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CISLUNAR DISTRIBUTED ARCHITECTURES FOR COMMUNICATION AND NAVIGATION SERVICES OF LUNAR ASSETS

Abstract

The last decade saw a renewed interest on the Moon as a well suited training premise in preparation to manned mission to Mars, but also as an interesting target itself, for scientific investigations, technological developments and new markets opportunities. As a result, numerous and very different missions to the Moon are currently being studied and implemented, assuming to have our satellite quite crowded soon.

Such a scenario motivates the settling of space infrastructures to offer recurrent services like data relays, communication links and navigation in the cislunar environment which would facilitate and enlighten the single mission's implementation and operation.

The paper presents the strategy adopted to address the design of the orbital configuration for a distributed architecture to answer the communication and navigation needs to serve at the best the diversified lunar missions scenario expected for the next decades.

First, a set of parameters of merit are identified and exploited to compute the performances of the service providers - placed on different orbits - against the identified users' domains. Three strategies are applied, to mimic a multi-agents decision making approach: first, a single set of servicer orbits performance with respects to the whole domain of users' volume is spanned; second, the performance of services for a fixed subset of users' volume against the whole servicer domain is evaluated; last, the optimal combination of servicer orbits which can cover the largest set of users while optimizing service performance is defined.

The paper critically discusses the effectiveness of the proposed approach in detecting the best suited distributed orbital architectures for the servicers according to the expected service performance: a wide set of users, spread all over the Earth-Moon volume - from Earth vicinity to Lunar surface - is targeted to be served with a given service quality. The benefits in the exploitation of the multibody dynamical regime offered by the Earth-Moon system to set up the most promising orbital set with a minimum number of servicing spacecraft are underlined as well.