Modeling of Optical Propagation in the Underwater Environment

Sherman Karp
Naval Ocean Systems Center

Water has a relatively high EM transmission window in the Blue/Green region of the spectrum. For this reason there is much interest in building systems which exploit this property. However, while the absorptive losses are modest, there is appreciable scattering which degrades the spatial and temporal coherence of the wavefront. The accepted method for describing the resulting process is by use of radiative transfer theory. For the forward scattering median, which characterizes water, a closed form solution exists for the mutual coherence function - the transform of the radiance function. In this paper we will present data taken at Catalina Island. This data consists of underwater measurements of the radiance pattern produced by observing the sun with an image dissector camera. It is shown that a good fit to the data can be obtained by approximating the mutual coherence function as a sum of the unscattered component and two gaussian terms. The first gaussian term is the standard result obtained by observing the mutual coherence function after several extinction lengths of propagation. The second gaussian term is obtained by subtracting the unscattered term and the first gaussian term from the exact solution and making an empirical fit to the remainder. This latter term produces a result which exists for approximately ten extinction lengths, causing a hale and eventually disappearing.