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GEOSTATIONARY SATELLITE NAVIGATION SYSTEMS: A REVIEW

Dr. Pijush Kanti Tripathi

Associate Professor, Postgraduate Department of Geography, Haldia Government College, W.B., India.
Email: pijushgeo1970@gmail.com

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***Corresponding author**

ABSTRACT

Nuclear power and renewable energy are two of the world's most popular energy sources. However, reducing pollution and combating climate change require a shift to greener energy sources like nuclear power and bioenergy. An overview of the effects of various energy sources on pollution is given in this review, which also looks at how they affect the quality of the air, water, and soil in addition to how they influence climate change. This review also gives an overview of how these energy sources affect human health and ecosystems.

INTRODUCTION

Satellite navigation systems are becoming essential tools in an increasingly connected world, serving a wide range of purposes from directing travellers on uncharted territory to assisting with precision farming and streamlining logistical processes (Stephenson, 2016). Among the various satellite constellations, geostationary satellite navigation systems stand out for their unique characteristics and widespread utility (Al-Hraishawi et al., 2022).
According to Lechner and Baumann (2000), geostationary satellite navigation systems are an essential part of the current global location and communication infrastructure. In contrast to conventional satellite navigation systems, which often depend on groups of satellites circling the Earth at different altitudes (Maral et al., 1991), geostationary systems feature satellites that stay stationary with respect to a particular location on the planet's surface (Zed, 2013). They are especially helpful for applications that need consistent and continuous coverage over wide geographic areas because of their special quality.

KEY CHARACTERISTICS OF GEOSTATIONARY SATELLITE NAVIGATION SYSTEMS:

Geostationary Orbit: According to Ilčev and Ilčev (2019), geostationary satellites orbit the Earth at a height of roughly 35,786 kilometres (22,236 miles) above the equator. They can stay motionless in relation to a particular location on the Earth's surface because, at this height, their orbital period coincides with the Earth's rotation period (Iucci et al., 2005).
Fixed Position: From the ground, geostationary satellites appear to be stationary, in contrast to satellites in low Earth orbit (LEO) or medium Earth orbit (MEO), which move in relation to the Earth's surface (Vishwakarma et al., 2014). Without requiring ground stations to follow satellites, this stable placement allows for constant communication and navigation services (Kumar and Moore, 2002).
Global Coverage: Most of the Earth's surface is covered by geostationary satellite navigation systems, which usually cover entire continents or even wider regions (Ha and Robertson, 1987). By putting several satellites in key locations around the equator, it is possible to attain this worldwide coverage (Narayanasamy et al., 2017).
High Altitude: Compared to LEO or MEO satellites, geostationary satellites have a greater coverage area per satellite due to their higher altitude. But doing so comes with longer signal propagation delays (Su et al., 2019), which can affect how responsive navigation systems are in real time Kwan (M. P and Lee, 2005). The goal of this article is to present a thorough analysis of geostationary satellite navigation systems, examining its benefits, drawbacks, applications, and technology.

UNDERSTANDING GEOSTATIONARY SATELLITE NAVIGATION SYSTEMS:

A constellation of satellites in geostationary orbit, around 35,786 kilometres (22,236 miles) above the Earth's equator, is the foundation of geostationary satellite navigation systems (Kumar, 2014). Geostationary satellites circle the Earth at the same speed as the planet's rotation, in contrast to other satellite constellations that orbit the world at different altitudes and inclinations. This allows them to remain fixed with respect to a given location on the Earth's surface (Maini and Agrawal, 2011). They are perfect for applications like global navigation and communication that require constant and uninterrupted coverage across a wide geographic area because of their stationary positioning.
Geostationary Satellite Navigation Systems are a subset of satellite navigation systems that utilize geostationary satellites to provide positioning, navigation, and timing services. Here's a breakdown of how they work:
Geostationary Satellites: These satellites orbit the Earth at an altitude of approximately 35,786 kilometers (22,236 miles) above the equator. They orbit the Earth at the same rate as the Earth's rotation, which allows them to appear stationary from a fixed point on the Earth's surface. This characteristic makes them ideal for continuous coverage of a specific region (Madry, 2015).
Coverage Area: Geostationary satellite navigation systems primarily cover a specific region of the Earth's surface, typically an entire continent or a large portion of it. Due to their high altitude and fixed position relative to the Earth, they can provide consistent coverage over a wide area (Ha and Robertson, 1987).

