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SATELLITE CONSTELLATION DESIGN FOR SOLAR POWER SYSTEM

Abstract

"Space Based Solar Power" is a proposed to generate clean, green, abundant and renewable electricity in space using solar arrays and transmit to earth via microwave, radiowave or laser beams to corresponding receivers (ground stations). These traditionally are large structures orbiting around earth at the geo-synchronous altitudes. This paper aims for a design to reduce the high cost and improve technical challenges involved in the construction and operation of huge structures by introducing the concept of LEO based constellation system which consists of a network of satellites smaller in structure than the original proposed system. For this application a Repeated Sun-Synchronous Circular Track Orbit is considered (RSSTO). In these orbits, the spacecraft re-visits the same locations on earth periodically every desired number of days with the line of nodes of the spacecraft's orbit fixed relative to the Sun. A wide range of solutions are discussed, but this paper addresses specifically a 2 orbit constellation design with a number of satellites chosen according to the electricity generation requirements. The ground track is chosen such that it visits maximum number of ground stations during its orbital period. A set of ground stations are chosen for simulations based on the statistical data for locations meeting maximum electricity demands in the US and the world. A general mathematical model is used for the orbit determination so that it visits the maximum number of ground stations during a fixed period. j2 perturbations are also included to reduce the disturbances caused during the spacecraft motion.