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NEURAL POSE ESTIMATION ALGORITHM FOR RENDEZ-VOUS AND DOCKING OF NON-COOPERATIVE TARGETS

Abstract

The increasing complexity of in-space operations and the growing number of uncooperative targets in-orbit requires new intelligent concepts of operation to be put in place. Artificial Intelligence (AI) and Deep Learning (DL) in particular, enable the design and implementation of more capable and complex space missions, thanks to improved near real-time decision-making and data analysis functionalities in the space segment.

Similar to the vision for humans, AI-based Image processing will play a central role for intelligent systems in enabling space missions aimed at reducing the number of debris in orbit, enabling fully automated rendezvous and docking, and eventually allowing a deep exploration of the Solar System and beyond.

We propose a novel monocular pose estimation algorithm based on a Feature Pyramid Network (FPN), leveraging EfficientNets technology, ready to be deployed on space-grade embedded systems as a feature extractor combined with a reliable Efficient Perspective-n-Point routine (EPnP). The use of trainable neural networks offers: 1) the flexibility of a model ready to be adapted to several scenarios and 2) the representative power that DL can give in extracting meaningful features, automatically, from an image.

The whole pipeline is then tested on a low-powered embedded system based on the Google Coral accelerator.