Abstract

Surface coal mining has various environmental, ecological, and economical adversities, and causes huge land use and land cover changes. It is prone to air and water pollution. It has broadly five land classes (a) coal quarry, (b) coal dump, (c) coal overburden dump, (d) mine water body, and (e) reclamation regions. As no spectral index can encapsulate variances of such land classes, understanding their discriminating spectral characteristics in presence of other land cover classes is challenging. In the past, mostly semi-supervised and supervised classification techniques have been used to detect them. The aim of this thesis is to detect these land classes without labelled dataset but tolerant to seasonal variations using multispectral satellite images. The Jharia Coal Field (JCF) is chosen as the study area. In this dissertation, we propose a spectral index namely, coal mine index (CMI), which detects coal quarry and coal dump regions as a single class over the seasons. Lower values of CMI preserve them. Further, a hierarchical k-means clustering of CMI values has been proposed to detect them adaptively. In this process, at every step, clusters of higher values are discarded and lower values are subjected to clustering at the next level of hierarchy until a stopping criteria is met. Thereafter, a technique has been proposed to detect coal dump and coal quarry regions using their bare soil properties. Coal overburden dump follows near identical spectral characteristics with river bed regions. We have proposed an adaptive method to detect this land class using a hierarchical clustering approach and removing the anomaly of river bed regions. In addition, mine water bodies are detected using the distinctive geophysical properties of their surroundings. Each water body is treated independently. They are distinguished using different features such as, clay mineral ratio, iron oxide ratio, and CMI. There are several events in a mining region, like closing and creation of a mine, reclamation of a closed mine, coal seam fires, etc. The thesis contributes to multi-temporal analysis through CMI to detect closed, new, and active mines in adaptive manner. Closed mine are further considered to detect reclamation areas from them adaptively. The technique of detection of coal seam fires through land surface temperature may falsely attribute other high temperature regions as fire regions. In this thesis, we propose a technique to handle this limitation by considering geophysical properties of the fire regions. Overall, the thesis proposes different techniques to detect various land classes and events of surface coal mining in adaptive manner with seasonal invariability.

Key Words: Land Cover Analysis, Land Class Detection, Multispectral Satellite Images, Spectral Signature, Coal Mine Index, Surface Coal Mines.