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Multidimensional optimization of fusion reactors using heterogenous codes and engineering software[1] ZACHARY HARTWIG, GEOFFREY OLYNYK, DENNIS WHYTE, MIT Plasma Science and Fusion Center — Magnetic confinement fusion reactors are tightly coupled systems. The parameters under a designer's control, such as magnetic field, wall temperature, and blanket thickness, simultaneously affect the behavior, performance, and components of the reactor, leading to complex tradeoffs and design optimizations. In addition, the engineering analyses require non-trivial, self-consistent inputs, such as reactor geometry, to ensure high fidelity between the various physics and engineering design codes. We present a framework for analysis and multidimensional optimization of fusion reactor systems based on the coupling of heterogeneous codes and engineering software. While this approach is widely used in industry, most code-coupling efforts in fusion have been focused on plasma and edge physics. Instead, we use a simplified plasma model to concentrate on how fusion neutrons and heat transfer affect the design of the first wall, breeding blanket, and magnet systems. The framework combines solid modeling, neutronics, and engineering multiphysics codes and software, linked across Windows and Linux clusters. Initial results for optimizing the design of a compact, high-field tokamak reactor based on high-temperature demountable superconducting coils and a liquid blanket are presented.

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