1. The use of remote sensing and landscape metrics to describe structures and changes in urban land uses

Martin Herold, Joseph Scepan, Keith C Clarke

This paper identifies remote sensing technology potential for acquisition of detailed and accurate land-use information for management and planning of urban regions. This study introduces a methodology using information on image spatial formal landscape metrics which can be defined as quantitative indices to describe structures and pattern of a landscape to describe urban land-use structures and land-cover changes that result from urban growth. The analysis is carried out on spatial analysis of land-cover structures mapped from digitally classified aerial photographs of the urban region Santa Barbara, CA. The results of the landscape metrics analysis provided useful information for separation and characterization of three urban land-use types called commercial and industrial development, high-density residential, and low-density residential regions. In order to discriminate more accurately between the three land-cover types of interest i.e., Commercial and Industrial, High Density Areas and Low Density areas the landscape metrics were further refined into what are termed landscape metric signatures for the land-use categories. The analysis shows the importance of the spatial measurements as second-order image information that can contribute to more detailed mapping of urban areas and towards a more accurate characterization of spatial urban growth pattern. In order to make intelligent decisions, and to take timely and effective action, planners need extensive, comprehensive knowledge about the causes, chronology, and effects of these processes for which it shows the recent research which identifies a number of different approaches for data acquisition and for land-use characterization and analysis which utilize remote sensing imagery as source data in the derivation of spatial data sets with high temporal and spatial resolution. It also says that most of the urban land use studies have used remote sensing data from optical remote sensing satellites including Landsat Thematic Mapper (TM), Systeme Probatoire d'Observation de la Terre (SPOT), Indian Remote Sensing (IRS 1C) from where an effective separation of vegetation, water, and built-up land-cover categories is possible on a purely spectral basis. The separation of built-up and bare soil or rock areas as well as the discrimination of urban cover types and land uses (residential, commercial, industrial, and cultural) remains problematic with these data, principally because of the similar spectral response of these portions of the urban land-cover mix. In this paper a technique is described to quantify spatial urban patterns from high-resolution optical remote sensing data to describe structures and changes in urban land use. This has been explained on the following steps:
1. Multispectral optical remote sensing allows an accurate separation of diverse urban land-cover types (including built-up areas, vegetation, and water) to derive accurate thematic land-cover maps.

2. Spatial and textural context is important information for urban area characterization. Here they have utilized landscape metrics as quantitative measures of spatial structures and pattern to describe urban land-use features.

3. The discrimination of inner-city structures requires remote sensing data exhibiting very high spatial resolutions. Such data are quite recently available from new satellite sensor systems.

The application of the landscape metrics are also given in the paper like, The detection of landscape pattern, biodiversity, and habitat fragmentation, The description of changes in landscapes, and the investigation of scale effects in describing landscape structures. Finally to summarize this paper makes it very flexible for the planners, decision makes to make decisions of about the landscape and land uses from the high spatial resolution remote sensing data which can be used to distinguish different land uses in the urban areas.
2. Analyzing spatial restructuring of land use patterns in a fast growing region using Remote sensing and GIS

Xia Li, Anthony Gar

This study analyzes urban expansion and spatial restructuring of land use patterns in the Pearl River Delta of south China, using remote sensing and GIS. The region has pioneered the nation in economic development and urbanization process. Tremendous land use changes have been witnessed since the economic reform in 1978. Land use changes over two time periods, 1988–1993 and 1993–1997, are analyzed to demonstrate how enforcing land use policies can influence the direction and magnitude of landscape change. This study also provides new evidence with spatial details about the uneven land development in the Pearl River Delta. Fast urban expansion has triggered the loss of a large amount of agricultural land in the Pearl River Delta. It is observed from the study the similar land use problems will soon be found in other fast developing areas in China because of the rapid urbanization process. This study quantifies the amount and type of land use changes over two time periods, 1988–1993 and 1993–1997, in the Pearl River Delta. A single TM image covering the entire region is collected and a change detection technique based on principal components analysis (PCA) is used to monitor land development in the Pearl River Delta. This study takes a new focus on examining the process of spatial restructuring of land use patterns and identifying the temporal and internal variation in land development in the Pearl River Delta. Thematic Mapper images are used to detect land use changes, the first step of the PCA method is to put the two images into a stack consisting of a total of 2n bands. PCA is then carried out to compress these original bands into a number of components. Interactive supervised classification of land use changes is carried out on the compressed components in order to identify the patterns of the land use changes. The next step of this study is to understand the geometry of land development and land use patterns by providing detailed spatial information for land use planning. Using the information of the land use analysis buffer zones are created according to the distances to urban centers and roads. This has provided spatial variables from GIS to reflect the orientation and configuration of land development. Regression analysis has been used to examine the relationships between land use changes and spatial variables. The spatial patterns of the urban land use indicate the loss of agricultural land loss at the aggregated level by cities. This can help urban planners identify which cities or towns have severe land use problems. Spatial dependency of land use change from roads over two time periods are observed in 1988–1993 and 1993–1997. The above analyses reveal the spatio-temporal variations and restructuring of land use patterns, which reflect the dynamics and
complexity of economic and physical factors in the region. It is obvious that the cities or towns of fast economic development are consuming more land resources. This paper has provided much information needed to analyse the land use patterns of the pearl delta region for the two decades using the Thematic mapper images.
3. Evaluating environmental influences of zoning in urban ecosystems with remote sensing

