RESEARCH ARTICLE

EXTRACTION OF LINEAMENT AND LINEAMENT DENSITY ASSESSMENT FROM SATELLITE DATA IN KOLLI HILL, TAMIL NADU, SOUTH INDIA

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ABSTRACT

The purposes of this study are to extract lineaments from satellite images in order to contribute to the understanding of the faults. IRS -IC LISS - III geo coded image is used for the analysis which is processed by extraction of lineament and lineament density. The study of lineaments from remote sensed imagery offers an attractive alternative analysis technique. An effective approach for delineation of fracture zones is based on lineament indices extracted from satellite data. With a detailed structural analysis and understanding of the tectonic evolution of a given area it delivers useful evidence for geological mapping, groundwater flow and occurrence in fractured rocks. The accuracy analysis extracted lineaments and lineament density is determined from the high resolution satellite data and results in a higher quality of lineament and lineament density map.

INTRODUCTION

Linear features on the earth surface have been a theme of study for geologists for many years from the early years of the last century (Hobbs, 1904, 1912) up to now. A lineament is a linear or curvilinear feature of a surface whose parts align in a straight or slightly curving manner. Satellite images and aerial photographs are extensively used to extract lineaments for different purposes. Since satellite images are obtained from varying wavelength intervals of the electromagnetic spectrum, they are considered to be a better tool to discriminate the lineaments and to produce better information than conventional aerial photographs (Casas et al, 2000). Lineament identification via remotely sensed data is achieved by using two principal techniques. First, lineament data can be visually enhanced using image enhancement techniques (image ration, image fusion, directional edge-detection filters) and a lineament vector map can be produced using manual digitizing techniques (Arlegui and Soriano, 1998; Suzen and Toprak, 1998). Second, a lineament map may be produced using computer’s software and algorithms (Burdick and Speirer 1980, Karmeli et al., 1996; Baumgartner et al. 1999, Hung et al. 2002, 2003, Kim et al. 2004).

Study Area

The proposed study is taken up in Kolli hills, the area chosen for the present lies almost wholly in the Namakkal District of Tamil Nadu State (Fig.1), except a small pocket on the eastern part of the hills, which lies in Tiruchirappalli District. The study area is geographically situated between the north latitudes 11°11’ N to 11°30’N and east longitudes 78°16’E to 78°29’E covering an area of 485 sq.km. On the northern side, it is bounded by Salem District and in the eastern and the south eastern sides it is bounded by Tiruchirappalli District.

METHODOLOGY

The aim of this paper is to prepare the detailed long linear natural features and its density variation in Kolli hill is attempted. The processing is developed based on the map scale of 1/50,000 and shows the major steps which are applied for the lineament extraction and lineament density analysis. This methodology aims at incorporating remotely sensed data and principles of processing these data (Drury, 1993 Schowengerdt, 1997; Hung et al. 2002 and 2003; Kim et al. 2004).

The flowchart which are applied for the lineament extraction and analysis is given below, and comprises of five successive steps:

1) First step is the selection of the suitable band of IRS -IC LISS - III geocoded image for lineament extraction and geospatial analysis.
2) Second step is to apply the image processing methods to enhance the edge and direction of lineaments.
3) Third step is the techniques used for extracting the lineaments by using a sufficient values of remote sensing and GIS software.
4) Fourth step is the evaluation of lineament and lineament density map with their directions by calculating geospatial data, like density and the lengths of these feature.
5) Fifth step includes evaluating the tectonic setting of the area depending on the results of the proposed method in this paper.

Lineaments Extraction

The term lineament refers to the long linear or curvilinear natural feature that is mostly controlled by structure or lithology. Such lineaments are the surface expressions of faults, ridges, joints, valleys, dykes rocks etc. and may be related to regional tectonic activity. For the present study, the lineaments that represent the joints, faults, etc. of the area have been identified as these may provide some useful information for locating the fracture zones of the area. Since, these fracture
zones are less resistant to erosion than the rock, these represent the weak zones, which possess favorable conditions for groundwater occurrences.

For the present study, the IRS-IC LISS-III geocoded satellite images have been used for the identification of lineaments in the study area. Based on the shape and the tonal variations, the lineaments of the study area were identified, and those lineaments which represent the fracture zones alone have been considered for the present study. The lineaments thus identified are shown

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In fig.2. From the figure, it is evident that the lineaments of the study area are oriented in different directions. However, those which are oriented in the NE-SW and NNE-SSW directions are relatively more in number and length. Lineaments with such orientations are found to be dominant in the plateau portion of the hills and northern part of the study area. The lineaments oriented in NNW-SSE direction area are also found to occur considerably in the study area and they are mostly confined to the plateau portion of the hills. The lineaments of the outer slopes are found parallel to the local slopes in the study area. Most of the lineaments in the outer slopes are oriented in a nearly east-west direction, except in the southern slopes where their orientation is found to be in north-south direction.

**Lineament Density**

The study of lineament density may help to identify the weathered zones in an area, which is very essential in the studies relating to groundwater exploration, soil erosion, landslides etc. The lineament density map for the present study area was prepared using lineament map prepared by interpretation of satellite data.

The lineament map, which was prepared on 1:50,000 scale was over laided by a 2cm grid sheet. The total length of the lineament in each grid was noted down and the process was repeated for all the grids covering the study area. By carefully examining the values obtained, the data were grouped into four classes as low (lineament density less than 1 km/sq.km.), moderate (1-2 km/sq.km.), high (2-3 km/sq.km.) and very high (> 3 km/sq.km.). Isolines were drawn for these value and thus the lineament density map shown in fig.4 was obtained. In the study area, very high lineament density zones (> 3 sq. km) are found to occupy very less areal extent. Such very high density zones are found as small isolated pockets in the northern part of Bail Nadu reserved forest, northern parts of Bail Nadu and Sittur Nadu villages, Nayakkankombai reserved forest, in the eastern parts of Gundur and Vairichettipalaiyam reserved forest, southeastern part of Vazhavandhi Nadu, southern part of Valappur Nadu, eastern part of Ariyur Nadu, central parts of Devanur Nadu and Puliyanjolai reserved forest and in the eastern part of Selur reserved forest. Areas with high lineament density (2-3 km/sq.km.) are also found mostly restricted to the plateau portion of the hills. A large patch of the category is found in the south-central part of the study area covering the villages of Vazhavandhi Nadu, Valappur Nadu and the eastern part of Ariyur Nadu. Such patches are also found in the Selur reserved forests (southern and eastern parts), in the Puliyanjolai reserved forest (southern part), Gundur reserved forest, western part of Vairichettipalaiyam reserved forest, Nayakkankombai reserved forest, Bail Nadu reserved forest, Jambuthu, reserved forest and Karavallikombai reserved forest. Minor
patches are found in Bail Nadu (northern Valappur Nadu and Devanur Nadu.

From the above description, it is clear that higher lineament density classes are found mostly in the southern slopes and the central parts of the plateau portion. The areal extent of low lineament density class is found mostly in the outer slopes whereas moderate lineament density class is found well distributed in the plateau portions as well as outer slopes.

**CONCLUSION**

In this study, IRS -IC LISS - III geo coded image is used for successful extraction of lineaments from satellite images in order to contribute to the understanding of the faults. For the current study, lineaments which represent the fracture zones alone have been considered for the present study. Those lineaments oriented in the NE-SW and NNE-SSW directions are relatively more in number and length. Very high lineament density zones (> 3 sq. km) are found to occupy very less areal extent, and occur as small isolated pockets, especially in the central and southern regions.

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