ENHANCEMENTS IN THE DIII-D NEXT GENERATION DIGITAL PLASMA CONTROL SYSTEM

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Over the last 15 years, the capabilities of monitoring and controlling the various DIII-D tokomak systems during a plasma discharge has been largely dependent upon the DIII-D real-time digital plasma control system (PCS). Approximately 5 years ago, the PCS underwent an extensive upgrade. The DIII-D staff has used this opportunity to build upon and better the PCS while maintaining its previous functionality. This paper will discuss alterations and enhancements of the PCS which have been recently developed at DIII-D.

Since the PCS's initial migration onto a Linux/Intel based networked cluster, the PCS has more than doubled in the use of real-time central processing units (CPUs). These CPUs have extended the reach of the previous PCS versions as well as enlarged its computational resources. The increase in the number of real-time nodes has allowed the PCS to incorporate the DIII-D diagnostics Thomson scattering and charge exchange recombination spectrometry. Additional nodes have also increased, by two fold, the amount of motional Stark effect data collected and analyzed during a DIII-D discharge. Four more CPUs have doubled the computational power for the real-time EFIT. Work is also underway that would dedicate another CPU for control of the electron cyclotron heating launcher.

Continued software development of the PCS has expanded capabilities and improved performance. Most notably is the decrease of feedback cycle times from 50 microseconds down to 10 microseconds for the CPU which handles calculations and I/O of the resistive wall mode. Alterations in the physical configuration of DIII-D, mainly the rotation of one neutral beam (NB) source for counter injection, has spurred additional algorithm development for NB injection. Major developments in the PCS real-time EFIT include real-time calculation of the safety factor for use in current profile control and planned analysis on a 65x65 grid verses the previous 33x33.

Because of care taken in the redesign of the PCS for maintainability and support, a new generation of digitizers, analog output devices, as well Myrinet components have effectively and quickly been implemented into the PCS. Minor alterations in the PCS (diskless operation and larger real-time data displays) have been performed in response to lessons learned during operations and at the demand of end-users. The most visible of these is the new real-time boundary display.

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