



**ROHINI COLLEGE OF ENGINEERING AND TECHNOLOGY**  
**AUTONOMOUS INSTITUTION**

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**DEPARTMENT OF AGRICULTURAL ENGINEERING**

**AI3701 – REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYATEM**

**UNIT 2 DATA PRODUCTS AND IMAGE ANALYSIS**

**2.2 KEY ELEMENTS OF VISUAL IMAGE INTERPRETATION**

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### **2.3 KEY ELEMENTS OF VISUAL IMAGE INTERPRETATION**

Various terrain characteristics are very important to soil scientists, geologists, geomorphologists, geographers, real estate developers, irrigation engineers, environmental engineers and others who wish to evaluate the suitability of the terrain for various land uses. These characteristics and the terrain conditions are also important for botanists, conservation biologists, foresters, wild life ecologists and others concerned with vegetation mapping, management and evaluation.

Knowledge of spatial database is important for planning and management activities and it is considered an essential for modeling and understanding the earth as a system. As mentioned frequently, the source of data collection for the creation of such a spatial database is remote sensing system including photographic sensing systems. This spatial database along with the corresponding attribute database (discussed in the subsequent chapters) can be used as an input for Geographical Information System (GIS) for further analysis to deduce the results which can be used for decision-making and developmental strategies. If the creation of spatial database is based on the remote sensing data analysis, then the visual image interpretation (VIP) techniques and/or digital image processing (DIP) techniques can be employed. The spatial database consists of a number of thematic maps derived from different sources in general and from remote sensing data in particular. If the source of such data is remote sensing system, then the VIP and/or DIP analysis methods have to be applied and the second important source is existing maps/toposheets.

The maps information layers namely land use/ land cover, hydrogeomorphology, soils, geology, drainage network, road network, geomorphological units/landforms and other related maps can be derived from satellite data, whereas layers of information like slope, contour, and watershed boundaries are also considered spatial database and can be derived from other existing maps/toposheets. One of the most important benefits of GIS is the ability to spatially interrelate these multiple types of information layers stemming from a range of sources. Depending upon the application area under study, the analyst may use the themes as per the requirements of the GIS output. For example, a municipal administrator wishes to use GIS to study existing conditions of a particular city. The set of thematic maps for this study contains data related to land use, land cover, road network, drainage conditions, water distribution system, site selection maps, and urban change detection maps.

In another example, a hydrologist may like to use GIS to study soil erosion in a watershed. This system should contain the data or layers, namely, topography, soils, land use, land cover, geology, ownership of the land and so on. Visual image interpretation of satellite imagery, in

general, and False Colour Composite (FCC) in particular is extensively used for generation of thematic maps/layers, based on a systematic observation and evaluation of certain key elements.



