Advanced Methodologies for the Analysis of Multitemporal Remote-Sensing Images
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Satellites have been providing information about the Earth's surface and atmosphere for almost thirty years. Nowadays, remote-sensing technology represents a powerful tool for researchers and policy makers in many application domains. However, there is still a significant gap between the potential capabilities of this technology and its operational use in the real world. This is mainly due to the still low levels of automation of most widely used techniques for the analysis of remote-sensing data. In particular, the availability of an ever increasing number of remote-sensing satellites characterized by a short rivisitation time makes it possible to consider new advanced applications of remote sensing, ranging from monitoring and management of natural resources (e.g., forests, sea, etc.) to monitoring of land-cover dynamics (e.g., monitoring of ecosystems, monitoring of agricultural areas, etc.), from risk assessment (e.g., forest fires, landslides, floods, etc.) to damage mapping (e.g., burned areas, flooded areas, etc.), from assessment of urban expansion to updating of road maps on GIS systems. However, the methods currently available for the automatic analysis of multitemporal remote-sensing images do not seem effective enough to support and exploit the technological improvements in satellite and sensor characteristics. In this context, the primary objective of this thesis is provide the end-user with advanced automatic techniques aimed at analyzing multitemporal series of remote-sensing data, especially images.
After a detailed analysis of the state of the art, this dissertation is focused on the investigation, development and testing of novel techniques for the automatic analysis of multisource and multitemporal remote-sensing data. Three main tasks are considered: i) categorization of the Earth's surface, ii) monitoring of the land-cover dynamics from space on a regular basis, iii) analysis of Earth's atmosphere. Accordingly, the research was focused on three different but strongly interrelated topics: (i) classification techniques; (ii) change-detection techniques; (iii) techniques for monitoring air pollution by temporal series of remote-sensing data.