Structure and Configuration of the LunarSat Microspacecraft

A. Allen, L. Appolloni**, H. Baier*, M. Canales*, W. Dolezal*, R. Illig*, T. Matzies*, C. Ofer*, G. Öffenberger*, K. Pauly***, T. Pühlhofer*, F. Schlerka*, A. Stamminger*, I. Wilke**

** Technische Universität München, Germany*
*** ESA-ESTEC, Noordwijk, The Netherlands*
**** NASA Johnson Space Center, Houston, USA*

The European LunarSat microorbiter mission was initiated in 1996. The LunarSat spacecraft will orbit the Moon in a highly elliptical polar orbit and will provide new and detailed information about the lunar environment.

A major task in designing a new space probe lies in the study of its configuration and the structure to support it. This paper outlines the configuration of the LunarSat spacecraft and its requirements, in particular, the different subsystems and the location of their elements inside the spacecraft envelope.

The driving principle of the LunarSat design is to minimize cost. Therefore, the following design and organization principles were followed:

- Participation of many students and young graduates
- Utilization of commercial-off-the-shelf (COTS) components to lower development costs
- Design of LunarSat as microsatellite according to the Arianespace ASAP 5 specifications, to launch the probe on a Ariane 5 rocket as piggyback payload

LunarSat shall be the first three-axis stabilized microsatellite with a complete propulsion system which will be operating beyond low-earth orbit. The spacecraft is divided into two main segments by a middle plate separating the Propulsion Bay from the Upper Bay. Most primary structure elements are made of aluminum honeycomb. Based on ASAP 5 specifications its maximum envelope is 600x600x800mm³. The maximum spacecraft mass is 120kg and its center of mass has to maintain within a shift from the geometric center line of less than 5mm to the main axis.

The Upper Bay contains all payload and technical instruments, plus practically all components of each subsystem of the spacecraft, except for the propulsion system. The main engines, the propellant tanks and all propulsion elements are located in the Propulsion Bay. LunarSat uses four main engines with a thrust level of 22N each, using NTO and hydrazine. To achieve maximum controllability they are located in the four corners of the satellite. Two 1N hydrazine thrusters, mounted on opposite edges just at the bottom of the middle plate are used for attitude control along with three reaction wheels.

Several configurations have been analyzed for the Propulsion Bay, where the five tanks (two for the required fuel, two for the oxidizer and one pressure vessel) have to be mounted, and for the Upper Bay, where all the elements have to fit with respect to their requirements.