Jeffrey S. Wilson, Michaun Clay, Emily Martin, Denise Stuckey, Kim Vedder-Risch

The influence of zoning on Normalized Difference Vegetation Index (NDVI) and radiant surface temperature (Ts) measurements is investigated in the City of Indianapolis, USA. In this paper using data collected from the Enhanced Thematic Mapper Plus (ETM+) remote sensing system. Study basically involves the analysis of variance in the images which indicates statistically significant differences in mean Ts and NDVI values associated with different types of zoning. Multiple comparisons of mean Ts and NDVI values associated with specific pairings of individual zoning categories shows significant difference. It is understood in order to maintain physical characteristics and provides amenities to all the cities it is very important for the urban planners to deal with the concept of zoning to discuss about various parameter of density, population, commercialization, industrialization etc. Remote sensing science and technology has given an immense potential to the end users which provides the decision making possibility by proving synoptic data collection and analysis techniques which generate important information about the environmental implication of planning activities.
This paper given information about the necessity of the geospatial information technologies and remote sensing in developing countries to support sustainable development. This paper mainly discusses about the issues faced by many developing countries is the need for better utilization and protection of their natural resources for attaining sustainability in the resources using the GIS and remote sensing. In the world industrialized nations have used remote sensing and GIS technologies in various fields that include natural resources management and protection, environmental monitoring, agriculture, geology, hydrology and water resource management, disaster management, urban planning, monitoring spread of infectious diseases, and marine studies. It explains the benefits of remote sensing and GIS technologies, if it is implemented properly in the developing countries with large-scale and national GIS systems will integrate advanced computing platforms, high-speed networks, high performance image processing and GIS products, sophisticated data capturing devices can provide a variety of remotely sensed data (multi-temporal, spatial, and spectral resolution), geospatial, and in-situ data will be integrated to generate value-added products, extract thematic/spatial features, and derive information to support operational governmental applications and decision-making. Industrialized nations have proven the usefulness of remote sensing and GIS technologies through their cost effective implementation in a variety of applications at local, regional, and national levels. Remote sensing and GIS technologies are used in many applications that include, but not limited to, natural resources management and protection, environmental monitoring, agriculture, geology, hydrology and water resource management, disaster management, urban planning, monitoring spread of infectious diseases, and marine studies. Yet, very little is done to promote such technologies in developing countries. It is also known that industrialized nations have invested heavily in building and deploying space assets to observe/monitor earth resources. These assets and technologies which capture the information can be utilized to aid developing countries through provision of long overdue solutions to critical problems related to collection, maintenance, and dissemination of accurate, reliable data for better/proper management and protection of natural resources. Finally this paper has proved the usefulness of the remote sensing imagery in the field of urban planning in order to detect the changes of the urban sprawl. The following is a brief description of an integrated national remote sensing/GIS system and a model development.
approach which is discussed in the paper, which integrates remote sensing/GIS system in phases to provide information about
1. A Web-Based information system capable of processing large volumes of Geo-spatial data (National Data Archive) to show distinct and optimum relationships between the resources of the nation for planning and decision making;
2. Descriptive attributes, statistical information and graphical representations of the availability of resources (e.g. agricultural, recreational, and urban land use, and their various proportions) showing clearly the pressures on resources for sustainable planning
3. A platform for supporting government policy decisions at all levels of government;
4. An early warning system for catastrophes, hazard mitigation, disaster preparedness and mobilization capability (e.g. food crop shortage, natural disaster, technological accidents);
5. A means to develop an approach for the protection of the environment to achieve improved living standards.
This paper identifies the importance of the Remote sensing data from satellite and aircraft sensors to be very appropriate for operational management of urban microclimate quality and associated risks in urban areas i.e. pollution, intense precipitations, fires, etc., especially if processed and used in multi-band, multi sensor, multi-temporal combinations. Some climate-related parameters have been derived and a GIS approach defined for the data sets from new sensors (i.e. ESA ENVISAT, European Space Agency Environmental Satellite) was analyzed to search for other parameters and or improve accuracies of estimations. MIVIS hyper-spectral data were used to characterize urban and sub-urban covering surfaces. Results from the experiment further confirmed for wider areas, operational use of these data could substitute integrate conventional systems to locate pollution due to asbestos, cement and other polluting covering surfaces, in different conditions of use. MIVIS data has been used for instance to assess wear condition of road asphalt, or to obtain quantitative information on different covering surfaces present in urban area characteristics of complex and chaotic urban systems. Also specific problems related to thermal characteristics in Rome urban area have been taken into account the analysis was designed to formulate complex assessments in short time, so as to plan suitable actions before urban system evolves towards undesired stages. By means of shapes (lines, points, and polygons) extracted from gec-coded remotely sensed images and from digital maps, as well as through the superimposition and interpolation of other data in a data base, it would be easy to produce thematic maps with same graphic precision characteristics of traditional cartography. This paper mainly lays emphasis on the assessing of the urban environment using the remote sensing imagery to analyse the urban conditions.
6. Application of Remote Sensing and Geographical Information System for land use / land cover mapping and change detection in the rural urban fringe area of Enschede city, The Netherlands

