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TESTING OF AUTONOMOUS NAVIGATION CAPABILITY BASED ON PLANET PHOTOS AT ISS

Abstract

Spaceflight history is logically connected to the Solar System exploration. The Moon is the first space body which will be conquered by our human civilization. It is rational to use ISS capabilities for Moon exploration at the initial phase. Some engineering challenges have to be overcome for a successful crew mission to the Moon. Autonomous navigation during Moon flyby is one of them. Orbital parameters and corrective burns could be generated based on data received from ground tracking stations until a spacecraft (SC) overcomes some distance from the Earth. Data from onboard satellite navigation equipment could be used up to the distance, that to be defined during operation. When SC flies in the vicinity of the Moon, or when the Moon covers the Earth, corrective burns are made based on data received from autonomous navigation measurements (not dependent on the Earth). Optical instruments and sensors traditionally support these calculations to define the direction of the selected stars as well as Moon/Earth/Sun position. Planet images could also support to define SC orbital parameters. Nowadays, due to maturity of professional digital photography equipment, the crew could use special cameras as well as commercial cameras for autonomous navigation measurements just doing handheld shooting of the illuminated lunar surface through the window. The crew imports digital camera pictures to onboard computer and make required transformations to determine the shooting position, i.e. the camera position in space during image taking. If needed, these data, autonomously calculated by the crew, could be downloaded into a control system (manually or autonomously, if onboard laptop is matched with a control system). Taking images of the Moon could be used for providing a back-up, controlling or emergent autonomous navigation system. If there is a computer with a sufficiently large display aboard SC performing Lunar flyby, a cosmonaut could view and save Lunar surface images as well as withdraw useful navigation data from them. To do that, the onboard computer should contain Moon's map (orthophotomap) in orthogonal projection and dedicated software that let a cosmonaut easily and efficiently convert images into the map projection. The image-taking camera position in space could be found from angular coordinates of all pixels retrieved by the software via processing of the lunar surface digital image.