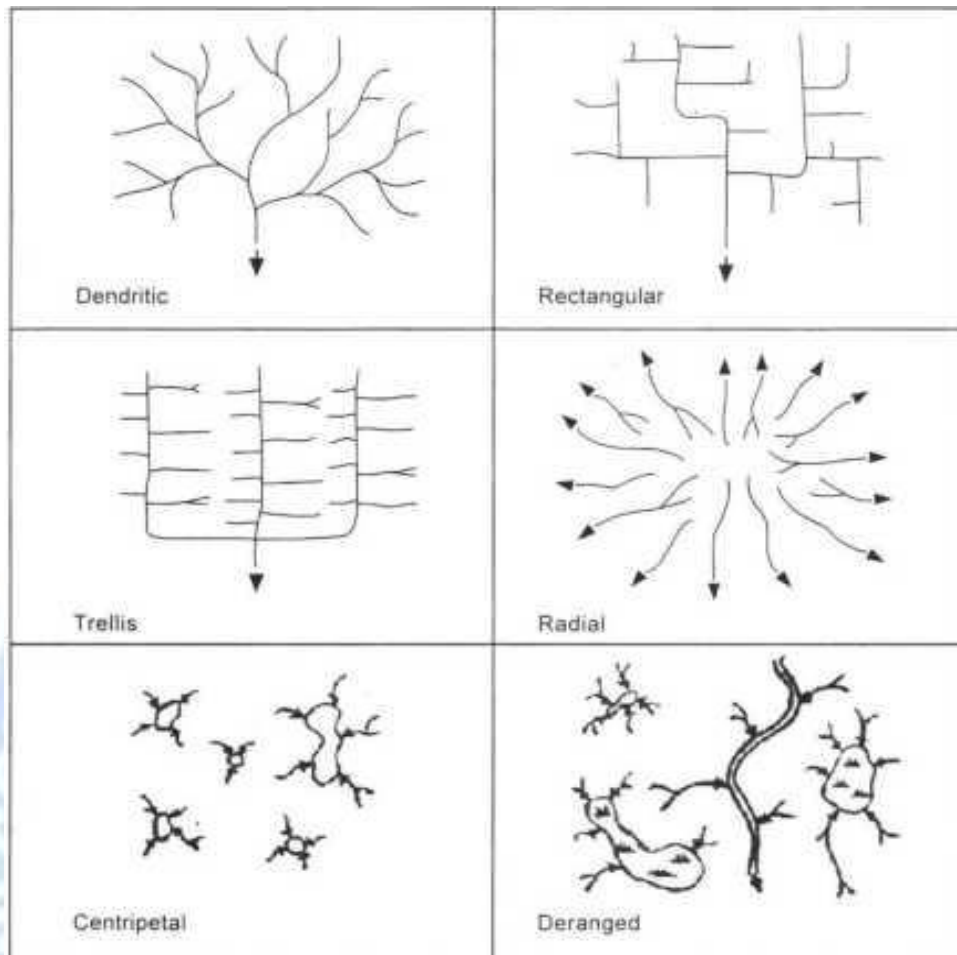
They are topography, drainage pattern, drainage texture and density, erosion, image tone, vegetation, and land use.

**Table Topographic features based on reflection characteristics- Visual interpretation of topographic features based on reflection characteristics of images**

Factor	Reflection Characteristics	Tonal Range
1. <i>Topographic</i> (a) Flat surface  (b) Sloping surface facing antenna/camera (c) Sloping surface facing away from antenna or camera (d) High relief	Specular reflection if surface is smooth; no return  Relatively high return due to orientation effects Relatively low return due to orientation effects  No return from shadow areas	Dark  Medium to light tones  Medium to dark tones  Dark tones
2. <i>Geologic</i> (a) Rough surface  (b) Smooth surface  (c) Natural corner reflectors produced by in bed rock by weathering	Diffused Reflection, medium to high return  Specular reflection if surface is flat: no return reflection influenced by topographic factors Maximum reflection, high return	Medium to light tones  Dark tone, lighter tones produced by orientation effects  Very light tones
3. <i>Vegetation</i> (a) Trees (b) Woods and Forests (c) Bush  (d) Natural grass  Broad leaf crops with high moisture content Small leaf crops	Diffused reflection High returns Higher returns with increasing densing of occurrence  Diffuse reflections, medium to low returns, dry sparse vegetation produces less scatter than bush rich-vegetation Diffuse reflection high returns Diffuse reflection medium return	Light tones Light tones Light tones in number in sub humid areas medium to dark tone in arid area environments  Medium tones in humid to sub-humid areas. Dark tones in arid environment.  Light tones Medium tones

### Drainage Pattern and Texture

The drainage pattern and texture seen on aerial and space images are indicators of landform and bedrock type and suggest soil characteristics and site drainage conditions. The drainage pattern which is a surface expression and can be discerned from the air photo or satellite image is a clue/key to infer something about the subsurface phenomena. Figure shows six of the most common drainage patterns that can be observed on different types of terrains: dendritic drainage pattern, rectangular drainage pattern, trellis drainage pattern, radial drainage pattern, centripetal drainage pattern and deranged drainage pattern.



