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AEROS: OCEANOGRAPHIC HYPERSPECTRAL IMAGING AND ARGOS-TRACKING 3U CUBESAT

Abstract

AEROS is a 3U CubeSat pathfinder toward a future ocean-observing constellation, which will operate in a 500 km Sun-Synchronous orbit, targeting the Portuguese Atlantic region. AEROS features a miniaturized, high-resolution Hyperspectral Imager (HSI), a 5MP RGB camera, and a software-defined radio (SDR) to interface with Argos, a globally distributed system of remote platforms that collect and relay oceanographic and meteorological data. These sensors will facilitate the advancement of Portuguese scientific and technological knowledge, and international space industry partnerships, with data processed and aggregated for end-users in a new web-based Data Analysis Center (DAC).

The HSI has 150 spectrally contiguous bands covering visible to near-infrared (470 nm – 900 nm) with 10 nm bandwidth (full width at half maximum). The HSI collects ocean color data to support studies of oceanographic characteristics (e.g. primary productivity, mesoscale ocean fronts, and eddies) known to influence the spatio-temporal distribution and movement behavior of marine organisms. To inform performance estimates for the HSI, radiometric analyses were conducted to characterize band sensitivity given varying atmospheric and target conditions. Simulated HSI images were generated to assess suitability for scientific purposes through interpolation of spectral information from Sentinel-2 imagery combined with the AEROS's sensor spectral responses (real calibrated data) and mission-specific parameters.

Usage of an SDR expands AEROS's operational and communication range and allows for remote reconfiguration. The SDR receives, demodulates, and retransmits short duration messages (401.650 MHz + 30kHz), from Argos sources including tagged marine organisms, vessels, autonomous vehicles, subsurface floats, and buoys. This allows AEROS to retransmit messages from Argos platforms to ground and processing stations that compute platform locations using Doppler effect measurements.

The future DAC will collect, store, process, and analyze acquired data, taking advantage of its ability to disseminate data across the stakeholders and the scientific network. Correlation of animal-borne Argos platform locations and oceanographic data will advance fisheries management, ecosystem-based management, monitoring of marine protected areas, and bio-oceanographic research in the face of a rapidly changing environment. For example, correlation of oceanographic data collected by the HSI, geolocated with supplementary images from the RGB camera and fish locations, will provide researchers with near real-time estimates of essential oceanographic variables within areas selected by species of interest (e.g. sharks, rays, and tuna). This is essential for determining how keystone species, or those vulnerable to overexploitation, interact with their environment. Other relevant applications include monitoring sediment transport, erosion, pollution, and human activities.