# Quadrupole Terms in Magnetic Singularity Identification, Part 2

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Abstract

In magnetic singularity identification (MSI) of conducting and permeable scatterers one considers the low-frequency poles with real natural modes and real natural frequencies to represent the magnetic-polarizability dyadic. This is an approximation neglecting the higher-order multipoles.

This paper continues the treatment of the quadrupole terms in magnetic singularity identification (MSI) in [C. E. Baum "Quadrupole Terms in Magnetic Singularity Identification", Interaction Note 569, 2001] which we can conveniently reference as Part 1. In that paper the magnetic-dipole formulae were extended to magnetic-quadrupole terms as certain integrals over the magnetization vector, particularly in the form of natural modes. Then questions were addressed concerning optimal choice of coordinate origin to "minimize" the quadrupole term associated with modes having a magnetic-dipole moment. The present paper (Part 2) further extends this development, including the use of norms and the point symmetry groups.

This paper (Part 2) extends the basic properties of magnetic quadrupoles in MSI. For minimizing such terms associated with natural modes with nonzero magnetic dipoles, the 2-norm over the unit sphere is formed. This leads to the definition of the optimal coordinate center (or center of the natural mode) for minimizing the quadrupole term. This does not necessarily make the quadrupole term zero, only minimum. Depending on various symmetrys of the target it is possible for certain of the natural modes to have a zero quadrupole moment. The case of two displaced magnetic dipole is generalized for zero quadrupole. The symmetry considerations are extended to discrete two-dimensional rotation with a transverse symmetry plane.

There may be other cases to consider, but this should help in optimal employment of MSI.