R. K. Nigam

The purpose of the paper is to explain land use / land cover change analysis using remotely sensed data which has been applied to discover the trend of development of the rural urban fringe of Enschede city. The city of Enschede was experiencing physical expansion along with its horizontal intensification. Using COSMOS data (merged with TM) of 1993 and IRS Pan data (merged with LISS-111) of 1996 coupled with GIS technology they have provided important information about the developments which are taking place in rural urban fringe of Enschede city and there by which can play an important role in planning and managing the city. The purpose of this study was in two stages understanding the satellite imagery. First step using imagery to examine the land use / land cover changes which are occurred during the period from 1993 to 1996 and from 1996 to 1998. Second, to develop hot links and User interface allows accessing the required information to the users using the remotely sensed data. In spite of interpretation limitations due to the spatial resolution in IRS and as well as in COSMOS data the land use change analysis has predicted higher magnitude of change in Residential and Industrial land uses during the period 1993 to 1996, which constitute 37.1 ha. and 9.7 ha. respectively of the total area change. Using the unsupervised classification they have segregated the landuses and calculated the % change of landuses which helped them to access the urban land use change/land cover. The Cosmos data and IRS pan data were compared to get the analysis of land use change / land cover. This study lays the importance of the comparison of the ancillary data with the present data to access the urban patterns.
7. Object-oriented mapping and analysis of Urban Land use/cover using IKONOS data

Martin Herold & Joseph Scepan

A common problem associated with remote sensing imagery in the urban areas is discussed in this paper. Accurate urban area remote sensing problems results from the spatial and spectral heterogeneity of the urban environment typically consisting of built up structures (buildings, transportation areas), various vegetation covers (e.g. parks, gardens, agricultural areas), bare soil zones and water bodies. In order to accurately characterize this complex spatial environment, specific spatial and spectral sensor characteristics and improved image analysis techniques are used. In this paper Object-oriented classification is used on image segmentation which results in a more homogenous and more accurate mapping product with higher detail in class definition. Specific problems are identified due the spectral and spatial complexity of urban areas, causing confusion between different roof types, roads and bare soil and NPV using the satellite imagery. Finally application of high spatial resolution data and object-oriented approaches, The first step in object-oriented analysis with ecognition is a segmentation of the image which extracts meaningful image objects (e.g. streets, houses, vegetation patches) based on their spectral and textural characteristics for large urban agglomeration identifies the potentials of the combined application of high spatial resolution space-borne IKONOS data, object-oriented image analysis algorithms and spatial metrics for a detailed and accurate mapping and analysis of urban land cover and land use spatial Metrics. This is to further analyze and refine the land cover mapping product which applied a set of spatial metrics to describe the built up structure in the study area and to explore the ability to represent land use pattern and socioeconomic characteristics.
This paper conveys a sense of achievement that remote sensing is on the threshold of creating really useful urban inventories, tempered with some disquiet that increased technical precision in detecting the extent and morphology of urban ‘land cover’. Remote sensing is a technology that has conventional and objective measures of spatial distributions have the detailed interpretation of urban form clearly needs to move beyond conventional, per-pixel classifications of detected spectral reflectance. Remote sensing representations of urban systems are being geographically comprehensive, frequently updated and increasingly detailed at large scales to access the information about the changes in the urban analysis. This paper mainly focuses on the technical issues of data assembly and physical classification. This paper has suggested an interdisciplinary process for the planners, architects and geographers where they can understand the spatial distribution of the urban phenomena and how they can use the data to resolve the urban issues. Baudot described how urban remote sensing can provide a means of monitoring changes in the extent and form of urban settlements in the developing world using the imagery. Taken together, these contextual issues suggest a challenging role for the science of remote sensing in social science formulations of the form and functioning of urban systems. There are at least four components which have taken remote sensing to the new perspective on the application of the urban planning which are

1. New sources of satellite data
2. Vastly increased computer power, new methods of geocomputation, and new thinking about science through induction
3. The development of new digital data infrastructure, and its use as ancillary sources for RS image classification and
4. Reappraisal of the ways that an understanding of data fosters improved understanding of urban systems.

