Unmanned Aerial System Development for the Remote Reflectance Sensing Using Above-Water Radiometers

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Abstract : Due to the difficulty of the utilization of satellite and an aircraft, conventional ocean color remote sensing has a disadvantage in that it is difficult to obtain images of desired places at desired times. These disadvantages make it difficult to capture the anomalies such as the occurrence of the red tide which requires immediate observation. It is also difficult to understand the phenomena such as the resuspension-precipitation process of suspended solids and the spread of low-salinity water originating in the coastal areas. For the remote sensing reflectance of seawater, above-water radiometers (AWR) have been used either by carrying portable AWRs on a ship or installing those at fixed observation points on the Ieodo ocean research station, Socheongcho base, and etc. In particular, however, it requires the high cost to measure the remote reflectance in various seawater environments at various times and it is even not possible to measure it at the desired frequency in the desired sea area at the desired time. Also, in case of the stationary observation, it is advantageous that observation data is continuously obtained, but there is the disadvantage that data of various sea areas cannot be obtained. It is possible to instantly capture various marine phenomena occurring on the coast using the unmanned aerial system (UAS) including vertical takeoff and landing (VTOL) type unmanned aerial vehicles (UAV) since it could move and hover at the one location and acquire data of the desired form at a high resolution. To remotely estimate seawater constituents, it is necessary to install an ultra-spectral sensor. Also, to calculate reflected light from the surface of the sea in consideration of the sun's incident light, a total of three sensors need to be installed on the UAV. The remote sensing reflectance of seawater is the most basic optical property for remotely estimating color components in seawater and we could remotely estimate the chlorophyll concentration, the suspended solids concentration, and the dissolved organic amount. Estimating seawater physics from the remote sensing reflectance requires the algorithm development using the accumulation data of seawater reflectivity under various seawater and atmospheric conditions. The UAS with three AWRs is developed for the remote reflection sensing on the surface of the sea. Throughout the paper, we explain the details of each UAS component, system operation scenarios, and simulation and experiment results. The UAS consists of a UAV, a solar tracker, a transmitter, a ground control station (GCS), three AWRs, and two gimbals.

Keywords : above-water radiometers (AWR), ground control station (GCS), unmanned aerial system (UAS), unmanned aerial vehicle (UAV)
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