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Wed-Af-Po.01-04: Multi-Objective Optimization of C0 Stellarator Coils with Only Planar Segments in DESC

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Magnetic confinement fusion devices, such as tokamaks and stellarators, use coils to confine plasma in a toroidal shape. Tokamaks rely on D-shaped pancake coils but also require a toroidal current in the plasma to generate the desired magnetic fields. Stellarators, on the other hand, avoid the need for a plasma current by relying solely on external coils, which leads to complex 3D coil geometries. Although stellarators offer certain advantages over tokamaks, the complexity of coils and coil support structures complicate the construction of the magnets. In this work, we explore a previously unexamined coil concept that connects multiple planar coil segments to form a coil that is continuous in position but discontinuous in its derivatives (so-called C0 coils). Such coils can provide more flexibility in their design and potentially lead to more engineering-feasible coils. In this work, the stellarator optimization suite DESC, which can find and optimize coil geometries that produce the magnetic field needed for plasma confinement under specified objectives, is employed. With appropriate objectives, segmented C0 stellarator coils are designed with DESC. The results are shown and compared to traditional, continuously differentiable coil designs. The trade-offs between the two approaches are discussed.

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