Graphic interactive environment for the design of remote processing, analysis and visualization of fusion data

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ABSTRACT

- We introduce a client-server platform that separates the tasks of handling data, coding algorithms and preparing visualizations (for fusion specialists).
- A web-accessible server offer the service, grants access to authenticated scientists and provides a variety of fusion-specific software algorithms.
- A modern HTML client, allows scientists to connect to this service, interactively build a graph selecting among the well-documented elements defining a flow of data, and run the autogenerated program.

BACKGROUND

- Fusion community is constantly producing a vast quantity of data and new techniques and algorithms, specific to this topic. Learning all the programming involved and keeping track of new developments can be a very time-demanding task.
- We introduce a client-server platform under development designed to facilitate this tasks to fusion scientists. It separates the tasks of handling data, coding algorithms, computation and preparing visualizations.
- A web-accessible server, grants access to authenticated scientists and provides a variety of fusion-specific software algorithms for handling, processing, analyzing and visualizing the data.
- A modern HTML client, runnable on different devices, allows scientists to connect to this service remotely.

APPLICATION

THE SERVER

The server is the most important part of the platform, since it is responsible of the following services: 1) authentication of users, 2) access to data, 3) definition of the processing elements, 4) storage of user's sessions, 5) generating and running programs and 6) presentation of results.

HTML CLIENT

The client interface to our server services is a graphic editor that has been completely implemented using Web standards in particular HTML, CSS and JavaScript. This allows users to connect to the server using virtually any device connected to the Internet. Graphs are at the heart of our platform. Graph pages offer an editor and a collection of processing elements offered by the server for this user and project in the form of icons. Figure 1 shows a typical graph created with part of the collection of elements visible. The first path, shown in green, represents an exploration analysis of fusion data stored in MATLAB format, plot and Wavelet Transform (WT) to reduce its resolution. The second path applies a SVM model to the same MATLAB file.
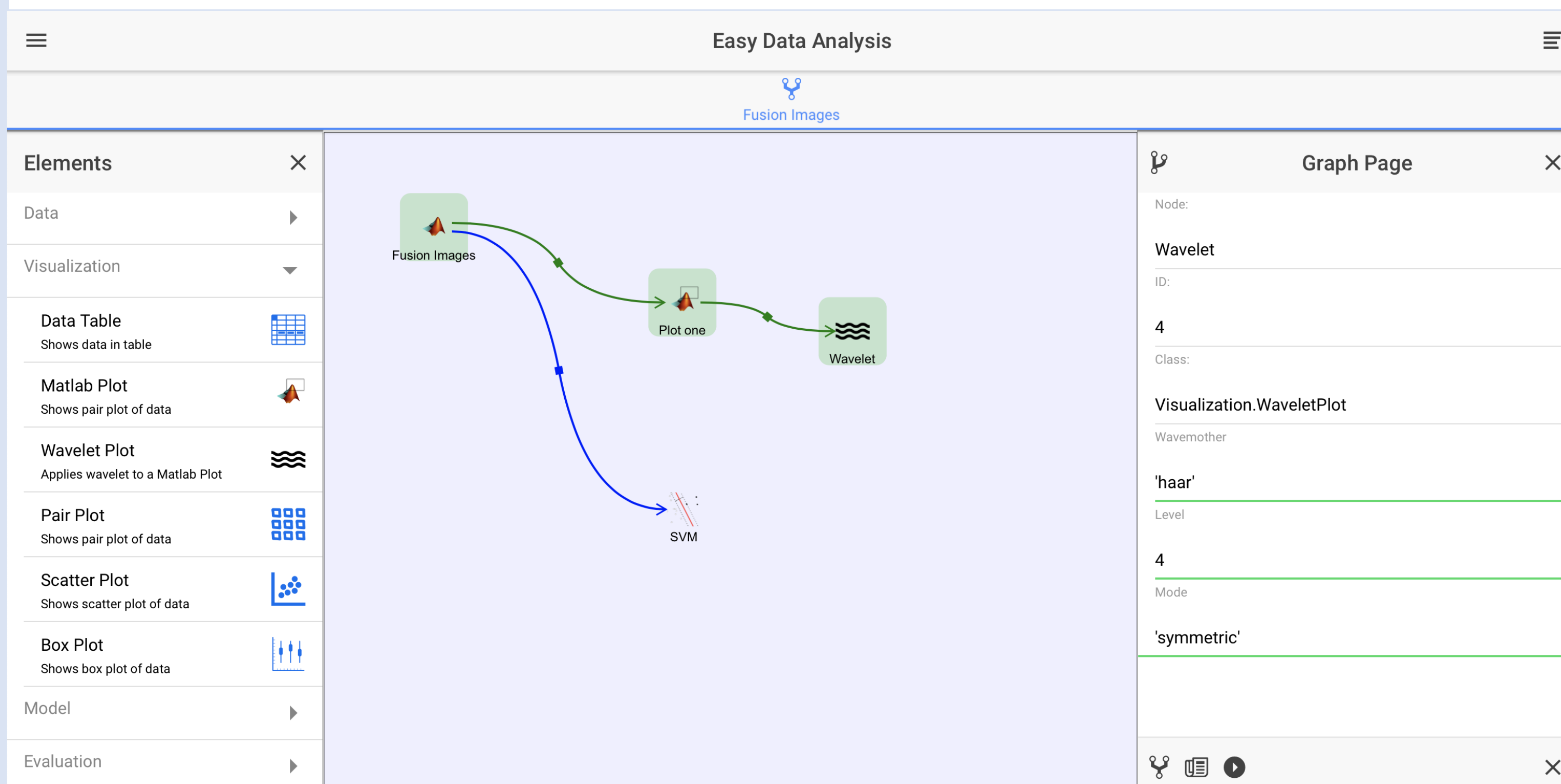

Fig. 1: A typical page for a processing graph.

