THE OFF-SPECULAR PEAK AND POLARISATION EFFECTS OF AN UNDULATING UNDERWATER SURFACE

W. R. Clavano and W. D. Philpot
453 Hollister Hall, Cornell University, Ithaca, New York, U. S. A. 06114-2211
wrc22@cornell.edu

Periodic undulations are used to describe underwater bottom roughness. An expression of the bi-directional reflectance distribution function (BRDF) is given that is dependent on the given roughness metric. Highlights include an off-specular peak and polarisation effects.

For an undulating underwater surface, we have shown through geometric optics that reflectance from a rough diffuse surface increases as the viewing direction approaches the backward direction even in the absence of shadowing and/or self-shading (Clavano & Philpot (2003), see also Cox & Munk (1956)). The effects of shadowing and self-shading are equivalent to applying a geometrical attenuation factor to specular reflectance, which is similar to an analysis of morphological effects using triangular waves by Zaneveld & Boss (2003).

We show that a reflectance peak displaced away from the specular direction occurs at large angles of incidence (relative to the global normal) as the surface gets rougher (part of work in Clavano & Philpot (2004)). Similar results have been shown for oil films on ocean surfaces using Monte Carlo methods by Otremba & Piskozub (2004) and Otremba (2004). As a general result, an expression of the full bi-directional reflectance distribution function (BRDF) is given. While geometrical effects play a significant role in the reflectance distribution, we consider polarisation effects (as in Mullamaa (1962, 1964)) to gain more insight into real-world reflectances and compare with empirical distributions described by Cox & Munk (1956).

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