Data availability and the advancements in the data processing provided the opportunity to explore the new application which makes us to understand, analyse and manage the infrastructure. Using object oriented programming spatial analysis is derived from the imagery which gives measures to be taken to improve the urban infrastructure.
This study explores the combined application of remote sensing, spatial metrics and spatial modeling to the analysis and modeling of urban growth in Santa Barbara, California. The investigation is based on a 72-year time series data set compiled from interpreted historical aerial photography and from IKONOS satellite imagery. Spatial metrics were used both specifically to assess the impact of urban development in four administrative districts, and generally to analyze the spatial and temporal dynamics of urban growth. The spatial metrics made it easy to understand the temporal and spatial properties of urban development, and shows definitively the impacts of growth constraints imposed on expansion by topography and by local planning efforts. The spatial metrics has provided a detailed description of the accuracy of the model’s historical simulations that applied to forecast the future development. The study focuses mainly on the spatial metrics the analysis from which offered improved description and representation of heterogeneous urban areas. This has provided a link between the physical landscape structure and urban form, functionality and process the urban analysis from the remote sensing. Furthermore, spatial metrics have been used for detailed analyses of the spatiotemporal patterns of urban change, and in the interpretation, assessment and verification of urban models. This study investigated the value of the combination of spatial modeling, remote sensing, and analysis with spatial metrics for the Santa Barbara, California urban region between 1930 and 2030. The historical analysis was based on remote sensing observations from archived air photos and IKONOS satellite data. The remote sensing-derived data layers were used in parameterization and calibration of the SLEUTH urban growth model. The SLEUTH model was used to predict Santa Barbara’s urban growth from 2001 to 2030, and to recreate missing historical time periods in the evolution of Santa Barbara’s urban extent since 1930. The result illustrates the utility of modeling in explaining the amount and spatial pattern of urban growth using the various techniques of remote sensing, modeling and urban models.
This paper given the information about the usefulness of Zadeh's fuzzy set theory in GIS modeling for urban land evaluation. The results indicated that incorporating fuzzy set theory into GIS modeling can provide more details about the gradual transition of urban land value than the traditional cartographic modeling approach. It basically discriminates the Boolean logic used to store the data in GIS and provides an insight into the new techniques called fuzzy GIS modeling for the urban land evaluation for the urban planners to get the analysis of the each and every plot without any decisions taken by the man. An alternative to the Boolean logic is the zedah fuzzy set theory which can be used for spatial data collection, representation, retrieval and display. This kind of data storage can be easily modified to the particular needs for specific applications. This paper has mainly explored the applications of the zadeh’s fuzzy set theory in GIS modeling for urban applications. A raster data layer in a GIS can be defined as fuzzy since it represent the most geographic features do not have sharp boundaries, and each grid cell (pixel) as the set element. In this technique multiple layers are stored in GIS for various activities. This paper has addressed a problem that is particularly common in GIS modeling for urban applications namely neither the objects nor their attributes may be uniquely defined. The black-and-white Boolean logic causes ambiguity in the cartographic modeling where as Zadeh’s fuzzy set theory, is an sensible extension of the normal Boolean algebra, can cope with the problems of uncertainty in terms of perceived possibilities of cartographic modeling approach which can avoid the loss of information that often arises when the strict Boolean logic is used on the basis of yes or no. Combining fuzzy set theory with GIS modeling procedures not only endows the GIS with the capability to deal with imprecision and vagueness, but also promotes further applications of fuzzy sets in the spatial decision making process.
11. Evaluating urban expansion and Land use change in Shijiazhuang, China, by using GIS and Remote sensing

Jieying Xiao, Jingfeng Ge, Ryutaro Tateishi, Changyuan Tang, Yanqing Liang, Zhiying Huang

