Novel Method for the Analysis of an Antenna Attached to a Planar Surface of a Conducting Body

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The traditional method to analyze an antenna attached to a conducting body involves the replacement of the conducting body surface and the wire surface with equivalent currents. An integral equation is then solved for these currents. Often, the current near the antenna-body junction varies rapidly. This is especially true in the case of a wire antenna mounted on a conducting body when symmetry is lacking. In a traditional integral equation/Method of Moment solution of the problem, special care must be exercised in modeling the current near the junction to ensure accurate calculation of matrix elements and continuity of current at the transition between the body and the antenna. One method that is often applied to these structures uses "attachment" modes to model the body current near the wire-body junction. Another method, proposed by Young and Butler (J.C. Young and C.M. Butler, Proceedings of the XXVIIth General Assembly of URSI, p. 1397, August, 2002) for antennas attached to planar surfaces of conducting bodies, applies the equivalence principle to define a surface that divides the original problem into two equivalent models. The two models are coupled together by matching tangential fields across the defined surface. The equivalent models are chosen so that the current on the planar surface of the body to which the antenna is attached does not need to be modeled. In effect, the modeling of the body current on the planar surface is replaced with the matching of tangential fields across a surface remote from the antenna where the fields vary less rapidly. Because the fields vary less rapidly on the chosen surface, one may use conventional Method of Moment techniques to compute matrix elements.

A review of the method of Young and Butler is offered, and a discussion of the equivalence principle as applied to this method is given to show that the method is exact. In addition, because the choice of "dividing" surface and equivalent currents for a particular structure is not unique, advantages and disadvantages of various surfaces and currents are explored. The method is specialized to that of a wire antenna attached to the planar surface of a conducting Body Of Revolution (BOR). In the context of BOR theory, equivalent currents on the various surfaces are expanded in Fourier series, and, boundary conditions are enforced for each Fourier mode. Computed and measured data of the input admittance of a straight-wire antenna mounted at various position on the planar cap of a conducting cylinder are presented. Good agreement is obtained between the measured and computed data. Even when the antenna is close to the edge of the planar surface, only a few Fourier modes are required for convergence of the input admittance.