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Jacobian for the design of variable-gap dipole magnets

Wednesday 4 June 2025 16:00 (2 hours)

We present a formula to calculate the Jacobian matrix of a numerical root-finding problem that is often encountered when designing fixed-field accelerators: the iterative search, with a 3-dimensional finite element code such as OPERA, for the optimal gap profile of a dipole magnet. We start by deriving exact closed-form formulae for this Jacobian in two limit cases: the non-saturated magnet (using conformal mapping) and the fully-saturated magnet (using current sheets). We thereafter present a method to combine these two formulae and cover all intermediate cases. We apply this method to design isochronous cyclotron magnets and numerically evaluate the rate of convergence of the algorithm.

Footnotes

Paper preparation format

LaTeX

Region represented

America

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