

CALCULATING THE CURRENT ALONG A COMPLEX WIRE CONFIGURATION USING THE EXACT KERNEL

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Abstract:

Through the years, many papers have been published addressing the current distribution along a perfectly conducting thin wire. The first one, entitled "Electrical Oscillations in Wires", appeared in October 1897 and was written by H.C. Pocklington. One of the best papers concerning the current distribution along a thin wire was written by Davies, Duncan & Funken and appeared in the Journal of Computational Physics in March 2001. They used Pocklington's equation as a basis to obtain the current distribution. This so-called integro-differential equation is usually discretized and solved using the Method of Moments. Several choices for the kernel of the integro-differential equation are possible. Most often used are the exact and the reduced kernel. In the reduced kernel the observation point is chosen along the central axis. The reduced kernel can easily be calculated numerically but it does not lead automatically to an accurate solution of the current distribution. For thicker wires, the inaccuracy of the solution increases. In the exact kernel, the observation point is chosen on the surface of the wire. This mathematically well-founded formulation leads to a weakly singular kernel, which is more difficult to implement. One of the elegant solution methods described by Davies et al, is used to calculate the current distribution along a general complex wire configuration. In our implementation we have developed a NEC-like code which uses the exact kernel formulation and reads NEC-input files. Subsequently, we considered the mutual coupling between wires, wire junctions and wire tapering. In the implementation we have advantageously used the elegant way in which basis functions are defined in the theory manual pertaining to the well known NEC-program. We will discuss several wire geometries and compare impedance calculations with measurements. In addition we address an inconsistency in the general thin-wire formulation and discuss its consequences.