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**Stellarator Equilibrium Construction based on a Poincaré Sections Approach** DANIEL DUDT, EGEMEN KOLEMEN, Princeton University — Computing ideal magnetohydrodynamic equilibria of non-axisymmetric devices is not trivial, and this presents a significant challenge for the continued advancement of stellarator research. A more efficient equilibria construction code could expand the search space during stellarator optimization and enable real-time control systems to deal with bootstrap currents. In contrast to the energy principle method used by traditional codes like VMEC, a new technique is proposed that casts the search for an equilibrium into solving a system of ordinary differential equations. The advantage of this approach is twofold: First, the equilibrium equations are used as constraints to reduce the system to minimum dimensionality, with the plasma modeled by variables that lie on Poincaré sections. Second, root-finding techniques such as Newton's method can be used to solve the system of equations, which is generally faster than optimization techniques to find a minimum energy state. An overview of the new method is presented along with numerical results to validate that it converges to the same equilibria solutions as VMEC for tokamaks and stellarators with finite pressure. Continued work is being done to quantify the speed and radius of convergence of this algorithm.

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