KEY PLAYERS AND SYSTEMS:

The Global Positioning System (GPS), created and maintained by the US government, is the most well-known geostationary satellite navigation system (Kumar and Moore, 2002). With a constellation of at least 24 satellites, GPS offers users with compatible receivers global location, navigation, and timing services (O'Connor et al., 2019). With the development of GPS over time, positioning precision has increased, and current receivers can achieve real-time accuracy down to the centimetre (Schaefer and Pearson, 2021).
To supplement or rival GPS, a number of different nations and organisations have created their own geostationary satellite navigation systems (Grewal et al., 2007). The European Union has Galileo, China has the BeiDou Navigation Satellite System (BDS), which has recently been expanded into

the BeiDou-3 constellation, and Russia runs the Global Navigation Satellite System (GLONASS) (Wang et al., 2022). These systems serve local or international user bases and have features like to those of GPS.

APPLICATIONS AND UTILITY:

Geostationary satellite navigation systems find applications across various sectors, including:

Transportation: Geostationary satellite navigation systems improve transportation safety, efficiency, and accuracy in a variety of applications, including ground-based vehicle tracking, aviation, and marine navigation (Januszewski, 2010).

Surveying and Mapping: For accurate mapping, land surveying, and urban planning tasks, surveyors, cartographers, and GIS specialists use geostationary satellite navigation systems (Olaleye et al., 2011).

Telecommunications: For accurate mapping, land surveying, and urban planning tasks, surveyors, cartographers, and GIS specialists use geostationary satellite navigation systems (Olaleye et al., 2011).

Emergency Services: Geostationary satellite navigation systems play a vital role in providing location-based information for search and rescue operations, disaster management, and humanitarian aid efforts during emergencies and natural disasters (Kose et al., 2012).

ADVANTAGES AND CHALLENGES:

Geostationary satellite navigation systems offer several advantages, including:

Global Coverage: The extensive geographic coverage provided by geostationary satellites allows for smooth communication and navigation across continents and oceans (Madry, 2015).

Continuous Availability: Geostationary satellites are able to provide continuous coverage regardless of shifts in satellite placements or visibility because of their fixed position with respect to the Earth's surface (Maini and Agrawal, 2011).

High Accuracy: High-precision positioning is provided by contemporary geostationary satellite navigation systems, allowing for accurate location determination for a variety of applications (Bhatta, 2021).

However, these systems also face challenges such as:

Signal Degradation: The efficiency of geostationary satellites is limited in some locations due to signal blocking or deterioration in urban canyons, dense foliage, and unfavourable weather (Sun et al., 2020).

Vulnerability to Interference: Geostationary satellite navigation systems, like any other satellite-based system, are vulnerable to deliberate or inadvertent interference, which can impede signal reception and jeopardise the precision of navigation (Ioannides et al., 2016).

Cost and Maintenance: Establishing and maintaining a constellation of geostationary satellites entails significant financial investment and ongoing operational costs, which may pose challenges for some countries or organizations (Garrity and Husar, 2021).

CONCLUSION:

Because they provide precise positioning, navigation, and timing information for a wide range of applications, geostationary satellite navigation systems are essential to modern society. As technology advances and more sophisticated satellite constellations are put in place, these systems keep improving efficiency, safety, and worldwide communication in a variety of businesses. Geostationary satellite navigation systems have many advantages over disadvantages, even with issues like interference and signal deterioration. As a result, they are essential instruments in today's technological environment.

REFERENCES:

Al-Hraishawi, H., Chougrani, H., Kisseleff, S., Lagunas, E., & Chatzinotas, S. (2022). A survey on nongeostationary satellite systems: The communication perspective. *IEEE Communications Surveys & Tutorials*, *25*(1), 101-132.

Bhatta, B. (2021). *Global Navigation Satellite Systems: New Technologies and Applications*. CRC Press.

Garrity, J., & Husar, A. (2021). Digital connectivity and low earth orbit satellite constellations: Opportunities for Asia and the Pacific.

Grewal, M. S., Weill, L. R., & Andrews, A. P. (2007). *Global positioning systems, inertial navigation, and integration*. John Wiley & Sons.

Ha, T. T., & Robertson, R. C. (1987). Geostationary satellite navigation systems. *IEEE Transactions on Aerospace and Electronic Systems*, (2), 247-254.

Ha, T. T., & Robertson, R. C. (1987). Geostationary satellite navigation systems. *IEEE Transactions on Aerospace and Electronic Systems*, (2), 247-254.

