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# DECENTRALIZED ELECTROMAGNETIC CONTROL OF CHIPSATS SWARM USING MAGNETORQUERS

**Abstract**

Small satellite formation missions offer new options for space exploration and scientific experiments. A group of satellites flying in short relative distances to each other allows various important applications such as spatially distributed instruments for atmospheric sampling or remote sensing system. The ability to autonomously control the relative motion of each satellite in the group is the most crucial. In the case of launch of a large number of satellites in a group the formation can be considered as a swarm with less demanding requirements to the relative trajectories.

Since the role of small satellites with limitations on mass, fuel and energy on board increases, the most interesting are the relative motion control approaches that has no fuel consumption. A new type of satellites called ChipSats has been recently launched as a swarm during KickSat-2 mission. These small-scale spacecrafts include a power unit, sensors, communication systems and a microcontroller on a 3.5 x 3.5 cm printed circuit board, with a thickness of 2.5 mm and a mass of about 5 grams. In this study a swarm of ChipSats equipped with miniature magnetorquers is considered. A small weight and extremely short relative distances up to several centimeters between each satellite allow using electromagnetic interaction force for the relative motion control.

Despite the limitations of the magnetorquers dipole moment and loss of dipole-dipole interaction force with an increasing distance between satellites, it is possible to obtain bounded relative trajectories in the ChipSat swarm. Assuming the relative motion between each satellite is known a decentralized Lyapunov-based control algorithm for a swarm of ChipSats is proposed in this study. The similar type of the launch as for KickSat-2 mission is considered. The constraints on the ChipSats initial conditions for successful construction of the swarm by magnetorquers are studied.