Preliminary Results Of An Algorithm To Derive Spectral Underwater Average Cosine Using Artificial Neural Network From The Satellite OCM-2

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The spectral average cosine of underwater light field, $\mu(\lambda)$ is a marine optical parameter that describes the angular distribution of underwater radiance at a given point. It is regarded as the average cosine of the zenith angle of all photons in the particular point and it equals to the ratio of the net irradiance to the scalar irradiance. Though the value varies between 0 to 1, it is usually limited in natural waters to 0.6 to 0.9 and is affected by scattering and absorption. It also provides a means to translate apparent optical property of diffuse attenuation of net radiance to inherent optical property of absorption coefficient. It is an important optical parameter in water and cannot be measured and hence the $\mu(\lambda)$ is computed using empirical algorithms with inherent optical properties. Inherent optical properties are difficult to derive with accuracy from the satellite data. Neural network methods have been successfully used to derive parameters from the satellite data. We used a feed forward back-propagation neural network trained with Lavenberg-Marquard optimization algorithm to derive $\mu(\lambda)$. The data used for our study consisted of in-situ measured marine optical data from the estuary, river and coastal waters of Goa, India. The input to the training data set consisted of spectral remote sensing reflectance, $R_{rs}(\lambda)$ measured using hyperspectral radiometer from for λ from 400 to 700 nm and the target were the $\mu(\lambda)$ over the same spectral range. Since there is no commercial instrument available to measure spectral average underwater cosine, $\mu(\lambda)$ the spectral average cosine were derived from radiative transfer simulations using measured optical data. The data set reserved for validation were used for neural network simulation and provided average cosine for three water types with good match with the neural network simulated output, with $R^2 = 0.9$, RMSE =0.03 for river, R^2 =0.84, RMSE = 0.03 for estuary and $R^2 = 0.8$ and RMSE =0.02 for coastal waters. The neural network algorithms were also tested to derive the $\mu(\lambda)$ using the spectral remote sensing reflectance $R_{rs}(\lambda)$ from the OCM-2 satellite data of for a coastal station and have provided encouraging results. The average cosine derived from the OCM-2 data was found to closely mimic the actual value for the wavelength till 600 nm and was found to overestimate in the red region. The comparison till 600 nm provided $R^2 = 0.4$ and RMSE =0.08.

Keywords : average underwater cosine, OCM-2, neural network, optical properties