A HIGHLY ACCURATE 3-D MAGNETIC FIELD SOLVER

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Abstract

We present a new high precision parallel three dimensional magnetic field solver. This tool decomposes the problem of solving the Poisson equation into the problem of solving the Laplace equation and finding the magnetic field due to an arbitrary current distribution. The underlying theory to find solutions to both these problems using Differential Algebraic methods is developed, resulting in a local field expansion that can be computed to arbitrary order. Using the remainder differential algebraic approach, it is also possible to obtain fully rigorous and sharp estimates for the approximation errors. The method provides a natural multipole decomposition of the field which is required for the computation of transfer maps, and also allows obtaining very accurate finite element representations with very small numbers of cells. The method has the unique advantage of always producing purely Maxwellian fields, and naturally connects to high order DA-based map integration tools. We demonstrate the utility of this field solver for the design and analysis of novel combined function multipole with elliptic cross section that can simplify the correction of aberrations in large acceptance fragment separators for radioactive ion accelerators.

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