Application of Beam Methods to Electromagnetic Antenna and Scattering Problems

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Abstract

It is well known that complex source beams (CSBs) are exact solutions of Maxwell's equations. A CSB is generated in a simple fashion when the location of an electromagnetic (EM) point source that is originally positioned in real space is now moved into complex space. The CSB can exhibit directive properties, and the amount of beam focusing depends on how far the position vector of the source is pushed into complex coordinate space. Properties of CSBs are described, and the reduction of CSBs within their paraxial region to standard Gaussian beams (GBs) is demonstrated. Such CSBs can be used as highly efficient basis functions for EM waves due to their focusing properties. A uniform geometrical theory of diffraction (UTD) can also be developed for CSBs; such a UTD for CSBs is seen to provide an extremely fast, closed form analysis for predicting the fields of very large reflector antenna systems (as, e.g., in contoured beam satellite antenna applications). Other modern application of CSBs are also indicated, namely, those dealing with a fast radome analysis, near field-far field transformation (as, e.g., in spherical near field antenna measurements), and with an efficient numerical moment method based solution of governing integral equations for antenna and scattering problems, respectively.