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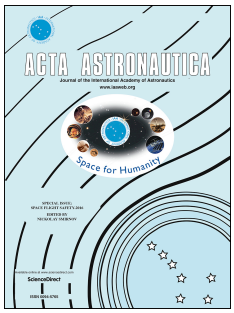

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Trajectory Design and Guidance for Landing on Phobos

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Abstract

While common Descent and Landing strategies involve extended periods of forced motion, significant fuel savings could be achieved by exploiting the natural dynamics in the vicinity of the target. However, small bodies are characterised by perturbed and poorly known dynamics environments, calling for robust autonomous guidance, navigation and control. Airbus Defence and Space and the University of Bristol have been contracted by the UK Space Agency to investigate the optimisation of landing trajectories, including novel approaches from the dynamical systems theory, and robust nonlinear control techniques, with an application to the case of a landing on the Martian moon Phobos.

Keywords: Landing, Small Bodies, Libration Point Orbits, Invariant Manifolds, Trajectory Design, Guidance

1. Introduction

Space sample return missions have a record of revolutionising planetary science. In 2012, new chemical analyses carried out by the University of Chicago on the lunar material collected by Apollo 14 fifty years earlier brought new elements to the disputed question of the origin of the Moon, casting a new doubt on the most widely accepted *Giant Impact* theory [1]. The US manned missions to the Moon of the Apollo programme were the first missions to return extraterrestrial samples, then followed by the Soviet Luna missions, relying solely

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