

SPACE EXPLORATION SYMPOSIUM (A3)  
Space Exploration Overview (1)

Author: Mr. Alessio Aboudan

CISAS – “G. Colombo” Center of Studies and Activities for Space, University of Padova, Italy,  
alessio.aboudan@unipd.it

Dr. Nicola La Gloria

CISAS – “G. Colombo” Center of Studies and Activities for Space, University of Padova, Italy,  
nicola.lagloria@unipd.it

Dr. Giacomo Colombatti

CISAS – “G. Colombo” Center of Studies and Activities for Space, University of Padova, Italy,  
giacomo.colombatti@unipd.it

Prof. Stefano Debei

CISAS – “G. Colombo” Center of Studies and Activities for Space, University of Padova, Italy,  
stefano.debei@unipd.it

AEROBOT AUTONOMOUS NAVIGATION AND MAPPING FOR PLANETARY EXPLORATION

**Abstract**

Mobility is a key requirement for planetary exploration missions. Autonomous airships (aerobots) can be used to explore unknown environments without obstacle avoidance problems, mapping large areas to different resolutions and perform a wide variety of measurements and experiments on planetary surface and on the atmosphere too. Sensor fusion between Inertial Measurement Unit (IMU) and vision systems can be used to support vehicle navigation and variable resolution surface mapping. In this work a minimal sensor suite composed by a navigation-grade IMU and stereo camera pair has been studied. Two different operating modes are considered. At altitudes below 100m stereo vision techniques can provide range, bearing and elevation measurements of a set of scattered points on the planetary surface. At higher altitudes only monocular vision can be used due to limited stereo camera baseline and only bearing and elevation of surface points are measured. Simultaneous Localization and Mapping (SLAM) extended Kalman filter algorithm has been adapted to deal with stereo and mono camera observations too. Sensor fusion with IMU measurements is used to track rapid vehicle movements and to maintain the vehicle position and attitude estimation also if, for a limited time period, no vision measurements are available. Moreover the SLAM algorithm produces a scattered points map of the entire travelled area. In this work vehicle position, attitude and mapping estimation accuracy have been assessed through tests on a set of simulated vehicle trajectories on Titan to show the reliability of this navigation solution.