**Figure Drainage patterns**

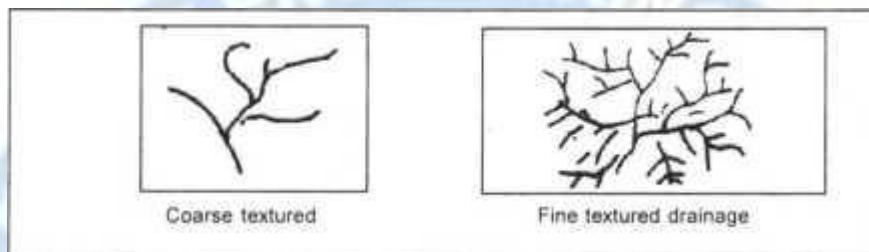
**Dendritic drainage** pattern is a well-integrated pattern formed by a main stream with its tributaries branching and rebranching freely in all directions. This type of drainage pattern commonly occurs on relatively homogeneous materials, such as, horizontally bedded sedimentary rocks and granite.

**Rectangular drainage** patterns are basically dendritic patterns and are modified by structural bed rock control such that the tributaries meet at right angles to its main stream. This type can be found on flat laying massive sand stone formations with a well-developed joint system.

**Trellis drainage pattern** consists of a number of streams having one dominant direction with sub tributaries as right angles to it. It can be found in areas of folded sedimentary rocks. Radial drainage patterns are formed from a central area and are radiated outward from this central area. All the sub-streams radiate away from a single point. These can be found on an area full of volcanoes and domes. Centripetal drainage pattern is the reverse of the radial drainage pattern . It can be found in the areas of limestone, sinkholes, volcanic craters and other depressions.

**Deranged drainage pattern** is a dis-ordered pattern , irregularly developed and directed short streams, ponds, wetland areas, and glacial till areas. These six drainage patterns are called destructional or erosional drainage patterns. The depositional constructional drainage patterns are remnants (products) of origin of landforms such as alluvial fans and glacial outwash plains.

**Drainage texture** is a combination of drainage or integration of different kinds of drainage patterns. Texture can be termed as "coarse textured and fine drainage patterns". Coarse textured patterns develop where the soils and rocks have good internal drainage with little surface runoff. Fine textured patterns develop where the soils and rocks have poor internal drainage and high surface run-off. Also fine textured drainage patterns develop on soft, easily eroded rocks, such as, shale, whereas coarse textured patterns develop on hard , massive rocks, such as, granite.



**Figure Coarse and Fine drainage texture**

A measure of texture of the drainage pattern is texture ratio (T). It is defined as the ratio of the highest number of stream order of a basin to perimeter of the basin (Vente Chow, 1979), and is expressed as

$$T = N/P$$

where, N is highest number of stream order of a basin and P is perimeter of the basin.

The high texture ratio indicates high runoff and low texture ratio indicates low runoff. For example, the texture ratio of watershed shown in Figure lies between 0.9 to 3.5, and indicates high runoff.

### **Drainage Density (D<sub>d</sub>)**

Drainage Density (D<sub>d</sub>) is a measure of the texture of the drainage basin and is defined as the ratio of the total stream length cumulated for all orders in the "basin to the basin area, that is

$$D_d = \frac{\sum L}{A}$$

where, D<sub>d</sub> = Drainage density in km/sq.km  
 L = Total length of all streams with in a basin in kms  
 A = Total area of the basin in sq.km.

The difference in drainage density are commonly attributed to difference of rainfall or relief, infiltration capacity of soil or terrain, and initial resistivity of the terrain to the erosion. The low drainage density favoured generally in the regions of highly resistant or highly permeable subsoil material under dense vegetative cover at low relief. On the other hand, in regions of weak impermeable, subsurface material, sparse vegetation and mountainous relief favour high drainage density.