Forum for Electromagnetic Research Methods and Application Technologies (FERMAT)

Antenna Design Using Characteristic Modes and Related Techniques.

Comment on the presentation by Mittra et al. "Systematic Design for Synthesis and Control of Radiation Patterns of Antennas Mounted on Complex Platforms," in EuCAP'16 Special Session on Theory and Application of Characteristic Modes, convened on Monday, April 11, 2016

It is not clear to this listener of the above presentation that this paper even belonged to the Sp. Session on CMs, since it appeared to criticize the CM approach more than it said anything positive about it. Furthermore, it appeared to recommend a completely different approach to pattern synthesis rather than following the CM approach. This listener has several questions about this paper. The list appears below:

Questions and Comments

1. It appears that the authors address the question of location of the antennas (or ECEs, if you prefer to call them that) up front. But, how can they guarantee that the desired CMs would be excited, and hence the desired pattern would be realized, by following the procedure they recommend?

   Our goal is to synthesize the desired radiation pattern, and the main point of our paper is that we can do this systematically *without* ever deriving the CMs, but by using the CBFs instead. The advantage of doing this is clear—in our method we don't have to look for ways by which we can excite the CMs, for which no systematic approach is available, specifically when the exciting antennas have been specified by the user a practical matter. In contrast to this, the CBFs that are derived by using these exciting antennas automatically provide a direct solution to the excitation problem.
2. Did they find situations where they couldn't synthesize the pattern specified by the user, and what do they recommend doing about it when that happens?

   Our approach to pattern synthesis is different from the conventional one, in which the CMs are used to approximate the pattern by utilizing the orthogonality property of the CMs with the weighting R, as has been shown by many authors. We set up an eigenvalue equation (this equation is very different from that used to derive the CMs; for one thing it involves very small-size matrices) to maximize the radiation in a certain angular range while minimizing the same outside of this range. This is far more realistic and practical, since it does not rely on the radiation pattern being available over the entire pattern space, which it never is.

3. It appears that the CBFs (Characteristic basis functions) are source-dependent and are different in general from the CMs, except for some special cases, e.g., thin wires with plane wave (and not voltage gap) excitations. How can we produce the CMs we want to excite when we are dealing with a more general geometry, if we are chosen to go with the CB route as a starter?

   We repeat, our goal is not to excite a particular CM, or combinations thereof. We go for the pattern directly using an eigenvalue formulation (see comment and respoe#2 above), totally circumventing the excitation issue which plagues the CM approach.
4. Why don't the authors employ an optimization procedure to determine the weight coefficients of the CBs, rather than solving an eigenvalue problem to find them?

   See Comments above.

5. How do they handle the situation if the eigenvalues are complex?

   The formulation we use yields real eigenvalues. In any case, we just select the CBFs such that they yield the minimum eigenvalue. We don't need to use the eigenvalue itself for anything.
6. Do the authors really believe that their approach is better than the CM method? If so, can they explain in which ways it is so?

   Please read responses to Comments above.

Submitted by: A CM enthusiast

Note Authors' responses to Comments by 'CM Enthusiast' are in blue.