Ilčev, S. D., & Ilčev, S. D. (2019). Satellite Meteorological Networks. *Global Satellite Meteorological Observation (GSMO) Applications: Volume 2*, 1-63.

Ioannides, R. T., Pany, T., & Gibbons, G. (2016). Known vulnerabilities of global navigation satellite systems, status, and potential mitigation techniques. *Proceedings of the IEEE*, *104*(6), 1174-1194.

Iucci, N., Levitin, A. E., Belov, A. V., Eroshenko, E. A., Ptitsyna, N. G., Villoresi, G., ... & Yanke, V. G. (2005). Space weather conditions and spacecraft anomalies in different orbits. *Space weather*, *3*(1).

Januszewski, J. (2010). Satellite navigation systems in the transport, today and in the future. *Archives of Transport*, *22*(2), 175-187.

Kose, S., Koytak, E., & Hascicek, Y. S. (2012). An overview on the use of satellite communications for disaster management and emergency response. *International Journal of Emergency Management*, *8*(4), 350-382.

Kumar, D. (2014). Satellite Communication. *Research Journal of Engineering and Technology*, *5*(3), 147-150.

Kumar, S., & Moore, K. B. (2002). The evolution of global positioning system (GPS) technology. *Journal of science Education and Technology*, *11*, 59-80.

Kwan, M. P., & Lee, J. (2005). Emergency response after 9/11: the potential of real-time 3D GIS for quick emergency response in micro-spatial environments. *Computers, environment and urban systems*, *29*(2), 93-113.

Lechner, W., & Baumann, S. (2000). Global navigation satellite systems. *Computers and Electronics in Agriculture*, *25*(1-2), 67-85.

Madry, S. (2015). *Global navigation satellite systems and their applications* (pp. 1-8). New York: Springer.

Madry, S. (2015). *Global navigation satellite systems and their applications* (pp. 1-8). New York: Springer.

Maini, A. K., & Agrawal, V. (2011). *Satellite technology: principles and applications*. John Wiley & Sons.

Maral, G., de Ridder, J. J., Evans, B. G., & Richharia, M. (1991). Low earth orbit satellite systems for communications. *International Journal of satellite communications*, *9*(4), 209-225.

Narayanasamy, A., Ahmad, Y. A., & Othman, M. (2017, November). Nanosatellites constellation as an IoT communication platform for near equatorial countries. In *IOP conference series: materials science and engineering* (Vol. 260, No. 1, p. 012028). IOP Publishing.

O'Connor, A. C., Gallaher, M. P., Clark-Sutton, K., Lapidus, D., Oliver, Z. T., Scott, T. J., ... & Fletcher, J. (2019). Economic benefits of the global positioning system (GPS).

Olaleye, J. B., Abiodun, O. E., Olusina, J. O., & Alademomi, A. S. (2011). Surveyors and the challenges of digital surveying and mapping technology. *Surveying and Land Information Science*, *71*(1), 3-11.

Schaefer, M., & Pearson, A. (2021). Accuracy and precision of GNSS in the field. In *GPS and GNSS Technology in Geosciences* (pp. 393-414). Elsevier.

Stephenson, S. (2016). *Automotive applications of high precision GNSS* (Doctoral dissertation, University of Nottingham).

Su, Y., Liu, Y., Zhou, Y., Yuan, J., Cao, H., & Shi, J. (2019). Broadband LEO satellite communications: Architectures and key technologies. *IEEE Wireless Communications*, *26*(2), 55-61.

Sun, R., Wang, G., Cheng, Q., Fu, L., Chiang, K. W., Hsu, L. T., & Ochieng, W. Y. (2020). Improving GPS code phase positioning accuracy in urban environments using machine learning. *IEEE Internet of Things Journal*, *8*(8), 7065-7078.

Vishwakarma, S., Chauhan, A. S., & Aasma, S. (2014). A Comparative Study of Satellite Orbits as Low Earth Orbit (LEO) and Geostationary Earth Orbit (GEO). *SAMRIDDHI: A Journal of Physical Sciences, Engineering and Technology*, *6*(02), 99-106.

Wang, B., Liu, X., & Zhang, Y. (2022). Global Navigation Satellite System. In *Internet of Things and BDS Application* (pp. 1-70). Singapore: Springer Singapore.

Zee, C. H. (2013). *Theory of geostationary satellites*. Springer Science & Business Media.