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Author: Prof. Yury Razoumny
Peoples' Friendship University of Russia (RUDN University), Russian Federation,
yury.razoumny@gmail.com

Dr. Daniele Mortari
Texas A&M University, United States, mortari@tamu.edu
Dr. Sanghyun Lee
Republic of Korea Air Force Academy, Korea, Republic of, kafalee@gmail.com
Dr. Martin E. Avendano
Centro Universitario de la Defensa, Spain, avendano@unizar.es

FLOWER CONSTELLATIONS FOR EARTH COVERAGE WITH BIG NUMBER OF SATELLITES

Abstract

The design of constellations with big number of satellites is recently of interest to increase redundancy in communications, to provide updated high resolution Earth's images, to provide internet from space, to take rapid decisions in emergency situations, and to increase coverage and accuracy in Earth observation. Large companies are now moving from planning to invest several billions of dollars and seriously considering the opportunity to design very large constellations.This paper investigates the problem of designing very large satellite constellations for Earth coverage - the constellations with big number of satellites (hundreds and thousands of satellites) in circular orbits. This is done using the Flower Constellations theory together with the elements of Route Constellations theory to have all satellites on the geosynchronous orbits moving along one or several repeated tracks on the Earth surface. Geosynchronous orbits are orbits whose orbital period (Tp) is synchronized with the period (Td) of a rotating frame NpTp =NdTd =Trep, where Trep is the repetition time, indicating the time the satellite and the rotating frame take to come back to the initial positions. This implies a relationship between the location of the satellites (in term of mean anomalies) and the R.A.A.N. value. The satellite trajectories in the constellation are designed such that they have not self-intersections. This condition, embedded in the theory, provides specific upper bounds for orbit inclination. These bounds can be increased by selecting inclinations maximizing the minimum distance. The examples of Flower Constellation configurations made with 2000, 3000, and 4000 satellites are presented. The configurations are independent from the orbital altitude, which is defined based on other constraints (resolution, communication power, van Allen belts).