DIII-D PLASMA CONTROL SIMULATION ENVIRONMENT*

J.A. Leuer, R.D. Deranian, J.R. Ferron, D.A. Humphreys, R.D. Johnson, B.G. Penaflor, M.L. Walker, A.S. Welander†, R.R. Khayrutdinov, V. Dokouka,‡ D.H. Edgell,§ C.M. Fransson¥

†General Atomics, P.O. Box 85608, San Diego, California 92186-5608

‡TRINITI Laboratory

§Fartech

¥Chalmers University

Jim.Leuer@gat.com

Many improvements have been made to the DIII-D plasma control simulation environment since the previously developed hardware-in-the-loop plasma shape simulation capability was reported[1]. In the present paper we summarize the major improvements to this simulation environment, including introduction of the non-linear plasma evolution code DINA[2] for the study of current profile control. The simulator fully integrates with the plasma control system (PCS), providing a test and validation platform for plasma shape control algorithm development. In addition, a software version of the PCS is available for connection to the DIII-D simulator. This allows for complete closed-loop, software simulation of control algorithms implemented in the PCS against DIII-D plant models. This environment provides a comprehensive test platform for implementing complex control algorithms in the PCS without requiring DIII-D machine time for development. Comparisons between the simulator response and that of the actual DIII-D plant will be shown.

The inclusion of the DINA module within our simulation environment extends our capability to simulate many non-linear aspects of plasma shape control, including current profile evolution. This implementation is synergistic with present efforts to make current profile information available in the PCS through upgrades to the real time EFIT[3] algorithm. Utilizing the DINA model of electron cyclotron current drive (ECCD) along with a model of resistive island dynamics, the system allows closed loop simulation of the interactions of ECCD with internal DIII-D plasma profiles for suppression of neoclassical tearing modes[4]. Results of controller development and experiments on DIII-D will be presented. Other models, including 3-D magnetics and resistive wall mode (RWM) dynamics are under development within the simulation environment. An overview of these models and their predictive capability will be presented.

The model-based simulation environment developed for the DIII-D machine is extensively validated against machine data and the environment architecture and many of the models are extensible to other devices. Its applicability to present and next generation fusion devices will be demonstrated.

---

*Work supported by U.S. Department of Energy under Contract DE-AC03-99ER54463.

---

[1] J.A. Leuer, *et al.*, 18th IEEE/NPSS SOFE, Oct.25-29,1999, p.531-34.
[2] R.R. Khayrutdinov, V.E. Lukash, J. Comput. Phys **109** (1993) 193.
[3] J.R. Ferron, *et al.*, Nucl. Fusion Vol. 38, No. 7, July 1988, 1055-1066.
[4] D.A. Humphreys, *et al.*, Bull. Am. Phys. Soc. 46, 299 (2001).

J.A.Leuer
General Atomics
P.O. Box 85608
San Diego, CA 92186-5608
(858) 455-2673
Fax (858) 455-3569
e-mail: Jim.Leuer@gat.com

Prefer:

- Oral
- ✔ Poster

Topic Category: Plasma Control Systems