ASTRODYNAMICS SYMPOSIUM (C1)
Mission Design, Operations & Optimization (2) (2)

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OPTIMIZATION DESIGN FOR A COMMUNICATION NANOSATELLITE CONSTELLATION

Abstract

Miniaturization and technological innovations have paved the way for new mission concepts for satellite constellations. The reduction in satellite platform costs can lead to a mission concept of numerous inexpensive satellite constellations, while the access to space problem of small satellite requires an optimization of the launches and the orbital planes required. A trade-off design must be achieved in order to allow for optimal coverage and access, while limiting the overall system launch cost.

This paper summarizes a feasibility study on the design of a nanosatellite LEO constellations for communication applications. Three different use cases, trade-offs and considerations are shown: The first, designing a constellation for communication over a specific region (surrounding about 1000 km from a specified center); Second: Designing a constellation which is required to provide constant, or near constant access to two different regions on the globe; and finally: Designing a more general constellation with a wide area coverage (like access over all of Europe). In considering the communication access requirement the trade-off in the number of satellite required in the constellation will be shown when comparing between almost complete-no-gap access (aspiring to 100%) and the near constant access requirement (97%).

Using optimization methods several constellation designs will be compared, and the resulting access and communication coverage will be shown. In addition comparison will show when the traditional Walker constellation design is preferred and when it is more recommended to use different symmetric and asymmetric satellite dispersion. Finally, launcher considerations will affect the feasibility and attractiveness of the different constellations, since the overall constellation cost rises with more dedicated orbital planes required. The resulting preferred recommended constellation is such that provides a near complete communication access, but which requires less dedicated orbital planes.