Development of the ThomsonViz Application for NSTX-U

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Multi-Point Thomson Scattering on NSTX-U

MultiPoint Thomson Scattering (MPTS) is an established, accurate method of finding the temperature, density, and pressure of a magnetically confined plasma. Two Nd:YAG (1064 nm) lasers are fired into an experimental plasma with a final effective frequency of 60 Hz, and the photon energy absorbed by the electron is radiated with a Doppler shift caused by Thomson scattering.

Polychromators located in 42 radial channels on the NSTX-U midplane collect the scattered photons at various radii/scattering angles, and the avalanche photodiode voltages are then saved to an MDSplus tree for later analysis.

IDL code is then used to calculate plasma temperature, pressure, and density from the captured polychromator measurements via Selden formulas.[1]

ThomsonViz:
Review Plasma Diagnostics Quickly Through a Shot

Thomson Visualization software was developed to quickly display Thomson temperature, pressure, and density data along with other time-based signals simultaneously for correlation and intuition.

Using the OMFIT Python libraries to interface with the MDSplus data tree, nodes are loaded and displayed intuitively to a data consumer. An interactive cursor can be used with time-dependent data to display the nearest associated MPTS-sampled data to a time signal at a specific interval.

Current Features

Zoom capabilities exist to allow rapid evaluation for boundary layer conditions, disruption locations and development, and other plasma characteristics.

Any time-based signal can be configured to be used in the two right panes of ThomsonViz.

At any time point in a specified shot number, a customer may export the plots displayed to either EPS or PNG format. A further option is to also export the displayed data sets in CSV format. The exported plots are saved at 1000DPI for printing fidelity.

Implementation

The software is written using the Anaconda distribution of Python for ease of development, porting and deployment to either the PPPL computing cluster or to a Web-based framework as an extension of this work. The graphs are standard matplotlib objects which are hosted in the Tkinter graphic environment.

The data access is currently programmed against the NSTX-U MDSplus tree using the OMFIT data objects as designed by General Atomics in San Diego. [2] The visualization architecture is modular enough to be applied to any MDS data tree.

Individual user data preferences and data sources are saved in external configuration files, allowing data customers to specify their own data traces, units, scaling factors, and plot configuration.

Documentation and feature details are available at http://nstxdata.pppl.wikispaces.net/

Future Work

• Extend ThomsonViz data sourcing to other MDSplus experiments
• Port to Flask framework, host on Internet-based platforms and through smartphones
• Integrate real-time Thomson signal processing

References


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