66th International Astronautical Congress 2015

HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Advanced Systems, Technologies, and Innovations for Human Spaceflight (7)

Author: Mr. Ralf Boden
University of Tokyo, Japan, boden.ralf@mytum.de

Mr. Andreas Hein
Technische Universität München, Germany, andreas.hein@mytum.de
Dr. Junichiro Kawaguchi
Japan Aerospace Exploration Agency (JAXA), Japan, Kawaguchi.Junichiro@jaxa.jp

# DEVELOPMENT OF A MASS ESTIMATION TOOL FOR FUTURE HUMAN SPACE MISSIONS

**Abstract**

Beyond LEO and the Moon, locations exist which are of interest for future human exploration. These include the near-Earth libration points, near-Earth objects, and of course the Mars system. The Moon and surrounding area (Cislunar space) also remain in the focus of manned missions.

For the purpose of studying future human space missions, a tool is developed to provide a fast method to estimate the on-orbit masses needed for these missions. The tool is designed to be used on a wide range of mission concepts, as no restrictions are placed on the starting and ending points of the mission.

By including the use of unmanned cargo vehicles, most mission scenarios can be accounted for by the tool. These scenarios range from short stays near Earth, all the way to long-term Mars missions. The transport of equipment to the target can be accounted for, as well a the return of samples and other items from the target location. As the focus lies with the transfer vehicles, ground segments and ascend/descend vehicles remain outside the scope of the developed model.

The developed mass estimation tool consists of an underlying calculation model and a user interface that provides access to the model's functionality. Based on mission requirements and the utilized trajectory profile, spacecraft subsystem and component masses are estimated. Where possible, the user has control over the exact spacecraft setup. Predetermined choices are available for more complex systems.

The user interface provides access to all available settings, allows the user to save and load spacecraft setups, and execute the mass estimation. Mission profiles can be calculated individually or in batches, using an identical spacecraft setup for multiple trajectory profiles. Results are displayed numerically and graphically.

A comparison with data from past mission and detailed studies shows that the tool's performance remains within an accuracy of 20%. In most cases a deviation of less than 10% from the original on-orbit mass is achieved.

Current design issues that limit the tool's area of application and accuracy are also discussed, and noted as points for future development.