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A new stellarator coil design tool using space curves[1] CAOXIANG ZHU, University of Science and Technology of China; Princeton Plasma Physics Laboratory, STUART HUDSON, JOSHUA BRESLAU, SAMUEL LAZERSON, Princeton Plasma Physics Laboratory, YUNTAO SONG, Institute of Plasma Physics, Chinese Academy of Science, YUANXI WAN, University of Science and Technology of China — Finding easy-to-build coils has always been critical for stellarator design. Conventional approaches assume a toroidal "winding" surface. Either a surface current potential is constructed using a Green's function; or a discrete set of filamentary coils lying on the winding surface is non-linearly optimized. The winding surface concept ensures that the coils are separated from the plasma surface; however, requiring the coils lie on a given winding surface may overly constrain the coil optimization process. In this work, we investigate whether a winding surface is required. Our starting point is to represent each discrete coil as an arbitrary closed curve embedded in 3D space. From the Fundamental Theorem for Curves, such curves are uniquely described by the curvature and torsion functions. Our representation does not need a winding surface and can allow coils to evolve arbitrarily. We have constructed different penalty functions, F, that incorporate both the 'physics' and 'engineering' constraints. The first and second derivatives of F with respect to the parameters describing the coils are constructed analytically and are exploited to enable fast optimization algorithms for finding minima. Illustrations of coils for W7X and other stellarators will be presented.

[1]China Scholarship Council

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