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A DEEP LEARNING BASED VISUAL NAVIGATION SYSTEM FOR DEEP SPACE NAVIGATION

Abstract

Space exploration will require the application of advanced technologies, for both lowering the cost associated with the deployment of space systems and the costs associated with complex operations in deep space.

In this context the development of Artificial Intelligence, and in particular, the latest advancements in deep learning, capable of mimicking the perception of mammals' brains (of visual cortex in particular), is currently disrupting a wide variety of industrial sectors solving huge challenges in different domains.

Space is embracing this technology and will constitute one of the foundations for a multi-planetary future.

In this context, the use of actual DL-based vision techniques applied to deep space can provide reliable information to the navigation system. However, the presenting approach constitutes the first step toward the creation of a fully autonomous deep space system.

This work will present a deep learning-based approach to visual navigation applied to asteroid navigation. The use case analyzed is the navigation during the approaching phase with the binary system 65803 Didymos.

The use of state-of-the-art localization techniques currently applied to drone navigation and autonomous driving is exploited and adapted to the use case, showing the strong capabilities of a neural network.

The adaptability of the method is applied to a wide variety of situations (e.g.: light conditions, body shape, initial position), and his strong robustness is shown and evaluated.

Moreover, the presented method is tested and deployed, in open-loop, on a hardware accelerator already tested in space and resembling a realist future deep space exploration mission.