HF Resonant Structure Design Using Characteristic Modes

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Characteristic Modes are current modes obtained numerically for bodies of any kind of geometry. Its element factor provides a physical interpretation of the inherent radiation characteristics of an object, independent of any sources or excitations applied. Obtaining the characteristic modes allows us to make better decisions about antenna placement, feeding locations, and coupling so that we can use the platform as a radiator. In addition, once the current distribution of the characteristic modes is obtained it is well known that the reflection coefficient is also improved over the entire aperture. This leads to increased operating bandwidth and provides for increased spatial developments of exciting extremely large broad band apertures. However, unlike traditional impedance matrices of which are utilized to form these underlying characteristic modes of which there were 23 presentations about the theory of characteristic modes related to antenna applications during APS 2014. It will be demonstrated that these modes can be derived much differently from the traditional techniques of characteristic mode methods. This new methods applies probability distributions that arise from ordinary differential equations of which are then applied to topology distributions. Moreover, these modes can either be leverage in continuous structures or discretely into non-continuous structures or array design. Hence, it will be seen that there are two underlying characteristic modes of concern those of the continuous element distribution and those of the discrete structure of which is to be denoted the array factor. Hence, this has significant impacts of which will be applied to non-traditional array designs of which are randomly distributed. This also removes surface limitations of phased arrays and provides mobility towards utilizing global apertures or other swarm characteristics of unmanned autonomous systems. Lastly, similar to matching and loading of which is traditionally done to continuous structures of which can lead to decreased radar cross section (RCS) of the platform. These global apertures will also lead to lower (RCS) characteristics due to their discrete nature.

Until 2013, there was no commercial solution available to obtain the eigenvalues necessary to describe the currents in an arbitrary geometry. Our approach leverages the characteristic modes solution commercially available through FEKO and will append these results to the ODE method for comparison using HFSS and Matlab.