This paper presents an integrated study of urbanization trends in Shijiazhuang City, Hebei Province of China, by using Geographical Information Systems (GIS) and remote sensing. The study explores the temporal and spatial characteristics of urban expansion from 1934 to 2001, and land use/cover change from 1987 to 2001. Temporally, urban expansion shows fast and slow growth stages in the study. The spatial patterns of urban growth is understood into three types: special objectives oriented type, social-political intervention type, and normal urban growth type. The remotely detected land use/cover change from 1987 to 2001 shows that the land use/cover was largely changed. The land use/cover conversion relationship implies that temporal changes are governed by urban expansion, which produces a force to drive the land use changes in search of a higher return. In this study, multi-annual socio-economic statistical data, multi-temporal city maps, and two scenes of satellite multi-spectral image are collected for evaluating the temporal and spatial characteristics of urban expansion from 1934 to 2001 and the land use land cover change between 1987 and 2001. The five maps of different historical periods were digitalized and put into GIS software. The topographical map of 1981 was used for the reference as the base map. The urban area borders in the different periods were determined for calculating the extension rate. Historical maps are used to extract the boundaries of the city to identify the patterns of urban expansion form the satellite images. By the use of the maps annual growth rate is determined and area of the city in each decade in calculated. Using the natural break method spatial characteristics are evaluated for the city for all the decades. Two scenes of Landsat images were collected for analyzing land use land cover change between 1987 and 2001. In order to start land cover classification, a 9-class classification system was developed using the land properties of the study area as urban/built-up, agricultural, vegetable field etc. The widely used supervised classification method, Maximum likelihood was employed to detect the land cover types. According to the land use map of 1991 and the large scale map of 2001, they have created two sets of ground truth samples for each image, one of which was used as training data set and the other was used as a testing data set for accuracy assessment. This how for over the past 70 years the process of urban growth urban agglomeration of Shijiazhuang is depicted on the maps using GIS and Remote sensing satellite images. This has been really useful in depicting them onto the maps by preparing five historical maps with urban expansion analysis. The data extracted from the maps represented in the following way such that the expansion process can be understood.
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very easily. Urban expansion has been divided into four stages namely: (1) initial growth stage from 1934 to 1949, (2) short recovery stage from 1950 to 1955, (3) slow growth stage from 1956 to 1980, and (4) fast expansion stage from 1981 to 2001 to understand the patterns. This paper lays the importance of the ancillary data and its capability in predicting the future of the urban cities. It also speaks majorly about the classification use and its application which made the study easy to understand the characteristics of urban growth.
12. The Spectral Dimension in Urban Land Cover Mapping From High Resolution Optical Remote Sensing Data

Martin Herold, Meg Gardner, Brian Hadley and Dar Roberts

This paper analyzes the spectral dimension of urban materials from comprehensive field spectra measurements and hyperspectral AVIRIS as well as simulated IKONOS and LANDSAT TM data in 4 m spatial resolution. The highly complex and diverse spectral properties of urban land cover types are represented using the Hyderspectral AVIRIS Data sets. Paper focuses on the high-resolution remote sensing data from the remote sensing spatial satellites for a variety of applications related to urban planning and management. This paper explains about the high degree of spatial heterogeneity in terms of various artificial and natural land cover categories, the high-spatial, low-spectral resolution satellite data which remain largely untested for mapping the urban environment particularly because of the spatial sensors which are unable to detect the urban environment. This problem can be solved using Hyperspectral data which can provide extensive spectral information that potentially can discriminate urban materials on a larger level with less expensive. It also explains about the spectral confusion between specific urban land cover classes.

This study is focused on a specific urban region of Santa Barbara and Goleta, located 170 kilometers northwest of Los Angeles in the foothills of the Californian Coast Range. The study used remote sensing data from the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) acquired 9th of June 2000 and IKONOS data recorded 18th of August 2000 to understand the urban classification. The urban environment is a mix of spatially and spectrally complex assemblage of various land cover types including diverse impervious surfaces, vegetation, water, and bare soil. AVIRIS and IKONOS images are used to understand the land use characteristics of the Santa Barbara due to complexity of the urban environment there was an poor and insufficient knowledge about urban materials and their spectral properties and separation. Further they have divided the land cover types as Type I divides the land use categories, Type II further classes the type I categories like built-up into roof types, type of construction etc and Type III describe the material properties of the elements. Basically it discussed much about the spectral properties of the urban area and the problems involved in the classification of the spectral properties of the urban area because of the material aging processes, atmospheric influences, vegetation fouling and others. From the study we can observe the reflectance brightness varies for the different targets and shows the largest dynamic range in the SWIR region. The reflectance is comparatively low for parking lots, dark gray roads, slightly higher for dark gray tar roofs, red...
gray tar roofs and light asphalt roads and highest for wood shingle roofs and red tile roofs. It also makes the inferences about the VIS and the SWIR II regions which show a fair amount of spectral variation and small-scale reflectance features for some urban targets which also contribute to the separation of specific land cover types. It can infer from the paper that the AVIRIS data can be used to further investigate important spectral bands most suitable for accurate separability. Finally Image classification of the AVIRIS data was performed using Maximum Likelihood classification on the ten optimal channels for best average separability which gives the importance of the investigation of spectral lines in order to determine the spatial characteristics of the land cover/land use to make use of the correct wavelengths to determine the characteristics of the urban region.
13. Application of Remote Sensing and GIS techniques in monitoring of urban sprawl in and around Jharia coalfields (Dhanbad)

