APPLICATION OF COHERENCE THEORY TO MODELING OF BLACKBODY RADIATION AT CLOSE RANGE

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A passive blackbody target is an indispensable component for some microwave remote-sensing radiometers. The radiation from the blackbody, in addition to the cosmic microwave background, provides calibration references for resolving the unknown brightness temperature of the observed scene. The blackbody target is often placed closer to the radiometer front end than that given by the *Fraunhofer* distance. Consequently, the far-field (FF) condition is not always met strictly and the FF approximation may result in inaccurate estimation of the brightness temperature. An in-depth study of the microwave radiation by the blackbody at close range is required to account for the difference.

We apply the second-order coherence theory to model the blackbody source. From a passive-radiation standpoint, all natural objects are correlated to some extent. A blackbody source is no exception. From the angular dependence of its FF radiation, the degree of coherence of the source can be determined. An experimental investigation verifies that the FF radiation from a blackbody target follows the *Lambert* cosine law, which allows us to obtain the correlation property of the blackbody source. We further formulate the mixed cross-spectral density tensor based on the correlation property to develop a closed-form expression of the radiation from the *Poynting* vector. The formulation consists of a quadruple integration, which is amenable to the multi-dimensional fast *Fourier* transform (FFT). The simulation by use of the FFT algorithm enables numerical computation of the radiation at close range when the FF asymptote doesn't apply.

We present some simulation results for different target sizes at a variety of distances. A comparison between the radiation at close range and the FF radiation reveals non-negligible difference. Such a study provides a quantitative approach to evaluate the accuracy of using the blackbody target at close range as a calibration source.