

An Open-Source Divertor Digital Twin Environment for Fusion Power Plants

Wednesday 10 December 2025 16:00 (1h 30m)

Digital engineering is reshaping fusion R&D, and the in-development **Divertor Digital Twin Environment (DDTE)** aims to provide an end-to-end, *open-source* workflow that shortens the path from late-stage divertor design to plant operation readiness. The DDTE is organised around three complementary flavours, each deliberately modular so that best-in-class community codes can be swapped in as they mature.

Design Studio –Starting from native CAD or equilibrium geometry, the pipeline invokes established mesh generators to create prototype meshes and optimises candidate diagnostics. Material and thermal properties are inserted via OMAS-compatible databases, ready for local or HPC execution.

Scenario Lab –3D plasma-surface interaction scenarios are assembled by chaining HEAT, FUSE and, as development continues, edge-SOL solvers such as SOLPS-ITER and HERMES-3. Each run outputs time-resolved temperature, stress and erosion fields annotated with VVUQ metadata, and feeds a prognostics-and-health-management module estimating damage accumulation.

Twin Console –A divertor digital twin instance will ingest live diagnostic streams (infrared, thermocouples) and *fuse* sensor data before *assimilating* into an ensemble of scenario predictions through Bayesian state estimation. The console reconciles data gaps and forecasts lifetime & maintenance windows.

Key characteristics are: (i) free and open-source software licensing to encourage broad uptake; (ii) an intuitive GUI with scripting back-ends to assist commercialisation; (iii) active multi-institutional co-design to avoid “reinventing the wheel”; and (iv) easy-click installer *and* pre-built Apptainer deployment that scales from laptops to clusters. Current prototyping milestones are presented together with a roadmap that charts the next steps toward a minimally viable DDTE.

Country or International Organisation

United Kingdom

Affiliation

University of York

Speaker's email address

mike.battye@york.ac.uk

Author: BATTYE, Michael (University of York)

Presenter: BATTYE, Michael (University of York)

Session Classification: Poster Session (at PSFC)

Track Classification: Simulation and Data Integration