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An introduction to Remote Sensing and GIS

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SUMMARY

Remote Sensing and GIS are two interrelated technologies that deal with the collection, analysis, and visualisation of spatial data. Remote Sensing is the process of acquiring data about the Earth's surface and atmosphere from a distance using sensors mounted on satellites, aircraft, or drones. GIS is the system that stores manages, manipulates, and displays the data collected by remote sensing or other sources using maps and other graphical tools. Remote Sensing and GIS have many applications in various fields, such as environmental monitoring, natural resource management, disaster management, urban planning, agriculture, and security. Remote Sensing and GIS can also help to understand the spatial patterns, relationships, and trends of various phenomena on the Earth.

INTRODUCTION

Remote Sensing involves the use of electromagnetic radiation (EMR) to measure the properties of the Earth's surface and atmosphere. EMR is a form of energy that travels in waves and has different wavelengths and frequencies. The electromagnetic spectrum is a way of classifying EMR into different types based on its wavelength or frequency, such as gamma rays, X-rays, ultraviolet rays, visible light, infrared rays, microwaves, and radio waves. Remote Sensing sensors are devices that detect and record EMR reflected or emitted by the Earth's surface or atmosphere. These sensors can be passive or active. Passive sensors rely on the natural EMR from the Sun or the Earth itself, while active sensors emit their own EMR and measure the response from the Earth. Remote Sensing sensors can also be classified based on their spatial resolution (the size of the smallest feature that can be detected), spectral resolution (the number and width of the wavelength bands that can be measured), temporal resolution (the frequency of observation), and radiometric resolution (the sensitivity to the intensity of EMR).

Remote Sensing

Remote Sensing platforms are vehicles that carry the sensors and transmit the data to the ground stations. These platforms can be satellites, aircraft, or drones. Satellites are objects that orbit around the Earth or another celestial body at different altitudes and speeds. Satellites can have different types of orbits depending on their mission and design, such as low Earth orbit (LEO), medium Earth orbit (MEO), geostationary orbit (GEO), sun-synchronous orbit (SSO), or geostationary transfer orbit (GTO). Aircraft are vehicles that fly in the atmosphere at different altitudes and speeds. Aircraft can be manned or unmanned, fixed-wing or rotary-wing. Drones are unmanned aerial vehicles (UAVs) that can fly autonomously or remotely controlled by an operator.

Geographical Information System (GIS)

GIS is a system that integrates hardware, software, data, and people to store, manage, manipulate, analyse, and display spatial data. GIS can handle both vector data (points, lines, polygons) and raster data (pixels). GIS can perform various operations on spatial data, such as inputting, editing, querying, transforming, projecting, overlaying, buffering, intersecting, clipping, joining, summarising, classifying, interpolating, extrapolating, modelling, simulating, optimising, visualising etc. GIS can also integrate data from other sources besides remote sensing, such as census data, demographic data, surveys, GPS etc. GIS can also use various methods to represent

spatial data, such as maps, charts, graphs, tables, diagrams etc. GIS can also use various techniques to enhance the visualisation of spatial data such as colours, symbols, labels, legends, scales, north arrows etc.

Understanding the difference between data and spatial data

Spatial data is a type of data that describes the location, shape, and size of objects or features on the Earth's surface. Unlike regular data, which can be any kind of information that can be stored and processed by computers, spatial data has a geographic context and can be displayed on a map. Spatial data can be used to analyse and visualise spatial patterns, relationships, and trends in various domains, such as environmental science, urban planning, transportation, health, and business. To understand the difference between data and spatial data, let us consider an example. Suppose we have a table that contains information about some cities in India, such as their names, populations, areas, and GDPs. This is an example of regular data because it does not tell us anything about where these cities are located or how they are distributed on the map. However, if we add another column to the table that contains the coordinates (latitude and longitude) of each city, then we have spatial data because we can use these coordinates to plot the cities on a map and see their spatial distribution. We can also perform spatial analysis on this data, such as calculating the distance between two cities, finding the nearest city to a given point, or clustering the cities based on their attributes.

Spatial data can be classified into two types: vector data and raster data. Vector data represents spatial features as points, lines, or polygons, each with a set of coordinates and attributes. For example, a point can represent a city, a line can represent a road, and a polygon can represent a lake. Raster data represents spatial features as a grid of cells or pixels, each with a value that indicates the presence or intensity of a certain phenomenon. For example, a raster image can represent the elevation, temperature, or vegetation of an area. Spatial data can be stored in various formats, such as shapefiles (.shp), GeoTIFF (.tif), or KML (.kml). Spatial data can also be accessed from online sources, such as web services or APIs that provide geospatial information. For example, Google Maps API allows users to query and display spatial data on interactive maps. One needs specialised software or tools to read, write, manipulate, analyse, and visualise spatial data to work with spatial data. Some examples of such tools are ArcGIS, QGIS, and R. These tools can help users perform various tasks with spatial data, such as geocoding (converting addresses to coordinates), georeferencing (aligning images or maps to real-world coordinates), spatial join (combining attributes from different spatial datasets based on their location), spatial query (selecting features that satisfy certain spatial criteria), spatial statistics (calculating summary measures or testing hypotheses based on spatial data), and spatial modelling (creating predictive models based on spatial data).

CONCLUSIONS

Remote sensing is a technique of collecting and analysing information about an object or phenomenon without making direct contact with it. Remote sensing uses electromagnetic waves to measure the properties of the Earth's surface and atmosphere. Remote sensing data can be acquired from various platforms, such as aircraft, balloons, satellites, etc. Remote sensing data can be displayed as images that show the spatial distribution of different features and phenomena. Remote sensing has many applications in various fields, such as geography, hydrology, ecology, oceanography, geology, etc.

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