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A Ray Analysis of the Radiation by Realistic Small Antennas Mounted Directly on Large Locally Convex Platforms

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A Uniform Geometrical Theory of Diffraction (UTD) ray approach has been used successfully, in the past, to predict the high frequency radiation by infinitesimal electric or magnetic current moments of constant strength, which are placed directly on locally convex but otherwise relatively arbitrary shaped electrically large structures, such as aircraft, missile, or spacecraft geometries. However, there is currently a need for modeling platform mounted, electrically small, realistic, and hence complex (or inhomogeneous) antennas whose radiation characteristics are significantly different from those of tiny constant current moments. Some examples of the latter complex radiators are various types of printed antennas, including spirals, as well as a variety of cavity backed antennas, and so on. One notes that a conventional numerical based solution, albeit more rigorous for the present problem, is unable to provide a physical picture for the radiation mechanisms which the UTD can provide; furthermore, unlike the UTD, conventional numerical techniques can also become highly cumbersome, if not intractable, for large realistic platforms. A preliminary UTD solution to the present problem was discussed recently by the authors (at ISAP 2017, Phuket, Thailand). Here, that work is better formalized and applied to more variety of antennas. In this present UTD approach, the far field of any realistic small antenna on a flat ground plane is first obtained via a commercial simulation software, or appropriate measurements. The latter field is asymptotically matched in the deep lit zone of the antenna to a well known analytical UTD solution for a point source placed on a locally convex surface where the original antenna is to be mounted. A resulting equivalent UTD type point source, whose strength depends on the aspect in the lit zone, can thus be systematically identified for modeling the complex antenna as will be described in detail. Such an equivalent UTD point source can now be placed at the antenna location on the actual structure of interest to in turn provide an accurate UTD based radiation pattern of that antenna in the presence of the same structure. A theoretical basis for the present UTD approach, and numerical examples based on it, will be presented to demonstrate the simplicity, utility, and accuracy of the method.