Kennedy, Timothy, "Modification of Current Distributions on Existing Conducting Structures"

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Increasing the number of antennas for wireless communications, while concealing them within their environment, is an area of great importance as demand for wireless devices increases. Locations for new antennas, however, are decreasing as communities enact regulations to prevent new cellular tower construction due in large part to their perceived ubiquitous presence in the community.

Currently the radiating portion of the antenna is essentially independent of the support structure upon which the antenna is mounted. An alternative is to use part of an existing structure as the radiating element. Candidates for antennas are the many different conducting portions of the structures, which will often be electrically large at wireless communication frequencies. Hence, the natural current distribution on the conductors needs to be modified and controlled to obtain optimal radiation characteristics.

Due to mechanical reasons, physically shaping or cutting the existing conductors is often not an option; hence, electrical loading will instead be used for shaping currents. A novel composite dielectric load is introduced for modification and control of currents on electrically long wires. A wire model is discussed for this element and a genetic algorithm (GA) is described for designing resonant antennas using electrically long wires and the composite dielectric element.

To use more complicated conducting structures as antennas, such as window frames and conducting plates, the composite dielectric load is made conformal and a 2.5-D finite element method (FEM) formulation is derived for designing the shape of the loads. A simple procedure to place the conformal loads is also described, such that the overall structure becomes resonant at the desired frequency.

Excitation of the antennas created from existing structures is performed using T-Match feeds. A T-Match enables the feed to be applied without cutting the conductors to insert a gap source or aperture-type feed. Generalized design procedures are outlined for the feed and are successfully demonstrated for the excitation of a loaded 4λ window frame model, as well as an electrically large conducting plate.