat 5 thematic mapper optical image of Los Angeles, California, is used in this study which shows a long period of the forest fire continued from July until October 2009. Early forest fire and later forest fire optical remote sensing images were acquired on July 5, 2009 and October 25, 2009, respectively. The proposed technique is used to detect the fire (which causes change on earth's surface) and compared with the existing K-means clustering technique. Experimental results showed that proposed technique performs better than the already existing technique. The proposed technique can be easily extendable for optical hyperspectral images and is suitable for many practical applications.

Keywords : burned area, change detection, correlation, fuzzy clustering, optical remote sensing
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