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Tangential Shimming Pole Face Simulation for Quadrupole Magnet

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Quadrupole magnets are normally used for transverse beam size control in particle accelerators. They have magnetic field properties that can focus or defocus the charged particle beam. To build an ideal quadrupole magnet is difficult because four pole faces must have hyperbolic shape. In this work, we studied tangential shimming of a pole face and simulated the magnetic field for designing a practical quadrupole electromagnet. A pole face's geometry was first created by using the MATLAB script. Then, the magnetic field was simulated with the computer program POISSON. The initial and final tangent points of each tangential line were varied to find optimal shimmed pole face geometry. We found that for a quadrupole magnet with an aperture radius of 20 mm provides the gradient of 309.75 G/cm with a tolerance of 0.05% at an excitation current of 5 A. The maximum good field region is about 18mm.

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