Vinay Kumar Srivastava

This paper studies the area of Jharia Coalfield which is the only source of prime coking coal in India and has been subjected to unplanned and haphazard mining activities for the last several decades. This has led to over all degradation of environment and uneven development of all settlement thus the area looks desolate with dominance of disarranged mining, quarries waste lump, subsidence, scattered settlement etc. The remote sensing images of Landsat-TM acquired in Aug. 1990 have been used for present study in order to study the unplanned growth of the city. The digital data was processed for geometric and radiometric correction using ERDAS Images processing software which was applied for a standard false color composite test. Image was generated using Landsat TM band 2,3 and 4 (visible and near infrared images). This color image was then interpreted using standard photo-interpretation technique based on shape, size & color for delineating urban boundary. In F.C.C. urban area is associated with bluish grey to mottled grey color tone due to presence of plantation and bushes in and around the built up area. The study area was also traced from topographical sheets of 1974 from Survey of India. This traced boundary was then superimposed on map of 1990 prepared from remote sensing images and then a changed status map was drawn. Results have shown that the 60% of the area has been extended from the topographical sheets of 1974. Results indicated the new centers of urban growth came up in addition to increase in dimension of earlier settlement centers. This paper has explored the possible ways to delineate the changes at a macro level from the LANDSAT TM corrected with FCC with Survey of India’s topographical sheets. Finally the study has demonstrated the importance of integrated study satellite remote sensing images in conjunction with other geographic maps and GIS data base. The technique is cost effective faster compared to conventional method of urban data acquisition and survey methods.

Biswajit Sarma

In India, rapid urbanization is resulted due to the unprecedented population growth coupled with unplanned developmental activities. This urbanization, which lacks in infrastructure facilities, has posed serious implications on the resource base of the region. The city of Guwahati in India provides a typical case of haphazard and unplanned urbanization. Keeping these perspectives in view, this paper attempts to provide opportunities to realize a strategic assessment to determine the current status of land use, land suitability information, identification of the patterns of change during the past years, assessment of the impact of infrastructure development in terms of zoning regulations, transportation facilities, public utilities, drainage system, population, industry, tourism etc to meet the challenges in Planning and Management of Guwahati City using integrated remote sensing and GIS technology. The process of gathering data, integration and processing of topographic details their customized presentation and analysis can be developed using the remote sensing satellite images and GIS. GIS-based Land Information System (LIS) is an interactive computer-based system that helps decision makers utilize data and models to solve unstructured problems. Coupled with a digital map, GIS records, stores, and analyzes information about the features that make up the earth's surface. In this study an integrated remote sensing and GIS-based methodology is developed and successfully tested by generating an up to date digital database. Finally a Land information System (LIS) is designed for the city development authorities. This paper gives the explains about the identification of urban sprawl using Ikonos satellite imagery, it also indicates the land available for urban growth or satellite township, using remote sensing images we can monitor the land development and land use changes, the growth pressure with land use and zoning regulation are understood, finally an interactive land information systems is prepared for plot wise detailed information of the land.
15. Remote Sensing & GIS in assessing physical transformation of Bhopal city, India

Dr. Aruna Saxena

This paper gives information about the capability of remote sensing & GIS in being able to monitor the physical transformation in cities and the multi-dimensional dynamic nature of the community environment. The paper focuses mainly on possible extensions in the existing GIS with other software techniques related to remote sensing can make it a more useful tool for planners, and policymakers. In order to access the organic pattern of the Bhopal city, they used IRS IC remote sensing data to prepare a development plan. They have compared the images of the past and the present to understand the organization pattern of the city. They have observed the tremendous growth in the outskirts of the city which encourages industries and the people who cannot afford to buy houses in the core city preferred to live in the peripheral areas. Using the satellite imagery many problems have addressed like land use transformation, unauthorized constructions take place, this is where the degradation of urban environment starts off, and the issue of assessing urban transformation and the infrastructure facilities are discussed in the paper. Using spatial information for the IRS IC digitized in the auto-cad with the capability of GIS they have prepared a web-based application tool which provides information about the land parcel and various details about the land use type, owner name, year of construction etc. They have incorporated this data to understand the urban agglomeration and street network patterns. It explains about the transformation stages of urban agglomeration as Rural - Predominantly agricultural land use.

- Transitional
- Pretransitional - Gradual change starts in rural character.
- Transition - It can be categorized under urban extension.
- Post transition - Becomes almost part and parcel of urban area.
- Urban

From the imagery, they have also pointed out the problems of transformations like reduction of agricultural land holdings, increase in built area and concentration of urbanized land, loss of fertile agriculture land, new buildings and built forms, increase in density, occupational change, immigration, out migration, increases in economic status of villagers but usually decrease in quality of life, fixed use increases change from primary to tertiary, more dependence on the parent city, decrease in open spaces. This paper mainly provides an insight into the application of the remote sensing imagery into urban agglomerations.

