A free-boundary MHD code for axisymmetric equilibrium configurations with flow.

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The calculation of MHD equilibria is routinely required in many contexts in fusion plasmas, starting at the initial phases of the design of the confining magnetic configuration and extending into the interpretation of multiple diagnostic systems during their operation. In many situations, however, significant plasma flows exist that can affect the geometry and properties of the equilibrium in a non-trivial way. The fusion community has developed various codes that calculate their effects in the magnetohydrodinamics equilibria. Most of them, however, consider a fix-boundary at the plasma edge. This is a reasonable assumption when measurements from the discharge to be analyzed can provide with information about the plasma shape. However, it is not so convenient when trying, for instance, to assess in advance the modifications to the plasma shape, the position of the X point or the magnetic flux expansion at the divertor associated to the presence of these flows. This work aims at showing how to build a free-plasma-boundary code from a previously existing fixed-boundary code. It is done by modifying the computational volume and integrating the information about the external coils using scheme previously used successfully in the stellarator equilibrium code SIESTA.

The fixed-boundary code uses pseudo-spectral methods and finite differences in an eulerian frame. As an example, an ITER equilibrium has been studied by using a set of different flow profiles with different intensities with which the capabilities of the free-boundary code could be showcased.

References