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Tokamak Scenario Trajectory Optimization Using Fast Integrated Simulations JAKUB URBAN, Institute of Plasma Physics CAS, Prague, Czech Republic, JEAN-FRANÇOIS ARTAUD, CEA, IRFM, F-13108 Saint Paul Lez Durance, France, LINDA VAHALA, Old Dominion University, GEORGE VAHALA, William & Mary — We employ a fast integrated tokamak simulator, METIS, for optimizing tokamak discharge trajectories. METIS is based on scaling laws and simplified transport equations, validated on existing experiments and capable of simulating a full tokamak discharge in about 1 minute. Rapid free-boundary equilibrium post-processing using FREEBIE provides estimates of PF coil currents or forces. We employ several optimization strategies for optimizing key trajectories, such as Ip or heating power, of a model ITER hybrid discharge. Local and global algorithms with single or multiple objective functions show how to reach optimum performance, stationarity or minimum flux consumption. We constrain fundamental operation parameters, such as ramp-up rate, PF coils currents and forces or heating power. As an example, we demonstrate the benefit of current over-shoot for hybrid mode, consistent with previous results. This particular optimization took less than 2 hours on a single PC. Overall, we have established a powerful approach for rapid, non-linear tokamak scenario optimization, including operational constraints, pertinent to existing and future devices design and operation.

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