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Three novel software tools for ASDEX Upgrade

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HIGHLIGHTS

- Key features of innovative software tools for data visualization and inspection are presented to the nuclear fusion research community.
- 3D animation of experiment geometry together with diagnostic data and images allow better understanding of measurements and influence of machine construction details behind them.
- Multi-video viewer with fusion relevant image manipulation abilities and event database features allows faster and better decision making from video streams coming from various plasma and machine diagnostics.
- Platform independant Web technologies enable the inspection of diagnostic raw signals with virtually any kind of display device.

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ABSTRACT

Visualization of measurements together with experimental settings is a general subject in experiments analysis. The complex engineering design, 3D geometry, and manifold of diagnostics in larger fusion research experiments justify the development of special analysis and visualization programs. Novel ASDEX Upgrade (AUG) software tools bring together virtual navigation through 3D device models and advanced play-back and interpretation of video streams from plasma discharges. A third little tool allows the web-based platform independent observation of real-time diagnostic signals. While all three tools stem from spontaneous development ideas and are not considered mission critical for the operation of a fusion device, they with time and growing completeness shaped up as valuable helpers to visualize acquired data in fusion research. A short overview on the goals, the features, and the design as well as the operation of these tools is given in this paper.

1. Introduction

In 25 years of operation ASDEX Upgrade's (AUG's) data acquisition has grown by a factor of 10000 from megabytes to tens of gigabytes. So respectively the number and kinds of diagnostics, the number of channels per diagnostic, and the temporal resolution per channel have grown. During this time the experiment has undergone regular redesigns in many aspects concerning e.g. the geometry of the divertor, the interior wall details, the location and set-up of diagnostics, and last not least the kind of diagnostics. Latter today comprise a reasonable number of video diagnostics in the infrared and visible spectral range. These kinds of "novel" diagnostics were not supported by the original data analysis and visualization tools. While some generic viewers exist for these kinds of data streams, with an increasing number of streaming channels one soon finds out, the generic tools do not suffice for a scientific view to the data.

These various modifications and renovations of the experiment over time led to a couple of developments on the data analysis side of which the here presented three software solutions because of their originality and universal applicability seem of particular

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[3] Work carried out in 2012.
[4] Main author of AUGpy.

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0920-3796/

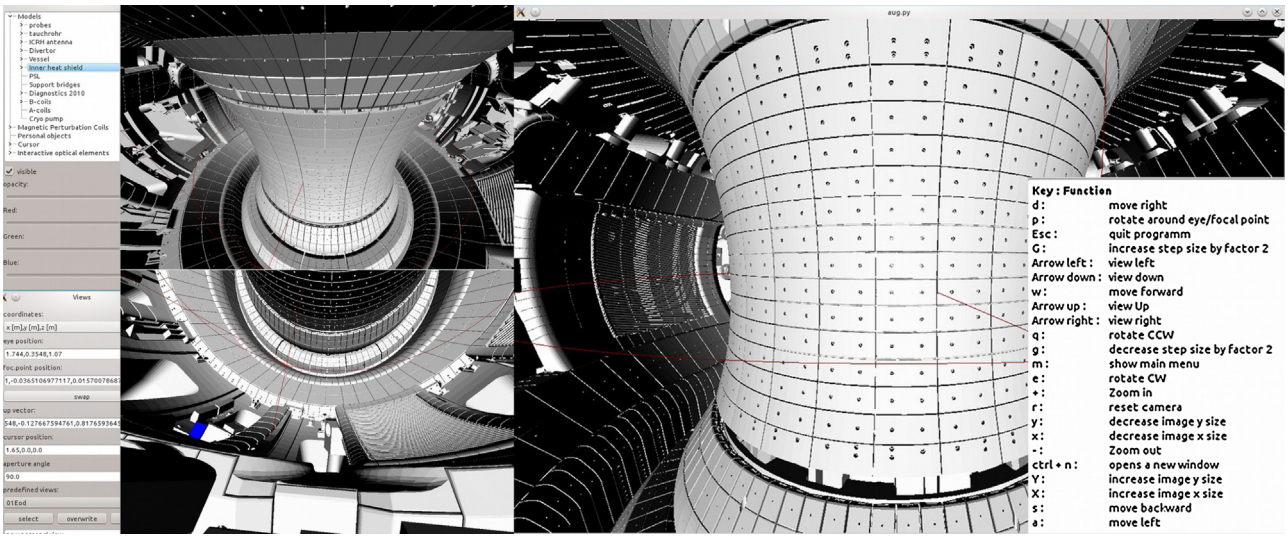

Fig. 1. Virtual 3D navigation inside the ASDEX Upgrade vessel model. Three different perspectives of the inner heat shield and looking down to the divertor are shown. The menu insets left and right give a glance about the user control possibilities of the tool.

interest for a broader fusion science community. They are mainly based on publicly shared software developments providing great benefit for this kind of scientific applications.

