V. Conclusion and Outlook

The concepts for robotic mission operations as described in section III, are applied for the setup of a demonstration prototype. This system demonstrator will be used to provide the proof of concept. This demonstration will be performed in late summer in a realistic scenario within the GSOC. The selected mission type is agreed to be an on-orbit servicing mission incorporating robotic manipulators on board the spacecraft. This special scenario has been selected as it induces a number of challenging requirements in all areas discussed in this paper and by that allows demonstrating most aspects of the common mission operations concept.

The results extracted will also be beneficial for future robotic missions. For these missions the guidelines and also prototype implementations can be used to set up the ground segment in a harmonized way. With view on the upcoming DEOS mission, the conceptual ideas for this robotic OOS type mission are prepared and can be used for the mission preparation.

Acknowledgments

The MICCRO project is funded by the Space Agency of the German Aerospace Centre (DLR) with federal funds from the Federal Ministry of Economics and Technology in accordance with the parliamentary resolution of the German Parliament. (Grant no. 50RA1015 and Grant ID 50 RA 1016).

References

[1]Reintsema, D., Thaeter, J., Rathke, A., Naumann, W., Rank, P., Sommer, J., "DEOS The German Robotics Approach to Secure and De-Orbit Malfunctioned Satellites from Low Earth Orbit", *i*-SAIRAS, August 29- September 1, 2010, Sapporo, Japan

[2]Sellmaier, F., Boge, T., Spurmann, J., Gully, S., Rupp, T., Huber, F., „On-Orbit Servicing Missions: Challenges *2010 Conference*, Huntsville, Alabama, USA, AIAA 2010-2159

[3]F. Sellmaier, M. Plura, M. Stelzer, A. Ohndorf, H. Müller, and K. Landzettel, "Mission Operation Concepts For Robotic Missions", 62nd International Astronautical Congress, 03-07. Okt. 2011, Cape Town, South Africa, 2011.

[4]Settelmeyer, E., Lehrl, E., Oesterlin, W., Hartmann, R., Landzettel, K., "The Experimental Servicing Satellite – ESS", *IARP* 98-c-14, 1998

[5]Landzettel, K., Preusche, C., Albu-Schäffer, A., Reintsema, D., Rebele, B., Hirzinger, G., "Robotic On- Orbit Servicing - DLR's Experience and Perspective", *Proceedings of the 2006 IEEE/RSJ, International Conference on Intelligent Robots and Systems*, October 9 - 15, 2006, Beijing, China

[6]Landzettel, K., Albu-Schäffer, A., Brunner, B., Beyer, A., Gruber, R., Krämer, E., Preusche, C., Reintsema, D., Schott, J., Steinmetz, H.-J., Hirzinger, G., "ROKVISS: Verification of Advanced Light Weight Robotic Joints and Tele-Presence Concepts for Future Space Missions", *ASTRA 2006 – the 9th ESA Workshop on Advanced Space Technologies for Robotics and Automation*, ESA's research and technology centre, ESTEC, Noordwijk, Netherlands, 28-30 November 2006 and solutions for Spacecraft Operations", *AIAA SpaceOps*

[7]Montenbruck, O., Kirschner, M., D'Amico, S., Bettadpur, S., "E/I-vector separation for a safe switching of the GRACE formation", *Aerospace Science and Technology* 10 (2006) 628-635

[8]D'Amico, S., and Montenbruck, O., "Proximity Operations of Formation-Flying Spacecraft Using an Eccentricity/Inclination Vector Separation", *Journal of Guidance, Control and Dynamics*, Vol.29, No. 3, May- June, 2006, pp. 554-563

[9]Persson, S., Bodin, P., Gill, E., Harr, J., Jörgensen, J., „PRISMA – an Autonomous Formation Flying mission", *ESA Small Satellite Systems and Services Symposium (4S)*, 25-29 September 2006, Sardinia, Italy

[10]K. Landzettel, G. Schreiber, B. Brunner, B. Steinmetz, K. Deutrich, and G. Hirzinger, "DLR/NASDA's Joint Robotics Experiments on ETS VII", in J. NASDA (Editor), *ETS VII Symposium*, Tokyo, Japan, 14.03.2000, 2000, pp. 136–145

[11]S. Recher, C. Stoecker, and M. Brueggen, „Inputs to Future Missions: Lessons Learned from 10 Years Building Ground M&C Systems", in Procedings of SpaceOps 2012, Stockholm, Sweden, 2012.