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A satellite constellation optimization for a regional GNSS remote sensing mission

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Due to the recent advances in the Global Navigation Satellite System Remote sensing (GNSS¬R) applications, optimization of a satellite orbit to investigate the Earth's properties seems significant. The comparison of the GNSS direct and reflected signals received by a Low Earth Orbit (LEO) satellite introduces a new technique to remotely sense the Earth. Several GNSS¬R missions including Cyclone Global Navigation Satellite System (CYGNSS) have been proposed for different applications such as the ocean wind speed and height monitoring. The geometric optimization of the satellite orbit before starting the mission is a key step for every space mission. Since satellite constellation design varies depending on the application, we have focused on the required geometric criteria for oceanography applications in a specified region. Here, the total number of specular points, their spatial distribution and the accuracy of their position are assumed to be sufficient for oceanography applications. Gleason's method is used to determine the position of specular points. We considered the 2-D lattice and 3-D lattice theory of flower constellation to survey whether a circular orbit or an elliptical one is suitable to improve the solution. Genetic algorithm is implemented to solve the problem. To check the visibility condition between the LEO and GPS satellites, the satellite initial state is propagated by a variable step size numerical integration method. Constellation orbit parameters achieved by optimization provide a better resolution and precession for the specular points in the study area of this research.