Geostationary Satellites: Can We Place One Over Any Location on Earth?

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Satellites have many uses, such as communications, monitoring, and navigation. Satellites orbit the earth according to Newton's Law of Universal Gravitation. According to this law, the period of a satellite depends on its altitude, so from the Earth's perspective, most satellites move across the sky. Geostationary satellites are especially useful because they stay above the same point on the Earth so they do not appear to move. The drawback is that they can only be placed on the Equator and at an altitude of 35,786 kilometers, and those regions are becoming crowded. In my project, I explored the possibility of placing geostationary satellites at any latitude and altitude. After studying the geometry and physics of geostationary satellites, I wrote a MATLAB program that predicts the propulsion force necessary to keep a satellite in orbit at a specific altitude over a given point on Earth. The independent or input variables to this program are the mass of the satellite, and the fixed latitude and altitude of the orbit. The dependent or output variables are the velocity of the satellite and the propulsion force vector required to keep it in that orbit. I also wrote in MATLAB a 3D orbital simulator that takes into account any mass loss as the propellant is used up. Using the simulator, I collected data regarding the magnitude of the force necessary to keep a geostationary satellite in orbit. I then studied different propulsion technologies, and I discovered that geostationary satellites over Wyoming latitudes are feasible with current propulsion technology, but only at high earth orbit and over a short period of time. To place a geostationary satellite at low earth orbit or for an extended period requires propulsion technologies that are currently under development.

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