International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 10 Issue 6 ǁ 2022 ǁ PP. 31-35

A Brief Review of GPS, GIS and RS & Its Applications in Civil Engineering Perspective

Prof. Pavan P. Vispute
Assistant Professor in Civil Engineering Department.
Sandip Foundation's SIEM, Nashik, India.

Abstract: *GPS, GIS & Remote Sensing are the technologies used in modern survey. The surveying task has become so hassle free, easy and fast equally for all kinds of surveys such as land, ocean, geological etc. But for these purposes there must be a proper knowledge to the surveyor. Using such modern technology one can integrate lots of data together and share or use it according the necessity. The GIS capability can be used to use many different data types associated with the same location and integrate different sets of data into a single system. Remote Sensing has become a leading tool in the management as well as analysis of almost all kinds of natural resources like water, land, deserts, mountains etc. This technology brings us various new methods to tackle natural disasters too. The present paper focuses on these various uses giving principle emphasis on its applications in Civil Engineering.*
Keywords: *GPS, GIS, Remote Sensing, Mapping, Modern Surveying.*

Date of Submission: 20-05-2022 Date of acceptance: 03-06-2022

I. Introduction:

Information about anything has become one of the basic need and necessity of human being in modern world of technology. To fulfil this demand humans themselves have evolved different ways to gather, manage, analyse, store and share that information to other users too. GIS, GPS, GNSS, RS are used for the same purpose.

1.1: A geographic information system (GIS) is a system that creates, manages, analyses, and maps all types of data. GIS connects data to a map, integrating location data (where things are) with all types of descriptive information (what things are like there). It can be rather understood as a computer system which gathers, processes, stores and serves data collected using various remote sensing platforms such as ground based, aerial or space. It can give us basic information such as latitude, longitude, temperature, population, wind speed, rainfall data and so on for the places on the earth. Using GIS, a single map could include sites that produce pollution, such as factories, and sites that are sensitive to pollution, such as wetlands and rivers. Such a map would help people determine where water supplies are most at risk.

Fig: GIS Basic Architecture

1.2: The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense. GPS was originally intended for military applications, but in the 1980's, the government made the system available for civilian use. GPS works in any weather conditions, anywhere in the world, 24 hours a day, 365 days a year. The 24 satellites that make up the GPS space segment are orbiting the earth about 12,000 miles above us. These satellites are travelling at

speeds of roughly 7,000 miles an hour. GPS satellites are powered by solar energy. They have backup batteries onboard to keep them running in the event of a solar eclipse, when there's no solar power. Small rocket boosters on each satellite keep them flying in the correct path. Each satellite weighs about 2,000 pounds and is built to last about ten years.

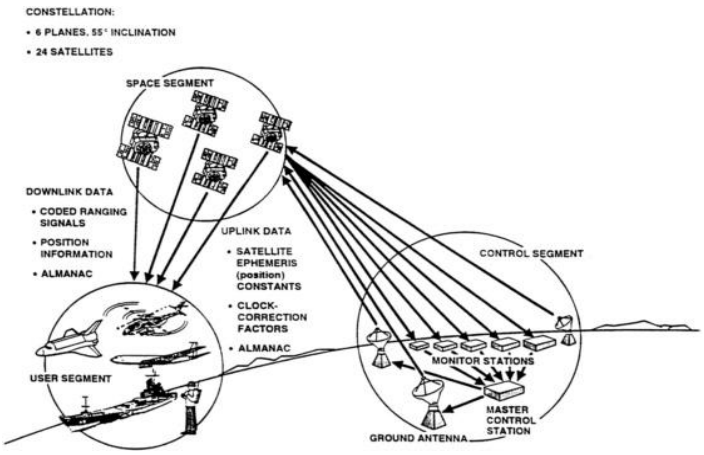

Fig: GPS Functioning

1.3: The GNSS comprises of each satellite system has specific signal characteristics, but each system attempts to be compatible with the others in order to prevent the interferences and attenuation between the signals. It is important to consider that the processing of all signals should be performed using the same receiver, thus a complex receiver design is supposed to be designed and built. As mentioned above, The GNSS frequency plan shall respect the radio-regulations as they are discussed and agreed on at ITU forums.

