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Orbital Inclination of Satellite

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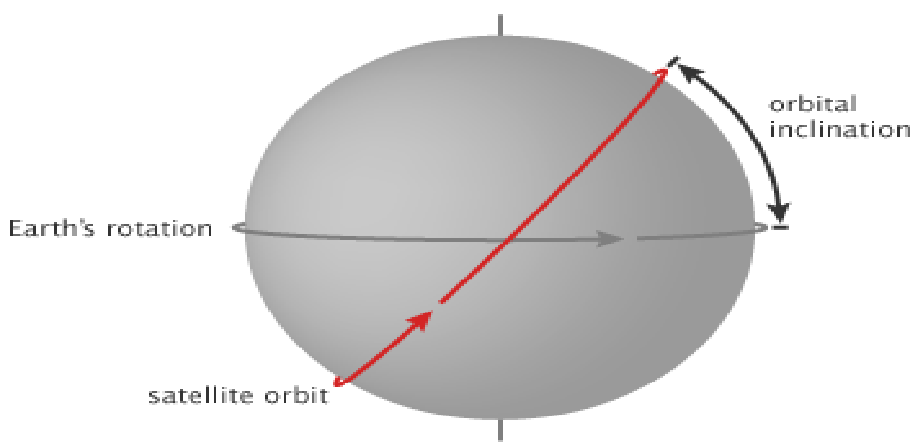
ABSTRACT

Equations are derived which govern the rate of change of the inclination of a satellite orbit to the equator of an planet. It is shown that if the motion of the satellite's ascending node on the equator plane has a period which is short as compared to with the planet precession period then the satellite's orbit will maintain a constant inclination to plane's equator. This criterion is satisfied by many satellite orbit in the soldar system. These include all satellite whose orbit planes lie in the planet's equator planes.

1. INTRODUCTION

The inclination is one of the six orbital parameters describing the shape and orientation of a celestial orbit. It is the angular distance of the orbital plane from the plane of reference (usually the primary's equator or the ecliptic), normally stated in degrees.

In the Solar System, the inclination of the orbit of a planet is defined as the angle between the plane of the orbit of the planet and the ecliptic. Therefore Earth's inclination is, by definition, zero. Inclination could instead be measured with respect to another plane, such as the Sun's equator or even Jupiter's orbital plane, but the ecliptic is more practical for Earth-bound observers. Most planetary orbits in the Solar System have relatively small inclinations, both in relation to each other and to the Sun's equator. On the other hand, the dwarf planets Pluto and Eris have inclinations to the ecliptic of 17 degrees and 44 degrees respectively, and the large asteroid Pallas is inclined at 34 degrees.



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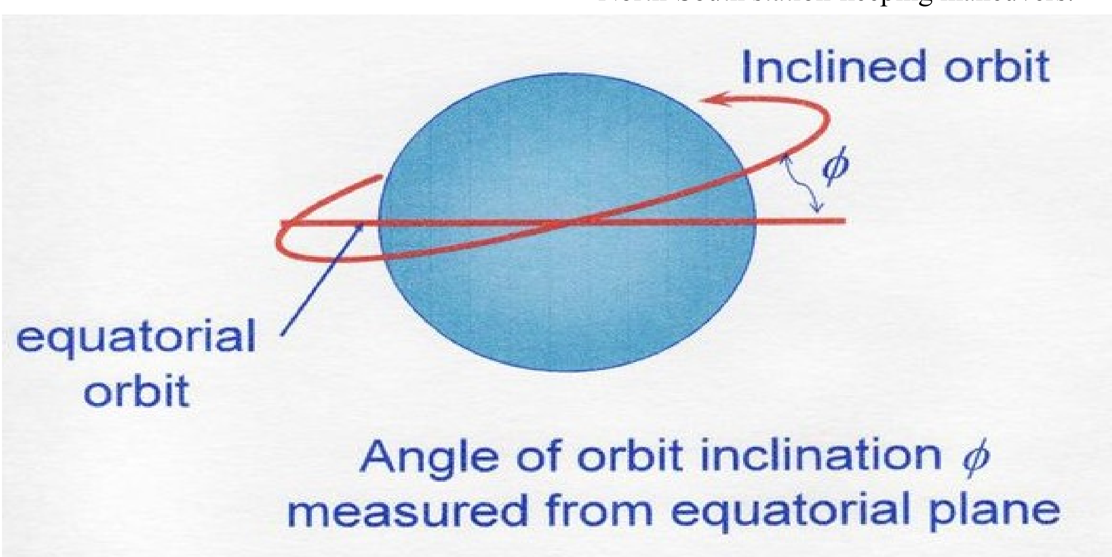
2. INCLINED ORBIT SATELLITES