2. AUGpy—mapping diagnostics views into 3D construction design

AUGpy is a 3-dimensional visualization application developed as a follow up application to AUGddd [1] now written in Python. It combines virtual CAD model data of the ASDEX Upgrade Tokamak plasma vessel and built-in components together with other geometry data from machine design and diagnostics. AUGpy allows to virtually walk through this combined spatial data model on screen. Vessel and diagnostic structures as well as coordinate lines, lines of sight, viewing planes of diagnostics and cameras are superimposed at the right positions. Even experimental data defined on spatial coordinates like profiles or images may be shown hovering in the model at the corresponding locations.

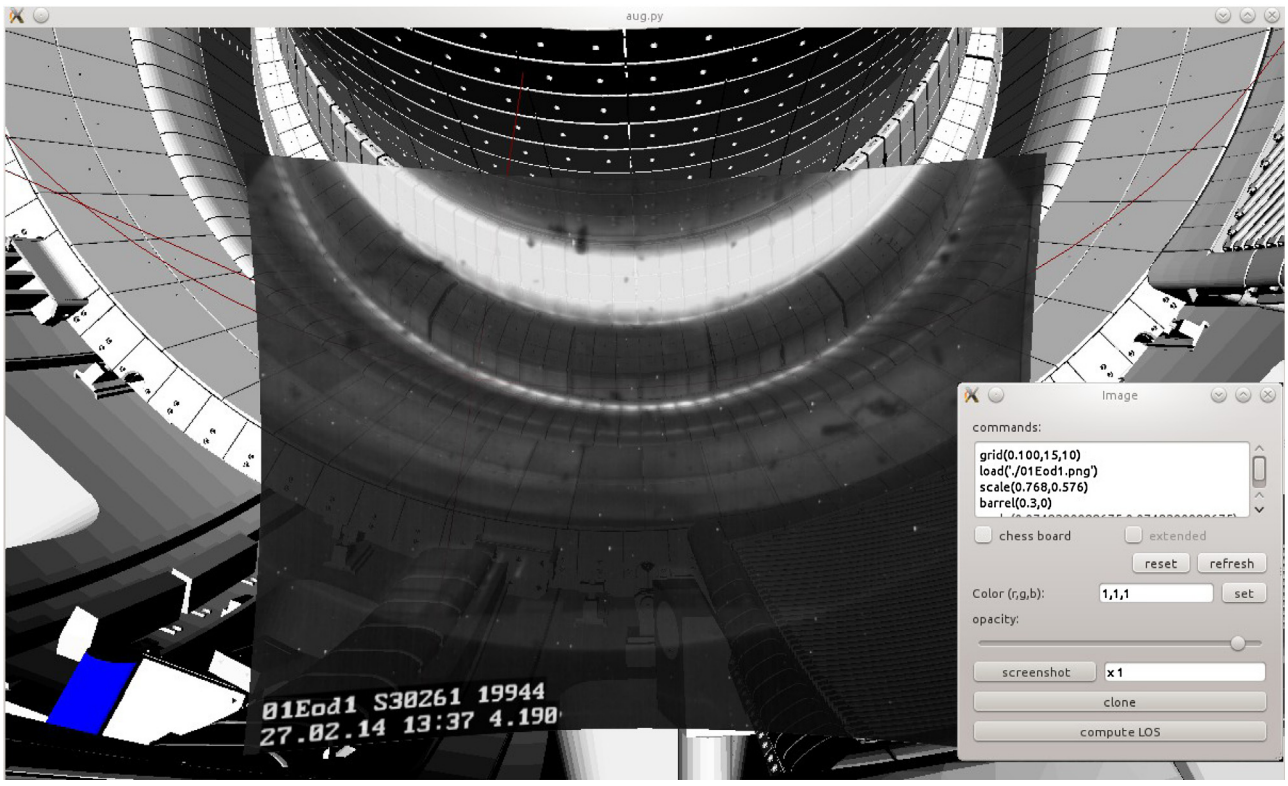

Fig. 2. Mapping a camera image into the 3D model applying geometrical adaptations (see text).

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