J. G. Masek, F. E. Lindsay and S. N. Goward

The Washington D.C. Area is used as the case study to understand the satellite derived estimates of the urban growth, the economic and demographic conditions. Landsat data archive is used to create the 3 epoch time series for the urban growth for the period 1973-1996. In this study they have used NDVI differencing approach for establishing urban change to understand land cover classification to minimize the confusion with the agriculture. This study also tells about the fields where remote sensing can be applied like measurements of earth surface conditions relevant to climatology, hydrology, oceanography and land cover monitoring etc. It describes the purpose of the landsat is to track the changes in the landcover which provides high spatial resolution with regular revisit times to understand the landcover at the regionally, nationally and globally. That’s how the spatial patterns of the study are understood using the imagery. Basically 25year landsat data is used to estimate the growth pattern of the Washington DC area in this paper. In order to the analyse the growth patterns of the area Land sat images of 1975, 1985, 1990 and 1996 are taken. The earliest image (1973) was acquired with the 79-m spatial resolution Landsat Multispectral Scanner (MSS), while the other three scenes were acquired with the 28.5-m spatial resolution Landsat Thematic Mapper (TM). Land cover changes were detected using two techniques. (1) Detection of changes in independently-produced classifications and (2) Determining change directly from radiometry. The advantage of the first approach is that the semantic meaning of the landcover change is immediately observed, thus avoiding confusion between different kinds of landcover change and the later was used the principles of radiometry to understand the land cover changes during the period. The radiometric analysis includes the process of image processing techniques for change detection, including change-vector analysis, image differencing, and comparison of derived classes for multiple dates. The study concluded that image differencing of TM band 2 (0.52–0.60 mm) was superior for most urban change applications. Some other studies have used the Normalized Difference Vegetation Index (NDVI) defined as the normalized difference between near-infrared and visible reflectance, this study indicates lower the values of NDVI indicate Urbanization. NDVI classification is used in the image analysis to detect the agricultural fields in the later image so that the urban expansion can be figured out. NDVI is defined as (band4 - band3)/(band4+band3), while for MSS it is band4 and band2. NDVI from the subsequent images is subtracted to identify the green areas.
using the ISOCLUS unsupervised classification algorithm implemented in PCI software, 22 spectral classes were extracted from each Landsat TM scene, and then aggregated into four land cover types: residential, commercial (including high-density urban), agricultural (including fields, grassland, and bare earth), and forest. Finally the output from the images indicates that the Washington DC metropolitan area has grown by 500 Sq km during the past 23 years, or 22 Sq kms per year on average.
17. The Potential use of new high resolution satellite data for urban and regional planning

Gotthard Meinel, Reggin Lipold

The advantages of the satellite based remote sensing are discussed over areal photo remote sensing. Pros and cons of the both the types are discussed and their impact on the imagery of urban planning. It is said that the satellite imagery can provide much information when compared to that of the areal photographs and it also reduces the amount of errors in processing the image. With the context of the satellite imagery and advancements in the remote sensing describes the purpose of the IRCS1 C and IRS 1D Satellites. He describe the use of imagery from the IRS satellite can be high resolution satellite imagery that can be used for Urban and regional planning.

The study covers the area of Dresden, Germany where one panchromatic and one multispectral (LISS III) IRS IC images are used. Panchromatic imagery is geo referenced using topographical features with the multi spectral imagery for the high locational accuracy of the image. In order to interpret the image, shady slopes and mountains they have converted intensity values into the relative reflection values. Whereas the intensity values of the green and the red channels are reduced by atmospheric adjustment. This kind of Image classification along with the multi spectral imagers can be very useful for the purpose of regional planning, urban planning, Land use planning, Environmental planning and surveying. IRS data has been over layed with the official topographic cartographic information system (ATKIS) for the creation of the digital or analogue cartographic bases for the visual interpretation. IRS data is merged with Multispectral imagery tested with 3 parallel test 1. Intensity hue saturation transformation, 2. Principal component and 3. procedures originated by Brovey for the best visual interpretation of the image. Imagery is also available in rich colours which make it feasible for many studies. Thus this data is widely used for the purpose of development plans in the city of Dresden to access the information about the land use, climatic changes, for the purpose of surveying, forestry, telecommunications, networking, transportation and for the regional and urban planning.
18. A Land use and Land Cover Classification System for Use with Remote Sensor Data

James R Anderson, Ernest E Hardy, John T Roach and Richard E Witmer

The framework of a national land use and land cover classification system is presented for use with remote sensor data in this paper. Earlier the maps were prepared without any standard classification and without any standards which makes the data to be used for only once. In the early 1980’s USGS has recommended a classification system with standards to be developed for the preparation of maps using the satellite imagery. The classification system has been developed to meet the needs of Federal and State agencies for an up-to-date overview of land use and land cover throughout the country on a basis that is uniform in categorization at the more generalized first and second levels and that will be receptive to data from satellite and aircraft remote sensors.

