

From Small Satellites to Planetary Rovers and Space Probes - a University Approach

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Ten small satellites for Earth observation or technology demonstration have already been developed by scientists and students of TU Berlin and were launched into orbit successfully. After seven satellites of the TUBSAT family, the CubeSats of TU Berlin with the names BEESAT-1, -2, and 3 were designed, built and brought into orbit. BEESAT-4 is now in preparation. Beside the CubeSat missions, several nanosatellite missions are under currently in development. The three-axis stabilized TUBiX-20 nanosatellite bus shall be launched in 2016 to demonstrate new technologies for small satellites. The results will be used in the follow-on Earth remote sensing mission TUBIN that is equipped with an infrared imaging payload. On the other hand, a 10 kg nanosatellite bus is being developed and tested to be used first in the S-Net mission. S-Net is a constellation of four nanosatellites with the objective to verify a communication payload for inter-satellite link and to demonstrate inter-satellite communication on a sophisticated level for distributed spacecraft systems and formation flying.

The transfer of the newly developed small satellite technologies to the use for low-cost interplanetary missions and the investigation of the options and the limitations are part of the research and education activities at TU Berlin. There are two points of focus in that area: planetary rovers and space probes. The works on planetary rovers include design studies of micro rover missions for exploration of Moon and Mars and gaining practical experience and validation of new system concepts in an analogue lab environment. One example is the development of a micro rover [1] with a mass of 20 kg to explore the Moon along the rim and the Shackleton crater. Another example is the development of the fully autonomous Mars exploration rover SEAR [2] that is being tested on a planetary surface test-bed. For low-cost planetary missions using nano space probes, the already space verified new nanosatellite technologies for on-board data handling, attitude control, communication, thermal control and power supply find their use in deep space missions. The results of the demonstration of a distributed network of small satellites are interesting for space weather observation, for investigation of the Moon, asteroids and planets.

The paper gives an overview to the activities and cross-links between the CubeSat and nanosatellite technology research activities of TU Berlin and the resulting options and limits of the transfer to low-cost planetary missions.

References

- [1] Alavi. R., Briess, K., Kornemann, G., Timm, C., Micro Moon Rover Based in Pico-Satellite Technology for Assistance of Lunar Missions. Proc. 60th International Astronautical Congress 2009, Dejon, Korea, 2009, IAC-09.B4.8.7
- [2] Avsar, Cem; Frese, Walter; Meschede, Thomas and Brieß, Klaus (2014). Developing a Planetary Rover with Students: Space Education at TU Berlin. Journal of Automation, Mobile Robotics & Intelligent Systems JAMRIS, 20-29.