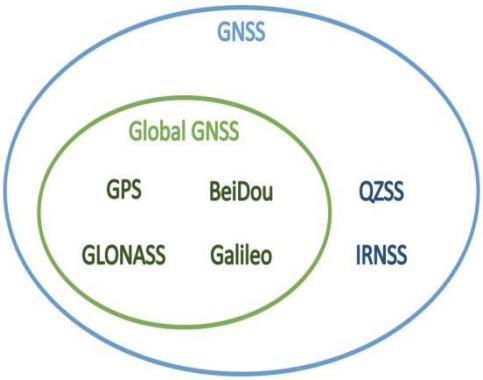

Fig: GNSS

1.4: Remote sensing is artistic and science to obtain information about opposition or feature without physical contact. People use far more insight into their everyday work through vision, hearing and smell. The collected data can take many forms, such as changes in the distribution of sound waves, changes in the distribution of force, changes in the distribution of electromagnetic energy

In other words, the departure is a different source of energy that is associated with energy, or features far away from different objects. It is identified by type or type of item, matter and local divide and it can be rated as 1975. Without RS there would be no place for modern surveying technologies. Thus the RS founds all the above mentioned satellite systems together and they all work together to fulfil the requirement of information to us.

II. Principle of RS:

It is a science comprising of laws of electronics engineering that the energy travels in the form of electromagnetic radiations also known as EMR. The group of these radiations also known as Energy Packets. The Remote Sensing is basically a multi-disciplinary science which includes a combination of various disciplines such as optics, spectroscopy, photography, computer, electronics and telecommunication, satellite launching etc. All these technologies are integrated to act as one complete system in itself, known as Remote

Sensing System. There are a number of stages in a Remote Sensing process, and each of them is important for successful operation. Detection and discrimination of objects or surface features means detecting and recording of radiant energy reflected or emitted by objects or surface material. Different objects return different amount of energy in different bands of the electromagnetic spectrum, incident upon it. This depends on the property of material (structural, chemical, and physical), surface roughness, angle of incidence, intensity, and wavelength of radiant energy.

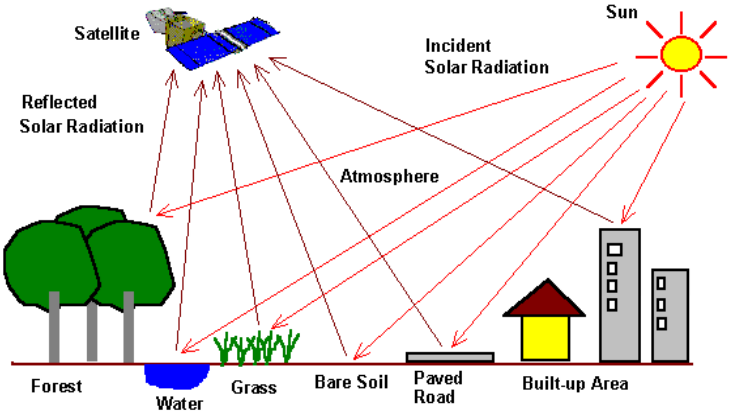

Fig: Principle of RS Operations

2.1:EMR: EMR is a dynamic form of energy that propagates as wave motion at a velocity of c = 3 x 1010 cm/sec. The parameters that characterize a wave motion are wavelength (λ), frequency (ν) and velocity (c) . The relationship between the above is c = νλ. Electromagnetic wave. It has two components, Electric field E and Magnetic field M, both perpendicular to the direction of propagation Electromagnetic energy radiates in accordance with the basic wave theory. This theory describes the EM energy as travelling in a harmonic sinusoidal fashion at the velocity of light. Although many characteristics of EM energy are easily described by wave theory, another theory known as particle theory offers insight into how electromagnetic energy interacts with matter. It suggests that EMR is composed of many discrete units called photons/quanta. The energy of photon is given by,