The proposed system uses the features of existing widely used classification systems that are feasible to derive data from remote sensing sources. It is intentionally left open-ended so that Federal, regional, State, and local agencies can have flexibility in developing more detailed land use classifications at the third and fourth levels in order to meet their particular needs and at the same time remain compatible with each other and the national system. This has created an opportunity for the various organizations to rely on the data which can be used extensively and can be modified according to the need of the project. This made every state, central and all other governing bodies to follow the standards in the preparation of the maps. It also explains about the need for standardization. It proposes a classification system which can be explained as a land use and land cover classification system which can effectively employ orbital and high altitude remote sensor data should meet the following criteria:

1. The minimum level of interpretation accuracy in the identification of land use and land cover categories from remote sensor data should be at least 85 percent.
2. The accuracy of interpretation for the several categories should be equal.
3. Repeatable or repetitive results should be obtainable from one interpreter to another and from one time of sensing to another.
4. The classification system should be applicable over extensive areas.
5. The categorization should permit vegetation and other types of land cover to be used as surrogates for activity.
6. The classification system should be suitable for use with remote sensor data obtained at different times of the year.
7. Effective use of subcategories that can be obtained from ground surveys or from the use of larger scale or enhanced remote sensor data should be possible.

8. Aggregation of categories must be possible.

9. Comparison with future land use data should be possible.

10. Multiple uses of land should be recognized when possible. This brings the data to be unique and widely accepted worldwide.
The high resolution satellite data like Quick Bird imagery has provided the planners to delineate the building, paths, roads and other land use features. In the present study each and every house structure and village amenities such as schools, religious places, chaupals, telephone booths, hospital/ dispensaries, NGOs office, and water supply sources like hand pumps, wells as well as water pipe line, irrespective of their conditions were delineated using the QuickBird imagery for village Chharora in Mewat district of Haryana. These features were studied through digital image processing with adequate ground truths and results are documented in this paper. It explains the capacity of the high-resolution satellite imagery to arrange and store the attributes data linked with digital image on single platform. The Chharora village reference maps from the Survey of India topo sheet No 53 D/16 on 1:50000 Scale and 53 D/16/NE on 1: 25, 000 scale are georeferenced with the high resolution imagery. This paper given the importance of the Remote Sensing and GIS which have created the tools for socio economic development and demographic and related statistics. For the study they have georeference the topo sheet in the UTM grid system and they have used ERDAS IMAGINE and ARC GIS for the visual interpretation of Quick Bird Image. They have created polygon theme for the house structure and prepared socio economic database. They have correlated the tables with the satellite image. They have used census data as the socio economic parameters. For the development planning the combination of multispectral data for classification and high-resolution panchromatic data gave the automated feature extraction of all type of constructions/ house structures, roads, pathways, streets, village amenities and facilities, sprawl and change detection, monitoring growth, and illegal construction detection other land use features. The obtained QuickBird imagery is corrected for the geometric and radiometric correction for the map projections and they have orthorectified it with radiometric, geometric and topographic correction. Thus using the digital image processing (DIP) on QuickBird imagery which covers Chharora village following thematic maps of Village Chharora, district Mewat in Haryana maps were prepared indicating the location of the village and surrounding in the geo reference images, map depicts all construction and building structure was created for the analysis of socio economic patterns. Thus the maps for the network, roads, and landuse classification are prepared.
20. Land Cover Classification from Remote Sensing Imagery: Revisiting and Reevaluating Classification Accuracy

Ramita Manandhar

This paper lays the importance of the image classification of aerially sensed and satellite imageries for land cover maps as land use information as the basis for many environmental and socioeconomic applications. Ancillary data has been used during the classification for the accuracy and reliability of the maps. They have applied the most popular Maximum likelihood classifier for the classification of the land cover of Lower Hunter region of New South Wales, Australia, using Landsat-TM for the year 2005. For classification purpose seven classes (Woodland, Pasture and scrubland, Vineyard, Builtup, Water body, Mine & quarry and Olive) were identified. With the advantages of the post-classification sorting using ancillary data, such as DEM, land use boundaries, roads, along with spatial texture and a vegetation index, the overall classification accuracy was improved from 79.5 % to 85.4 % with overall Kappa statistics from 0.74 to 0.81. Landsat Thematic Mapper imagery from the Australian center for Remote sensing of the year 2005 was classified with the most widely used maximum likelihood (ML) decision rule combined with a few ancillary data (e.g. DEM and knowledge of the locality, Land use data, vegetation index and textural analysis of the landsat imagery. During the image processing one thermal band was removed and classification was performed using bands 1, 2, 3, 4, 5 and 7. In cases where a single pre-defined land cover class has a different spectral signature in different areas, multiple signatures are created and used for the classification, but later merged into one signature for one land cover class. Thresholding was also performed which is the process of identifying the pixels in a classified image that are the most likely to be classified incorrectly. Finally accuracy assessment was performed for the imagery with the merged signatures. Later on the Texture analysis and NDVI tests are performed for the segregation of the land uses like built up classification, vineyard classification, differentiation of the wood lands, mine sand quarries. This kind of classification allows the integration of remotely sensed data with other sources of georeferenced information, such as land use, spatial texture and DEM to obtain greater accuracy. This paper demonstrated the use of the widely adopted maximum likelihood classifier for initial classification and then attempted to improve the classification accuracy incorporating additional data, such as land use, DEM, spatial texture and NDVI value of the landsat imagery for post classification correction.