

# DESIGN OF SATELLITE CONSTELLATIONS FOR A BRAZILIAN REGIONAL POSITIONING SYSTEM

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## ABSTRACT

In a former work [1], Geometric Dilution of Precision – GDOP [2] was used as a metric for the optimized preliminary design of three types of satellite constellations with the purpose of establishing a hypothetical Regional Positioning System – RPS over the Brazilian territory. The first one was based only on geosynchronous satellites. The second one was based on Medium Earth Orbit - MEO satellites placed in the Equator plane, and the third one was composed by Low Earth Orbit - LEO satellites with low to moderate orbital plane inclination angles.

In the present work, the preliminary work done in [1] is extended, by performing a full scale optimization design process for the three constellation types under consideration and the performance improvements achieved, in terms of the best GDOP values obtained for each constellation type are reported and analyzed. As already happened in [1], the optimization process is carried out with help of the Generalized Extremal Optimization plus Evolution Strategies GEO + ES hybrid algorithm [3]. GEO + ES is a global optimization algorithm, developed in order to conjugate the good convergence properties of GEO [4] with the self-tuning characteristics present in the ES [5]. The results of the application of the optimization process are presented, analyzed and discussed. A comparison among the three constellations types is also performed.

A second goal of the present study is to find the answer for two questions raised by the results obtained by the preliminary design process [1]. The first one is to find out what is the minimum number of LEO satellites that are needed in order to have good coverage of the entire Brazilian territory, since in [1] even with 120 satellites (the largest satellite number tried then) the constellation coverage was not good. The second question is to observe if the addition of a fifth satellite to the geosynchronous constellation is capable of eliminating the two GDOP peaks that occurred with four satellites, causing a significant deterioration in the performance of the system during the time intervals on which the peaks occur.

## References:

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