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ARTIFICIAL INTELLIGENCE FOR ONBOARD IMAGE PROCESSING

Abstract

The path towards a multi-planetary species passes through the implementation of disruptive technological innovation. Artificial Intelligence and autonomy on spacecraft will be a fundamental part of this future. Hence, leveraging on-the-edge AI accelerators, such as FPGAs, GPUs, VPUs, ASICs, will constitute an essential component of the spacecraft hardware of tomorrow.

This work presents a comparative work, specifically targeted to the use of on-board satellites. The work presents three applications related to observation: cloud segmentation, maritime vehicle detection, and ground target tracking implemented and deployed to the Intel Myriad X VPU, the Nvidia Jetson, and Google Coral. A comparison between the performances of the algorithms is provided, in the two cases of execution on a COTS processor and on the tested DL accelerators. The algorithms presented exploit state-of-the-art Deep Learning architectures (such as EfficientNets), based on Convolutional Neural Networks.

The combination of state-of-the-art Deep Learning algorithms, and innovative embedded processing units, provides a powerful setup to enhance the services provided by future satellite systems, making high-level information from payload data available on the spacecraft.In an era where Artificial Intelligence is making cars and other systems smarter and more autonomous, is possible to envision the development of Deep Learning applications on-board satellites to enhance the autonomy capabilities of satellites, in order to enable a faster reaction to events, more advanced concepts of operations (e.g. ground target tracking), improvement of the relevance of downlinked data, and finally enabling innovative and more effective services to the ground (e.g. surveillance applications).