There will be a code repository associated with a graphic editor (interactive environment) that will allow the processing and analysis (with high-performance computing capabilities) of new signals and discharges in an easy way. The interactive environment will provide users with software modules (input/output, plots and machine learning codes) that can be combined in several ways with a high level of interactivity. Figure 2 gives an architectural view of the different platforms the graphic interactive environment is involved.

Fig. 2: Schematic description (separation of equipment and tasks).

RESULTS

A NON-TRIVIAL EXAMPLE

One of the analysis that is carried out to study the plasma behavior is the well-known Thomson Scattering (TS) diagnostic. It acquires five types of images. Before to train an SVM classifier to extract features automatically, we first apply pre-processing to the TS images. Figure 3 shows these images and their corresponding processing images.
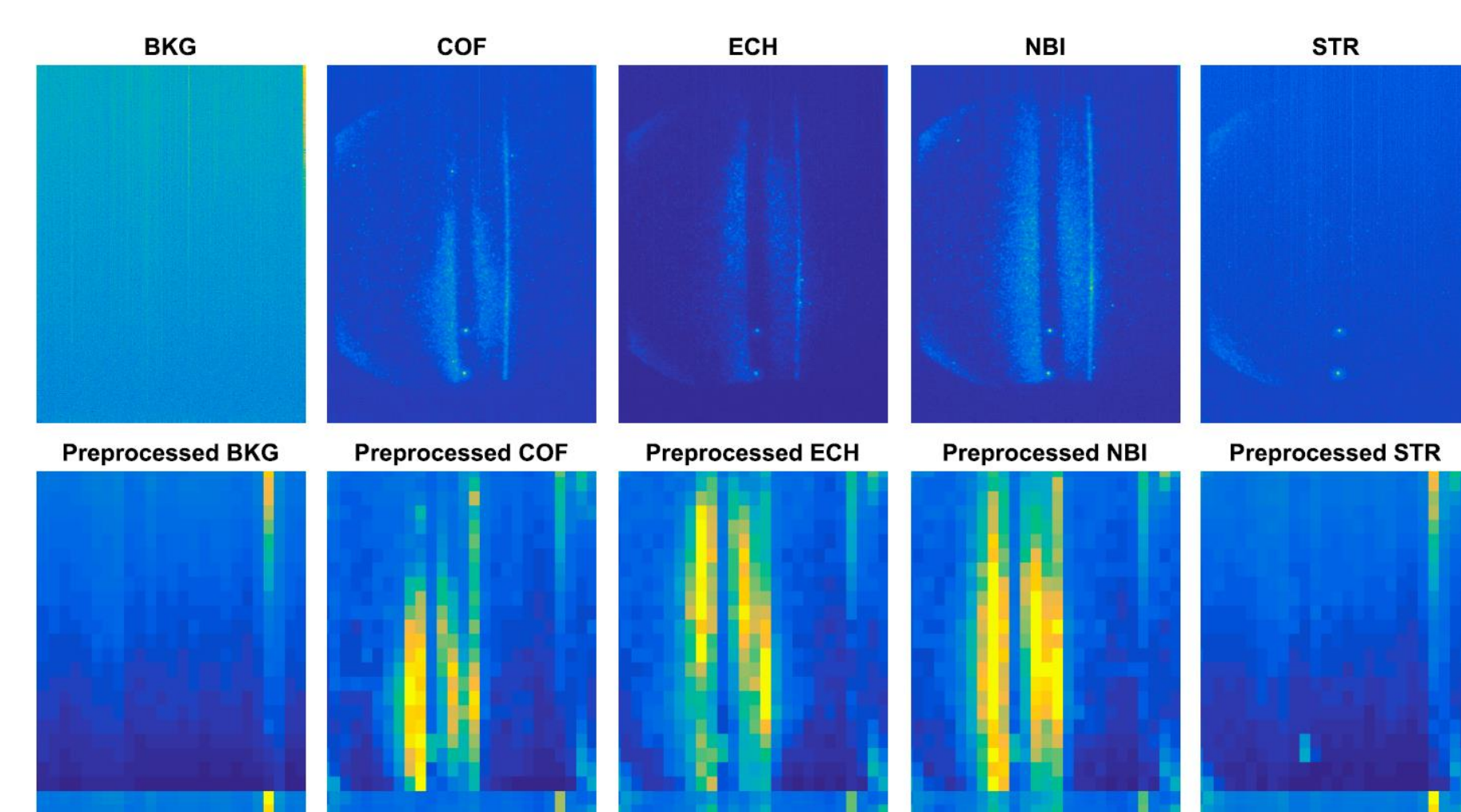

Fig. 3: Five type of TJ-II TS images and their corresponding pre-processed.

WT is applied to reduce the original 576x385 (221760) pixels to only 36x25 (900) pixels without loss of critical information, which makes easier and faster the subsequent steps. The problem of classification is applied to a set of 981 images of the TJ-II Thomson Scattering diagnostic. The obtained result in terms of success rate, based on the average of these 100 experiments, has been 98%.

CONCLUSION

- The platform introduced solves several of the typical problems fusion scientist face when working with fusion data: access to a vast quantity of data remotely and in a secure environment, the need to use a large and ever-growing set of libraries for data handling, preprocessing, analysis, modelization, and visualization of data.

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