ABSTRACT

Since the launch of Landsat-1, the first Earth Resource Satellite, in 1972, remote sensing has become an increasingly important tool for the inventory, monitoring and management of earth resources. With a rising number and increasing performance of upcoming sensors, more efficient remote sensing techniques are required to handle new tasks of extracting more detailed information. The cost and time involved in the manual photo-interpretation and information extraction led the evolution of knowledge representation and reasoning techniques in the remote sensing arena. The accuracy of digital classification decreases as the information content of the image increases due to greater "within class variability". The pixel based approach is complex even with additional knowledge, because it does not go anywhere near the human interpretation process. A constructive alternative is to include multispectral and multisensor data into the object recognition process.

The complexity of classification is more in case of urban land use, due to the heterogeneity found amongst and within the urban features. Hence, there is a need to incorporate the geometry, context and other image parameters along with spectral parameter for urban land use mapping through remotely sensed images. The population growth and related economical activities resulting in the urban land use dynamics pose grave problem to the urban planners. Hence, a detailed urban land use mapping is necessary for a proper city planning and related resource allocation. Therefore, a generic knowledge base applicable to urban
environment will be helpful in studying the urban land use variation and appropriate planning.

In this study, an attempt was made to evaluate the object based classification with respect to urban land use classification through formulation and representation of the interpretation keys that include spectral, structural and morphological information and implementing them with knowledge base to classify an urban scene. This study concentrated on the use of object based knowledge management through fuzzy-driven rule base for level 3 urban land use classification. IRS 1C PAN and resolution-merged (IRS 1C PAN + LISS III) data, acquired in the year 1998 pertaining to a part of Chennai city were used for this study. The classification covers major land cover classes like built up area in the higher level and finer land use types such as formal and informal settlements in the third level. The interpretation keys for the urban classes were formulated and implemented through a rule base for classification. In order to emulate the human expert’s way of interpretation, the rules normally used for the interpretation were constructed as a rule base. The integration of physical (spectral), structural (texture) and the spatial (contextual) domain knowledge were implemented through this knowledge base, because the objects are most convenient units to hold multi-information. The ambiguity in rules formulation and imprecision in decision boundaries of the urban features were handled with fuzzy logic. Results of classification with respect to thematic accuracy of the object based classification and the classification accuracy in comparison with conventional classification were assessed. The same methodology was applied on the IKONOS data covering a part of Anna University campus and its surroundings to demonstrate the applicability of the proposed approach to higher resolution remote sensing data, which culminated in a better urban feature extraction for large scale mapping.
variables. The classification of the urban area was performed using this fuzzy rule base on the objects.

An object based classification yields better thematic and classification accuracy compared to the conventional classifiers. The thematic accuracy was checked against the correctness of the keys. The classification accuracy of the object based method is superior with both PAN (75.34% against 61.29%), HIS-merged (87.56% against 78.95%) and IKONOS (91.98% against 78.89%). The absence of the multiple feature space with PAN data suffered certain limitation to classify land use classes, which are mixture of more than one land cover. However, resolution merging process, where the multispectral information is combined with spatial details, compensated this. In case of IKONOS data, contemporary high resolution remote sensing data source, the classification accuracy was improved from 78.89% to 91.98%, as compared to conventional method. However, the rule base and the segmentation parameters were different from those used for IRS 1C data products.

Hence, it is observed that a customized set of data processing and rule base can be developed which are specific to sensor and to the problem. The data preprocessing needs can be ascertained for different sensors for a specific application first to abstract desired information and then to extract useful objects. In fact, generation of objects from the original image by downscaling the original image resulted in workable units and enhanced by incorporation of additional information. Therefore, this methodology is a practical alternative where the computation is less than the conventional one and the downscaling of the spectral information is compensated by the additional attributes.
The study proved that the conventional classifiers delineate the urban land covers, not land uses as the decision boundaries are drawn in the feature space based on spectral values alone. Object based approach is useful in abstraction of the problem-specific knowledge that resembles human interpretation process. Especially, the dynamic and heterogeneous urban land use needs to be classified with such knowledge-integrated approach. The objects generated by segmentation were only approximate abstraction of the land use classes and use of rule base enhanced the classification. Fuzzy decision rules employed to account for the imprecise decision variables came in handy.

An elaborate showcase of details on earth resources that is offered by the present day high resolution Satellites demands the use of knowledge about textural, spatial and structural properties. A detailed up to date urban map is the primary tool to answer the challenges of the unlimited swelling of the urban centers. The future of use of domain specific knowledge through data models embedding the knowledge is very bright in remote sensing applications.