EOSTAR: A GEOMETRIC OPTICS APPROACH TO ATMOSPHERIC PROPAGATION MODELS

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Modern surface Navy ships require dependable and predictable communications, surveillance, and tracking systems. The next generation of surface Navy ships will have passive imaging systems operating in infrared wavelengths. In addition to the stealthy detection capability that a passive infrared sensor provides, an imaging sensor can provide superior location and target recognition.

It is important to be able to assess the performance of an imaging infrared sensor in an operational environment. The determination of the propagation environment for surface ships can be a difficult problem. Although the full atmospheric hemisphere surrounding the ship must be characterized, the most critical portion is the 50-meter-thick surface layer containing the ship and extending to the horizon. Extended horizontal propagation paths in the atmospheric surface layer encounter relatively dynamic refractivity conditions. Sub-refractive mirages are common in this environment and they can be exploited to improve detection probabilities.

We will describe work to develop the EOSTAR (Electro-Optical Signal Transmission and Ranging) model suite to provide accurate sensor performance predictions. The EOSTAR model is built upon a geometrical optics approach to infrared propagation: a ray is traced through the propagation environment, and path-dependent perturbations to the signal can be determined. EOSTAR is a valuable tool for prediction and exploitation of several phenomena common to this environment. The multiple-image created by a sub-refractive mirage can be exploited to provide a passive ranging capability. Sub-refractive mirages are responsible for a refractive propagation factor which provides a signal enhancement that can be exploited to extend the detection envelope. Scintillation effects can also be exploited to provide an early detection capability, and we will describe work to predict a signature frequency and variance to enable detection enhancement.