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The ACGF-SEM Approach to Electromagnetic Radiation with Applications in Radar and Inverse Modeling

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1 Extended Abstract

The traditional Singularity Expansion Method (SEM) has been known as a powerful method for analyzing target back radiation and scattering, where the main focus is laid on analyzing the response of scattering objects mainly in the time domain. By isolating certain fundamental resonances (known as the SEM data, i.e., poles and residues), it has been often possible to obtain deeper insight into the time-domain behavior of various Radar Cross Section (RCS) data. In this paper, we suggest a fundamentally different approach where the SEM is applied to the frequency-dependent Antenna Current Green's Function (ACGF) instead of the time-domain signal as is the practice. We manage to derive closed-form analytical expressions for the far field involving fundamental radiation functions analytically expressed in terms of the SEM data. The ACGF-SEM method is then a fully spatial domain approach, in contrast to the conventional SEM which requires working with time-domain data. Therefore, far-field measurement at a single frequency can now be used via the ACGF-SEM to understand and identify targets through RCS measurements. The new ACGF-SEM far-field expressions appear at first look to resemble the well-known characteristic modes of antennas but are shown to be different both physically and formally. Using the proposed ACGF-SEM, we provide a new physical insight into the general relationship between antenna currents and their radiated far fields, giving rise to new potential applications in inverse modeling and radar target identification.

References

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