$Q = hc / \lambda = h \nu$

Where Q is the energy of quantum &

h = Planck's

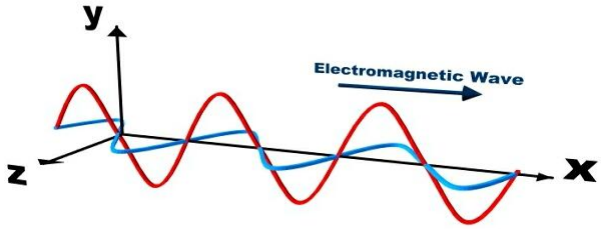

Fig: EMR Waveform

2.2: EMR Spectrum: It is a spectrometric graph that consists of of wavelengths of all kinds of waves which are responsible for carrying energy from collector to receiver. Thses wavegths can be visbible of invisible to depending upon its wavelengths. The least wavelength is for Gamma rays while that of longest wavelength is of radio waves. The electromagnetic spectrum covers the entire range of photon energies arranged in the increasing order of wavelengths on a logarithmic scale .The electromagnetic spectrum ranges from the shorter wavelengths (including gamma and X rays) to the longer wavelengths (including microwaves and radio waves). Almost the entire range of electromagnetic spectrum is useful for remote sensing in a way that every band provides unique information about the object of interest. Sensors on board earth resources satellites operate in visible, infrared and microwave regions of the spectrum. The spectrum regions are discussed in order of increasing wavelength and decreasing frequency.

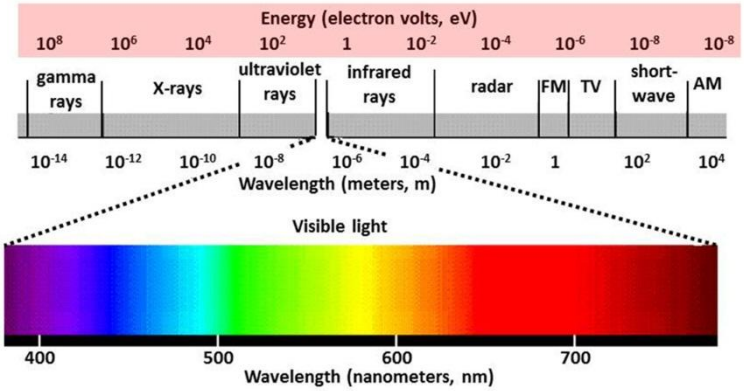

Fig: EMR Spectrum

III. Applications of GPS and RS in Civil engineering.

Several works in civil engineering are carried out in an unfriendly and complex environment which makes it difficult for the personnel to efficiently operate. But with the help of GPS or Global Positioning System, the work is carried out easier. Its ability to provide accuracy at centimeter and sub-meter levels in a highly cost-effective manner has changed the entire industry of civil engineering significantly.

This accuracy and free availability globally of the GPS signals for timing and positioning when combined with cheaper receiver chipsets makes GPS amongst the top preferred solutions for a wide range of applications when it comes to the civil engineering industry.

