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QLEVER SAT: USING AI IN A CUBESAT (6U) FOR EARTH OBSERVATION

**Abstract**

The launch of small satellites, down to nanosatellites, is revolutionizing the development of Earth Observation missions and the implementation of Space applications, most of them as yet unsuspected. At the same time, Artificial Intelligence and deep neural networks algorithms are enjoying impressive success for their results and the numerous applications they enable. Combining CubeSat standards with Artificial Intelligence capabilities will allow to push the boundaries of Space systems further. Led by the Grenoble University Space Center (CSUG), the QlevEr Sat project will embark such an algorithm aboard a CubeSat. The mission is to process data on board and send only the relevant results to ground stations, according to specific Earth Observation use cases. Onboard data is processed and interpreted. For example, from raw images taken with an Emerald® sensor by Teledyne e2v, forest/non-forest and cloud/non-cloud segmentation maps are inferred with the Qormino® processor by Teledyne e2v, to monitor deforestation. Cloud and forest detection are two pilot cases for the QlevEr Sat demonstrator, the former being rather generic, and the latter with more societal issues. Moreover, as fast and low-cost access to satellite data requires more and more bandwidth, as radio frequencies get overloaded, data downlink has become a major issue in NewSpace. Edge AI has the potential to transform the way we manage data. They can now be lighter, smarter, more useful, more reconfigurable. In this paper, we present how we have obtained such a result using an AI algorithm running on a Qormino® QLS1046-Space quad-core ARM processor. The specifically designed pixel-wise classification algorithm leverages Qormino®'s computing power to produce accurate high resolution binary maps. These maps were successfully tested under various conditions, using both satellite and ground test-datasets. This innovative scalable AI will be embedded into the Qormino® chip mounted onto a 1U-wide printed circuit board, providing a versatile potentially multi-purpose payload.