How to Use the Method of Moments for Small Scattering Features in Your Physical Optics Code

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Physical optics (PO) and the method of moments (MoM) both use equivalent currents to represent the electromagnetic (EM) fields scattered or radiated by a physical structure. The currents satisfy a surface integral equation that enforces the appropriate EM boundary conditions. PO finds the currents approximately using only the geometrical optics field and the local properties of the surface, whereas, the MoM solves for the currents via numerical solution of a matrix. It is natural to combine the two methods so that the currents on large, smooth portions of the body may be approximated using PO, and the currents on small features may be found more exactly using MoM. In this paper it is demonstrated how the two methods may be combined first using a hybrid iterative solution that includes the interactions between the PO and MoM regions (R.E. Hodges and Y. Rahmat-Samii, *IEEE Trans. on Antennas and Propagation*, 45(2), pp. 265-276, 1997). Then, to simplify the implementation into an existing PO code, a first-order reciprocity formulation is used to compute the scattered field from the small feature without having to iterate back to the large feature.

The iterative algorithm goes as follows:

1. Find the currents on the large body excited by the incident field using PO.
2. Using MoM, solve for the currents on the small feature excited by the incident field plus the fields radiated by the PO currents of step 1.
3. Find the modified currents on the large body due to the currents radiated by the small feature of step 2.
4. Repeat steps 2 and 3 until converged.
5. Compute the scattered field directly from all currents.

If only one iteration is needed, as is often the case, then step 4 may be omitted and steps 3 and 5 can be combined using reciprocity. The reduced algorithm is:

1. Find the currents on the large body excited by the incident field using PO.
2. Using MoM, solve for the currents on the small feature excited by the incident field plus the fields radiated by the PO currents of step 1.
3. Compute the scattered field using reciprocity.