Paper ID: 27484
poster

66th International Astronautical Congress 2015

SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations (IP)

Author: Ms. Graciela González Peytaví
Bundeswehr Univeristy Munich, Germany, graciela.gonzalez@unibw.de

Ms. Alena Probst
Bundeswehr University Munich, Germany, a.probst@unibw.de
Prof. Roger Förstner
Bundeswehr Univeristy Munich, Germany, roger.foerstner@unibw.de
Prof. Bernd Eissfeller
Bundeswehr Univeristy Munich, Germany, bernd.eissfeller@unibw.de

NAVIGATION CHALLENGES OF THE KANARIA ASTEROID MINING MISSION

Abstract

KaNaRiA is a feasibility study of an autonomous asteroid mining mission to the Asteroid Main Belt. The navigation department of the Institute of Space Technology and Space Applications (ISTA) of the Bundeswehr University in Munich is in charge of developing a concept for spacecraft orbit determination, inertial and relative navigation as well as deciding on the relevant spacecraft instrumentation for both navigation and the characterization of the asteroid.

This poster presents the navigation challenges identified for KaNaRiA in each of its mission phases: (1) interplanetary cruise, (2) target identification and characterization and (3) asteroid proximity operations. KaNaRiA is a multi-spacecraft mission deployed from a parking orbit at a distance of 2.8 AU from the Sun and is structured in two functional mission stages. The first stage consists of a flock of prospecting scouts. The second stage consists of a heavy-load spacecraft carrying the mining payload. Due to the complexity of the mission and the a-priori highly unknown dynamical environment in the vicinity of the small main belt asteroids, a high-degree of navigation autonomy is required for each of the mission modules.

In particular the following aspects are presented for each mission phase. For what concerns the (1) interplanetary cruise, three self-contained navigation concepts are compared: solar navigation, optical navigation and pulsar-based navigation. For the (2) target identification and characterization phase, various techniques for object rotation-state reconstruction are presented: light-curve, optical imaging with LADAR and visible range cameras and RADAR imaging. Finally, for the (3) asteroid proximity operations, concepts for asteroid surface relative navigation during mapping, descent and landing are discussed – i.e. optical navigation, LIDAR assisted optical navigation and RADAR navigation. For each phase, the presented concepts are compared according to the sensor technology readiness level, level of accuracy, power and mass demands, spatial range, estimated cost and sensor reusability.

KaNaRiA is financed by the German Aerospace Centre, Space Administration (DLR, Deutsches Zentrum für Luft- und Raumfahrt) on behalf of the German Ministry of Economy and Energy (FKZ 50NA1319). The KaNaRiA kick-off meeting took place in October 2013 and the project is foreseen for a period of four years.

Keywords: KaNaRiA, autonomous navigation, asteroid characterization, asteroid proximity operations