3.1: Transportation: GPS makes transportation more feasibly and convenient to find various locations. It also provides the real time tracking of any kind of transportation facility such as bus, railways, aeroplanes, ships etc. Several works in civil engineering are carried out in an unfriendly and complex environment which makes it difficult for the personnel to efficiently operate. But with the help of GPS or Global Positioning System, the work is carried out easier. Its ability to provide accuracy at centimeter and sub-meter levels in a highly cost-effective manner has changed the entire industry of civil engineering significantly.
This accuracy and free availability globally of the GPS signals for timing and positioning when combined with cheaper receiver chipsets makes GPS amongst the top preferred solutions for a wide range of applications when it comes to the civil engineering industry. The owners of private cars are also widely adopting the in-built GPS system in their cars and most of the manufacturers of the automobiles are into releasing newer vehicles that have an optional fitted GPS. The new technology that incorporates GPS and digital road networks and computer programs has been developed to provide direction for the push of a button. GPS role in this technology is to continue to identify the position of the car. In restricted areas such as urban fish and routes, GPS is compatible with soil systems such as DR programs to overcome the GPS signal disruption.
3.2: Environment Planning: civil engineers monitor the environment keenly before setting up a project. This is because the environment can impact the project positively or negatively. Also, in the efforts to reduce environmental pollution, the government uses GPS to monitor pollution. Civil engineers have to make sure that the project can fit in the provided location before commencing with the project.
3.3: Earthquake Detection: Oil and gas exploration largely depends on GPS data. For example, civil engineers have to carry out subsurface geology first to identify the perfect spot to drill. Also, Marine seismic surveying can be applied by civil engineers as they seek to study the composition of the subsurface rocks. This is done by sending low-frequency acoustic energy below the subsurface rocks. Both land and marine seismic is falling under the same category of seismic engineering.
3.4: Mapping: Mapping of land is considered one of the most core task done by the civil engineers. In traditional way of mapping there were uncountable readings had to be taken to plot a map of areas but after introduction of GPS it has now become convenient not only to plot a map of large territory but also to capture the image of it. And also to study time being changes in vegetation pattern, forests, urbanization etc. he need to display the discontinuity and patchiness in distribution patterns emerges while moving towards larger scales. Here, it would be impractical to derive maps through interpolation, because it would require sampling every patch, a costly operation particularly when larger areas are to be mapped.
3.5: Minerals Exploration: Now days there are so much advanced types of sensors which not only detect the underground mineral content but also estimate the volume/ quantity of it. I also suggest the right way to explore them. RS also helps to detect and analyse the strength of underground strata.

IV. Conclusion:

GPS is a real time based satellite system through which world is getting unimaginable advantages. In this paper a brief introduction of GPS, GIS and RS has been given along with some basic terms of RS. The paper also covers bold applications of this modern technology in civil engineering perspective. The more advance study of this topic will definitely open up new dimensions and will surely help the society. Efficient use of this technology will surely set new milestone in the study of Geotechnical Engineering.

References:

[1]. Hejmanowska, B., Kaminski, W., Przyborski, M., Pyka, K., & Pyrchla, J. (2015, July). Modern remote sensing and the challenges facing education systems in terms of its teaching. In *7th International Conference on Education and New Learning Technologies, Barcelona, Spain* (pp. 6549-6558).

[2]. Tanriverdi, C. (2006). A review of remote sensing and vegetation indices in precision farming. *J. Sci. Eng*, *9*, 69-76.

[3]. Matikainen, L., Lehtomäki, M., Ahokas, E., Hyyppä, J., Karjalainen, M., Jaakkola, A., & Heinonen, T. (2016). Remote sensing methods for power line corridor surveys. ISPRS Journal of Photogrammetry and Remote Sensing, 119, 10-31.

[4]. Ellis, J. B. (2013). Sustainable surface water management and green infrastructure in UK urban catchment planning. Journal of Environmental Planning and Management, 56(1), 24–41.https://doi.org/10.1080/09640568.2011.648752

[5]. Farahani, H., Wagiran, R., & Hamidon, M. N. (2014). Humidity sensors principle, mechanism,and fabrication technologies: A comprehensive review. Sensors (Switzerland), 14(5), 7881–7939.https://doi.org/10.3390/s140507881

[6]. Babar, S. and Ramesh, H., 2015. Streamflow response to land use–land cover change over the Nethravathi River Basin, India. Journal of Hydrologic Engineering, 20(10), p.05015002.

[7]. Tayari, E., Jamshid, A. R., & Goodarzi, H. R. (2015). Role of GPS and GIS in precision agriculture. Journal of Scientific Research and Development, 2(3), 157-162.

[8]. Sonti, S. H. (2015). Application of Geographic Information System (GIS) in Forest Management. Journal of Geography and Natural Disasters, 5(3), 1-5.

[9]. Seelan, S. K., Laguette, S., Casady, G. M., & Seielstad, G. A. (2003). Remote sensing applications for precision agriculture: A learning community approach. Remote Sensing of Environment, 88(1-2), 157-169.

[10]. Srivastava, P. K., Pandey, P. C., Petropoulos, G. P., Kourgialas, N. N., Pandey, V., & Singh, U. (2019). GIS and Remote Sensing Aided Information for Soil Moisture Estimation: A Comparative Study of Interpolation Techniques. Resources, 8(2), 70.