Contribution ID: **51** Type: **Oral**

CODAS for long lasting experiments. The SPIDER experience

Wednesday, 7 July 2021 17:10 (10 minutes)

The SPIDER experiment is the first of two experiments being held at the ITER Neutral Beam Test Facility in Padova (Italy). SPIDER has been operating since 2018, initially with pulse duration of a few seconds and currently with pulses lasting up to 3000s. SPIDER CODAS uses the MDSplus data acquisition and management system that is well suited to stream data acquisition thanks to the powerful concept of 'Data Segments' . Currently SPIDER data acquisition involves 768 signals continuously acquired via PXI ADCs with sampling rates ranging from 100 Hz to 100 kHz, 8634 signals derived from EPICS Process variables (PVs) and stored in MDSplus pulse files with sampling rates ranging between 0.1 and 10 Hz, 10 signals acquired at high speed (up to 250 MHz) upon event occurrence and the frames from 24 camera devices with frame rates ranging from 0.1 to 10 Hz. The pulse database is organized into 24 different databases logically linked to form a unique pulse file and all hosted by a single data server.

The paper reports the CODAS experience gained after three years of operation. In particular, Data Storage and Data Access adopted strategies will be discussed, that proved to be of high impact in overall system performance and maintainability.

Regarding Data Storage strategy, a tradeoff must be defined between the continuous and event driven data acquisition. Continuous data acquisition, i.e. sampling data at a constant frequency, represents the normal operation in short experiments, but can easily lead to an unmanageable amount of data for long lasting experiments. In any case, for a large set of signals, such as those derived from PVs that are acquired at slow rate, it makes no sense to complicate design in order to save a negligible amount of space in the pulse database. On the other side, Data acquisition at a varying rate, that is increased upon the occurrence of given events leading to an improved signal dynamics, is required for a subset of signals that describe physical phenomena with fast dynamics. Several strategies have been adopted in SPIDER to handle varying rate data acquisition and are discussed here.

Considering data access strategy, an important Use Case, especially when the pulse duration is long, is the concurrent access to the pulse file for online analysis and visualization. Concurrent data read and write is supported by MDSplus but performance can be affected by the required locks in file access. For this reason it is important to limit as far as possible useless data access. This has been achieved in different ways, such as setting a Region of Interest (ROI) in data access and by the extended usage of on-the-fly resampling in conjunction with the availability in the pulse file of different versions of the same data item, acquired at different sampling speeds. In addition, an extensive usage of low-speed data streaming decoupled from data access proved useful to cover a variety of use cases for data visualization such as wall display of important waveforms.

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Session Classification: Data Acquisition and signal processing 2

Track Classification: Data Acquisition and Signal Processing