Paper ID: 38831

SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advanced Technologies for Space Communications and Navigation (7)

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# A POWER EFFICIENT CLUSTERING SCHEME FOR THE INTERSATELLITE COMMUNICATION NETWORK IN OLFAR

**Abstract**

The OLFAR (Orbiting Low Frequency Antennas for Radio Astronomy) radio telescope consists of a swarm of 50 or more nano-satellites to form a space-based interferometer for astronomy observations below 30MHz. Due to strong man-made radio frequency interference (RFI) and opacity and scintillation in the ionosphere, the swarm must be located far from Earth. Therefore the data transfer capacity to Earth is limited and data compression is needed in Space. One way to do this is to perform the data correlation in the swarm. This requires data distribution between the satellites in the swarm. Because of the limitation of small satellites as well as the amount of data transfer, the inter-satellite communication is one of the major challenges. Based on analysis of the data distribution inter-satellite requirement, clustering was considered to be a potential solution to limit the data transfer. The swarm will be divided into several clusters with cluster heads. Inter-satellite communication exists between cluster heads and members in one cluster, and between cluster heads. To optimize the clustering, a new power dissipation model is developed. This K-means clustering method, both with static K and dynamic changed K options is analyzed. The K-means algorithm is mainly based on the Euclidian distances. Cluster head selection depends on residual energies of nodes. With static K option, an expected cluster number was set as a default input. With dynamic changed K, an expected cluster number zone was given. The swarm power dissipations are calculated for each K in the zone, and the best K with the minimum swarm power dissipation will be chosen. Because the swarm formation varied in time, the swarm will be re-clustered every ten minutes. A swarm with 50 satellite was used as an example. For the K static option, the results showed that with the increase of the number of cluster, the maximum satellite average power almost decrease, but the swarm maximum instantaneous power increase. This was good for controlling satellite power, but not suitable to limit the swarm power dissipation. For dynamic changed K option, this method gave the best K for each moment. With the cluster number increasing, the swarm average power, maximum instantaneous power, and maximum satellite average power were all decreased. The swarm will be more energy efficient and it can reduce the power requirement for each satellite. Simulation results showed this method would satisfy the inter-satellite data transmission requirements with the lowest power consumption.