. A satellite is in an inclined orbit when its orbital plane is tipped some number of degrees from the horizontal defined by the equator. In the case of an inclined geosynchronous orbit, although the satellite remains geosynchronous (that is, completing one orbit around the earth every 24 hours), it is no longer geostationary. From a fixed observation point on Earth, it would appear to trace out a small ellipse as the gravitational effects of other stellar bodies (Sun and Moon) exhibit influence over the satellite, as the effect accumulates over time the trace becomes an analemma with lobes oriented north-southward. The satellite traces the same analemma once each sidereal day.A geostationary orbit is not stable. It takes regular maneuvers to actively counteract the above gravitational forces. The majority of the fuel of the satellite, typically hydrazine, is spent for this purpose. Otherwise, the satellite experiences a change in the inclination over time. At the end of the satellite's lifetime, when fuel approaches depletion, satellite operators may decide to omit these expensive maneuver's to correct inclination and only control eccentricity. This prolongs the life-time of the satellite as it consumes less fuel over time, but the satellite can then only be used by ground antennas capable of following the north-south movement, Satellite Tracking earth stations. Before the fuel comes to an end, satellites can be moved to a graveyard orbit to keep the geostationary altitude free for subsequent missions.Satellites are allowed to drift into an inclined orbit to save satellite station-keeping propellant. East-West station-keeping maneuvers must be performed to keep the satellite in its assigned orbital position. North-South station-keeping is performed to keep the satellite in the earth's equatorial plane. Natural forces tend to cause the satellite's orbital plane to tilt, or become inclined to the earth's equatorial plane. By suspending North-South station-keeping maneuvers (while continuing East-West station-keeping), a significant savings of propellant can be realized. Typically, for a geostationary satellite, 90 percent of the total propellant usage is due to North-South station-keeping maneuvers.



3. TYPES OF SATELLITE ORBITS

3.1 CENTERIC CLASSIFCATIONS

- Galactocentric orbit: An orbit about the center of a galaxy. The Sun follows this type of orbit about the galactic center of the Milky Way.
- Heliocentric orbit: An orbit around the Sun. In the Solar System, all planets, comets, and asteroids are in such orbits, as are many artificial satellites and pieces of space debris. Moons by contrast are not in a heliocentric orbit but rather orbit their parent object.
- Geocentric orbit: An orbit around the planet Earth, such as that of the Moon or of artificial satellites.
- Areocentric orbit: An orbit around the planet Mars, such as that of its moons or artificial satellites.
- Lunar orbit (also selenocentric orbit): An orbit around the Earth's moon.
- Hermocentric orbit: An orbit around the planet Mercury.
- Aphrodiocentric orbit (also cytheriocentric orbit): An orbit around the planet Venus.
- Jovicentric orbit (also zeocentric orbit): An orbit around the planet Jupiter.
- Cronocentric orbit (also saturnocentric orbit): An orbit around the planet Saturn.
- Uranocentric orbit: An orbit around the planet Uranus.
- Neptunocentric orbit: An orbit around the planet Neptune.

3.2 ALTITUDE CLASSIFICATIONS FOR GEOMETRIC ORBITS

- **Low Earth orbit (LEO)**: Geocentric orbits with altitudes up to 2,000 km (0–1,240 miles). Medium Earth orbit (MEO): Geocentric orbits ranging in altitude from 2,000 km (1,240 miles) to just below geosynchronous orbit at 35,786 kilometers (22,236 mi). Also known as an intermediate circular orbit. These are most commonly at 20,200 kilometers (12,600 mi), or 20,650 kilometers (12,830 mi), with an orbital period of 12 hours.
- **Both Geosynchronous orbit (GSO) and Geostationary orbit (GEO)** are orbits around Earth matching Earth's sidereal rotation period. All geosynchronous and geostationary orbits have a semi-major axis of 42,164 km (26,199 mi).[3] All geostationary orbits are also geosynchronous, but not all geosynchronous orbits are geostationary. A geostationary orbit stays exactly above the equator, whereas a geosynchronous orbit may swing north and south to cover more of the Earth's surface. Both complete one full orbit of Earth per sidereal day (relative to the stars, not the Sun).
- **High Earth orbit**: Geocentric orbits above the altitude of geosynchronous orbit 35,786 km (22,240 miles).

4. CONCLUSION

In the paper we have talked about the various orbits which are being used for putting the satellite's in their respective orbits for performing their desired functions .The orbit chosen depends ipon the function to be performed. The orbits aren't only meant for artificial satellites but some planets do follow some of the orbit's rules.

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