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Implementation of High Speed Data Acquisition at DIII-D

Research at the DIII-D National Fusion Facility in San Diego focuses on short pulse plasma discharges that specialize on various shaping profiles. High speed data collection is a critical component for the operation of many of DIII-D's diagnostics. This is fundamental for capturing high resolution data used in experimental data analysis. Differing techniques enable the plasma control system (PCS) to perform complex real-time feedback control on microsecond time scales. This work presents a comprehensive overview of data acquisition, focusing on the hardware and software used in reliable data acquisition at DIII-D. The robust nature of the data acquisition system allows for various techniques to coexist seamlessly. However, as modern systems capable of nanosecond resolution become more common, existing architectures will need to be modified. By addressing the key challenges of high speed data acquisition, DIII-D is able to provide real time data used in plasma operation and has the ability to acquire high fidelity data needed for future experimental fusion reactors, such as ITER.

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