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Urban Growth Analysis Using Multi-Temporal Satellite Images, Non-stationary Decomposition Methods and Stochastic Modeling

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Abstract : Remotely sensed data are a significant source for monitoring and updating databases for land use/cover. Nowadays, changes detection of urban area has been a subject of intensive researches. Timely and accurate data on spatio-temporal changes of urban areas are therefore required. The data extracted from multi-temporal satellite images are usually non-stationary. In fact, the changes evolve in time and space. This paper is an attempt to propose a methodology for changes detection in urban area by combining a non-stationary decomposition method and stochastic modeling. We consider as input of our methodology a sequence of satellite images I₁, I₂, … I_n at different periods (t = 1, 2, ..., n). Firstly, a preprocessing of multi-temporal satellite images is applied. (e.g. radiometric, atmospheric and geometric). The systematic study of global urban expansion in our methodology can be approached in two ways: The first considers the urban area as one same object as opposed to non-urban areas (e.g. vegetation, bare soil and water). The objective is to extract the urban mask. The second one aims to obtain a more knowledge of urban area, distinguishing different types of tissue within the urban area. In order to validate our approach, we used a database of Tres Cantos-Madrid in Spain, which is derived from Landsat for a period (from January 2004 to July 2013) by collecting two frames per year at a spatial resolution of 25 meters. The obtained results show the effectiveness of our method.

Keywords : multi-temporal satellite image, urban growth, non-stationary, stochastic model
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