COHERENCE EFFECTS IN PASSIVE MICROWAVE REMOTE SENSING

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This work addresses the question of the importance of coherence effects in passive microwave remote sensing of vegetation. In the past, coherence effects in remote sensing of random media have attracted much attention especially over the last two decades. Some of these coherence effects exist irrespective of the statistics of the random medium, like the backscattering enhancement. Backscattering enhancement is attributed to particle-particle or particle-ground wave interactions in the backscattering direction. Some other coherence effects may also manifest themselves by modifying the extinction rate in the random medium and by enhancing return signals. There is also work in the literature where some of these enhancement effects are incorporated into the incoherent transport theory. The modified transport theory, for example, extends the classical transport theory by including the cyclical interaction terms to account for backscattering enhancement.

Most work regarding coherence in random media is considered for active remote sensing. For passive problems it is known that the emissivity of a layered medium is different when obtained by coherent wave theory and by transport theory. This is due to the coherent interactions of the reflections at layer interfaces. However, coherent interactions of particles and ground have not been considered in detail. It is known that passive problems can be related to active ones through reciprocity and energy conservation. This also implies the existence of similar coherence effects in passive remote sensing.

Specifically, a layer of randomly distributed particles over a flat ground is considered in this work. The Fluctuation Dissipation theorem is used to compute the field emitted from the layer with reference to sources of enhancement effects due to coherent wave interactions between the particles and the ground. Some relations between the magnitude of the enhancements, wavelength, layer depth and receiver bandwidth are established. Finally a brief discussion will be given regarding the relation between these enhancement effects and their counterparts in similar active problems.

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