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Optimized finite-build stellarator coils using automatic differentiation NICK MCGREIVY, STUART HUDSON, CAOXIANG ZHU, Princeton Plasma Physics Laboratory — Existing stellarator-coil-design codes either solve a convex optimization problem or compute analytic or finite-difference derivatives to perform gradient-based optimization in non-convex, high-dimensional spaces. Historically, such codes have not optimized for finite-build coils, instead assuming the coils are infinitely thin filaments. An active area of research in this field is to optimize the geometry of coils with non-zero thickness. In this article, optimized finite-build coils are found using a multi-filament approximation of the coil-winding pack. This new code, built on the existing FOCUS code, is called FOCUSADD. The derivatives of the finite-build coils are computed – with almost no additional effort from the authors – using automatic differentiation. Automatic differentiation (AD) is an automatic method of computing numerical derivatives, which could both simplify the stellarator optimization process and efficiently optimize new targets whose analytic derivatives cannot be found. The coils are parameterized in free space using a Fourier series with a multi-filament winding pack that has the freedom to move and twist in space. Optimization results for finite-build coils are compared with filamentary coils.

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