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Computing the shape gradient of coil complexity with respect to the plasma boundary with an adjoint method[1] ARTHUR CARLTON-JONES, ELIZABETH PAUL, WILLIAM DORLAND, University of Maryland, College Park — A major challenge associated with the stellarator concept is obtaining coils which can produce the desired configuration. Coil complexity metrics can be obtained from REGCOIL, which computes coil shapes using a linear least squares method based on a current potential approximation. We extend REGCOIL to compute derivatives of the objective function with respect to parameters describing the boundary. We represent the surface using a single Fourier series to describe the radial distance from an axis. This representation is advantageous over the VMEC representation, as it only requires a single cosine series rather than a sine and cosine series. It also uses a uniquely defined poloidal angle, which eliminates a null space in the optimization. When computing the derivatives, the adjoint method is used to obtain analytic derivatives. Rather than solving the linear least-squares system for every Fourier amplitude, it is only necessary to do this twice. This results in low computational cost and elimination of noise in comparison with finite-differences. These derivatives are used to obtain a shape gradient of the objective function, which describes the sensitivity to perturbations in the plasma shape. This can be used to optimize the plasma boundary to obtain simpler coils.

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