The Current State of Clutter Models for Electromagnetic Wave Propagation for Radar and Communications Applications

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The term "clutter" is defined differently in various communities. To someone in the radar community clutter might mean anything that generates an unwanted return signal while to someone in the communications community clutter might mean ground-based objects, excluding terrain, that cause signal loss or gain. Further complicating matters, what is considered clutter can vary within a community. For example, in the radar community if a jet is the target, then rain is clutter; however, for a meteorologist rain is the target. Clutter can greatly impact electromagnetic (EM) propagation and, therefore, must be accounted for in system models. Otherwise, predicted field strengths can be tens of dBs different from actual field strengths, which can result in missed target detections or in communication failures. Some propagation models inherently contain clutter models while other propagation models do not, and the effects of clutter must be accounted for outside the model. Therefore, to effectively model electromagnetic field strengths in various environments and applications, propagation model users must understand what constitutes clutter for their particular problem, understand whether additional clutter modeling is needed for the particular propagation model being used, and understand the strengths and weaknesses of various clutter models. Many clutter models are empirical, which means they are not universally applicable and are only valid under certain conditions. Other models are statistical in nature and can require specific knowledge of conditions of the environment to be modeled. A survey is presented to further the understanding of the applicability and limitations of various clutter models. Various types of clutter models including foliage models (e.g. ITU-R P.833, Wiessberger), man-made structure models (e.g. ITU-R P.2108), and atmospheric phenomena (i.e. rain, clouds, fog, etc.) models (e.g. ITU-R P.838, ITU-R P.840) are evaluated and compared. The survey gives the current state of the models and how they are relevant to predicting EM effects on Navy systems.