GLOBAL TRENDS IN REMOTE SENSING OF HUMAN SETTLEMENTS

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Advances in both airborne and spaceborne remote sensing systems have provided a range of tools for monitoring and managing human settlements. In particular the availability of very high spatial resolution satellite systems has dramatically increased access to high quality two-dimensional spatial information, while laser profilers and interferometric synthetic aperture radar have allowed acquisition of the third dimension. As human settlements can undergo rapid change either by unplanned growth or disaster impact, the return period of a few days to weeks means that change can be easily and rapidly assessed. In this paper the properties of systems and their acquired data, including high resolution satellite systems, hyperspectral sensors, synthetic aperture radar and laser profilers will be discussed with examples of their application related to population change, infrastructure planning and disaster monitoring. The paper concludes with an overview of future developments.

Over the past 100 years sensor systems have changed dramatically. Early systems were primarily airborne cameras that provided moderately high resolution, black and white or colour photographs, which imaged only a small part of an urban area. They could be used to determine heights and contours using overlapping, stereoscopic photographs, but their return period was project based. Landsat MSS provided the first whole city, regional view, in both the visible and near infrared spectral bands with repeatable passes every two weeks or so. However the images were low resolution, required digital processing and provided no ground height information.

In the past 30 years satellite and airborne systems with increased spatial resolution, increased spectral resolution, shortened return periods, and digital surface generation, have become available. These include Landsat TM, Spot, ALOS, Ikonos, Worldview-2. At the same time powerful low cost computers have made the processing and analysis of this image data fast and reliable, and when combined with GIS have provided a major tool for the analysis of human settlements. In addition the increased availability of both airborne and spaceborne radar imaging systems and interferometric SAR, airborne digital cameras, thermal imaging sensors, laser scanners and hyperspectral sensor systems, have greatly extended the time and conditions when images can be acquired, and provided stimulus to data fusion techniques to enable the extraction of more and better urban information.

Data fusion is becoming an increasingly powerful tool for the analysis of human settlements, allowing the improved spatial resolution of multispectral images by fusion with higher resolution panchromatic images from the same sensor, or the combination of images from different sources where these may have totally different frequency bands, to assist in the recognition of urban features as discussed in Gamba (2009), [1]. Better image resolution can also be obtained by a better understanding of the point spread function of the sensor system, whereby with a deconvolution filter a higher resolution image, with increased information content can be created [2]. Further research is also being undertaken on the mixed pixel problem, which is more prevalent in urban areas due to the often rapidly changing surface material.

Depending on the resolution, timing and spectral characteristics of the image data, remote sensing can be used for the detect the broad change and growth of cities, the loss of forest/agricultural land , and the sources of increased pollution, through to detailed land cover and land cover change, population and demographic studies, detailed infrastructure planning and post disaster assessment.

The future is seen as bright for the use of remotely sensed data for the study of human settlements worldwide. Some future trends will include more data integration with GIS, increased image data fusion, availability of higher spatial and spectral resolution sensors, development of geostationary "Metrosats", development of sensors to measure long wavelength emissions and chemical emission and identification, and greater integration of the information derived from image data with census data and meshblocks. An in depth study of the theory and applications of remote sensing for urban areas can be found in "Remote Sensing of Human Settlements" [3].

REFERENCES

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