Data-enabled Fusion Technology (DeFT)

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PI: Craig Michoski, SapientAI LLC
Co-PI: Todd Chisholm, General Fusion
Co-PI: Todd A. Oliver, University of Texas at Austin

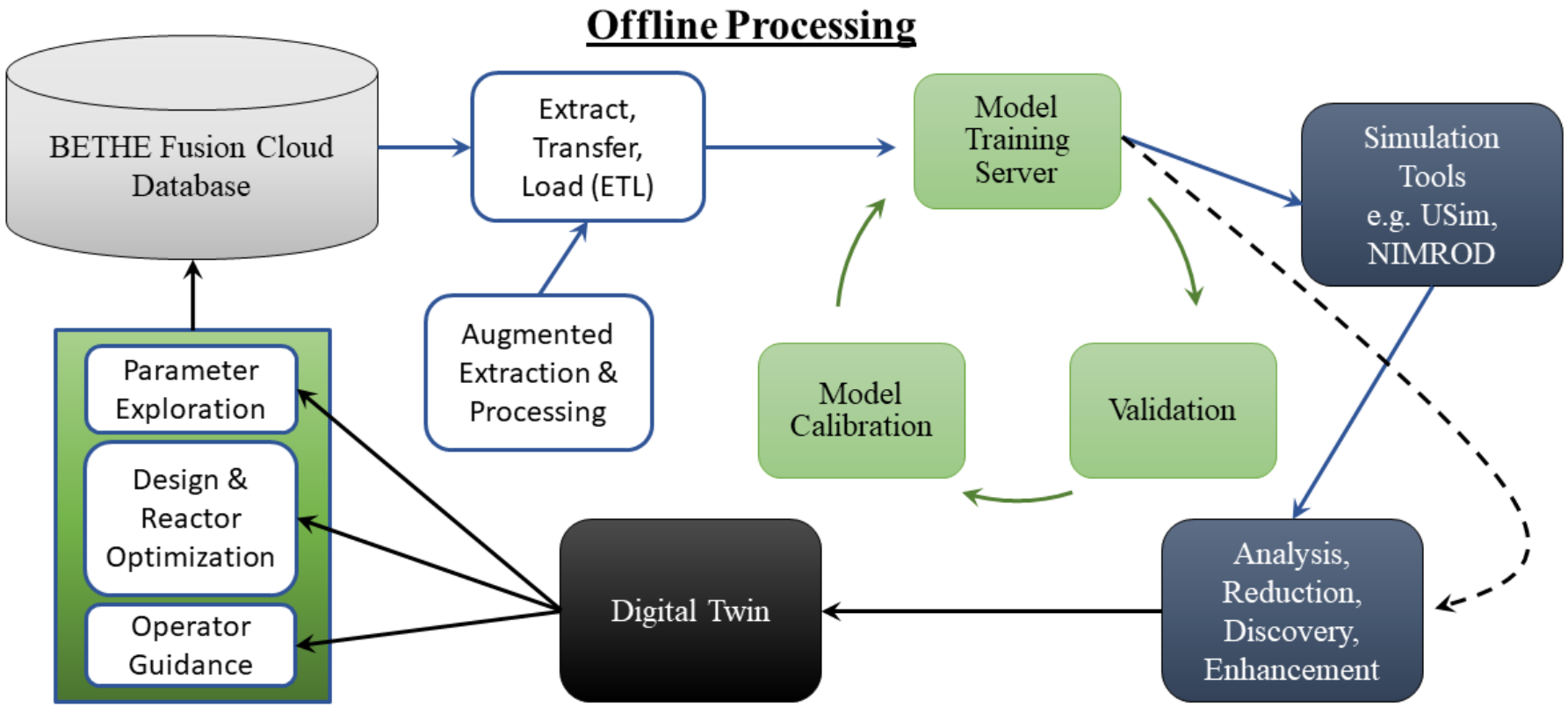
Team members and roles

- Craig Michoski (Sapientai)– Principle Investigator, Computational Engineer
- David Hatch (Sapientai) – Senior Personnel, Plasma Physics
- Todd Oliver (UT Austin) – Co-PI, Computational Engineer and Applied Mathematician
- Dongyang Kwang (UT Austin/Sapientai) – Software development, ML/AI/ADA
- Data Scientist(Sapientai) (TBD)
- Computational Engineer (Sapientai) (TBD)
- Todd Chisholm (General Fusion) – Software Engineer
- Stephen Howard (General Fusion) – Principal Investigator, Plasma Injectors
- Meritt Reynolds (General Fusion) – Physicist
- Alex Mossman (General Fusion) – Director of Applied Physics
- Myles Hildebrand (General Fusion) – Engineering Physicist
- Peter de Vietien (General Fusion) – Computational Physicist
- Daymon Krotez (General Fusion) – Engineering Physicist
- Charles Eyrich (General Fusion) – Physicist

High-level motivation and goals of the project (speak directly to the goals of your project's technical category)

- As a Category C capability team: to provide state-of-the-art capabilities to Category A concept teams by utilizing Advanced Data Analytics (ADA), Machine Learning (ML), and Artificial Intelligence (AI)
- To provide diagnostic calibration tools, along with advanced data processing and boosted diagnostic capabilities
- To develop optimization and parameter exploration tools
- To develop inference engines and deep data classifiers on measurements
- To develop operator guidance tools for machine operators
- To develop validation-driven model enhancement, model discovery, and system identification capabilities
- Develop interpretative physics interfaces for "black box" predictive utilities.

Dataflow Chart for the DeFT Project



1. Diagnostic calibrations, advanced data processing, and boosted diagnostics
2. Optimization and parameter exploration tools
3. Validation-driven model enhancement and discovery capabilities

Major tasks (and technical risks), milestones, and desired project outcomes

- Milestone: Implement operator guidance tools into *Ousai* for the LANL/PLX
- Milestone: Develop an inference tool for spectroscopy data (to extract better/more info from spectroscopy data)
- Milestone: Develop optimization tool for CTFusion based on current drive controls
- Milestone: Model enhancement of existing reduced models used by CTFusion, to improve model extrapolation and interpretability
- Milestone: Model discovery and re-parameterization of existing CTFusion models
- Parameter configuration classifier of General Fusion's "configurations of interest" (e.g. classifier capability) using the Aurora database
- Develop an operator guidance mapping for General Fusion, between machine configuration and machine performance history metrics)

Key techno-economic metrics of the project (and, if applicable, its commercial fusion-energy application)

- To develop a fusion energy ML/AI/ADA software ecosystem for diagnostic design, analysis, processing, operator guidance, optimization, classification, parameter exploration, enhancement, discovery, and system identification
- The *Ousai* software aims to become an "off the shelf" software tool kit, that can be easily leveraged by and for fusion concept teams
- Classifiers for state changes → Current: Operator eyeball, proposed: Automated, statistical likelihood >60%
- Parameter Optimization → Current: Brute force, Proposed: Quantifiable predictive accuracy (e.g. statistically principled)
- Model enhancement, discovery, and system identification → Current: trial and error, Proposed: Automated and optimal