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DESIGN AND ARCHITECTURE OF A NANOSATELLITE FOR EARTH-TO-MOON TRANSFER AND LUNAR OPERATION

Abstract

Despite looking familiar, our natural satellite is yet poorly understood. With a less expensive and eased access to the Moon, scientific interest in the exploration of our natural satellite may regain the momentum it once had. A number of missions are scheduled for the end of the decade, with notably the release of CubeSats around the Moon. Could the challenge be taken one step forward and create a fully autonomous platform from release to operation, including transfer? The following paper summarizes the feasibility of the nanosatellite MILOU (Mission for Insertion in Lunar Orbit of a 27U nanosatellite), capable of transporting a 1kg / 1U / 5W scientific payload in orbit around the Moon. The spacecraft is designed to be fully autonomous (i.e. no other help from satellite or intermediary stage) from the release in Earth orbit to the end of lunar operation. This includes Earth-to-Moon transfer and complete operational life once in orbit around the Moon. The nanosatellite, weighing around 23kg, will be released from the launcher using a 27U canister, and will use electric propulsion to reach the Moon in a little more than a year. It will feature deployable and articulated solar array, innovative strategies for attitude and orbit control, S-band for uplink communications and X-band for downlink (via a deployable directional antenna), and a dedicated shielding to protect sensitive electronics from the radiative environment. The first nanosatellite of this kind ought to be a technological demonstrator, to show maturity of certain miniaturized components (X-Band transmission, electric propulsion, power generation). The following paper focuses on the design of the satellite itself. In particular, we develop the communication and data handling architecture, the AOCS, the power management, the thermal and radiative study. The overall configuration of the satellite is finally discussed and the future challenges presented.

Key words: Nanosatellite, Student project, Low-Thrust Earth-to-Moon transfer, Electric propulsion, Technological Demonstration.