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Image Annotation at European XFEL

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ABSTRACT

Cameras and imaging tools in diagnostic systems are valuable sources of information at photon sources, and instrument scientists rely on their information to perform their experiments. Defining the reference position of the beam during alignment of the instrument setup, monitoring and tuning the beam stability or aligning the position of the target with respect to the beam are examples of tasks performed with imaging cameras. However, at the European XFEL, existing tools do not allow the extraction of this kind of information in a computer-readable form and thus make tracking the events observed during the different phases of the experiment or, even across experiments, difficult. As part of the AMORE (Automated Metadata annotation Reconstruction Environment [1]) project, the European XFEL Control group has developed a set of tools that allows instrument scientists to extract and integrate metadata from/to existing imaging tools already in the control system, as well as to process and store them. This contribution summarizes the tools under development and their applications.

IMAGE ANNOTATION @ KARABO

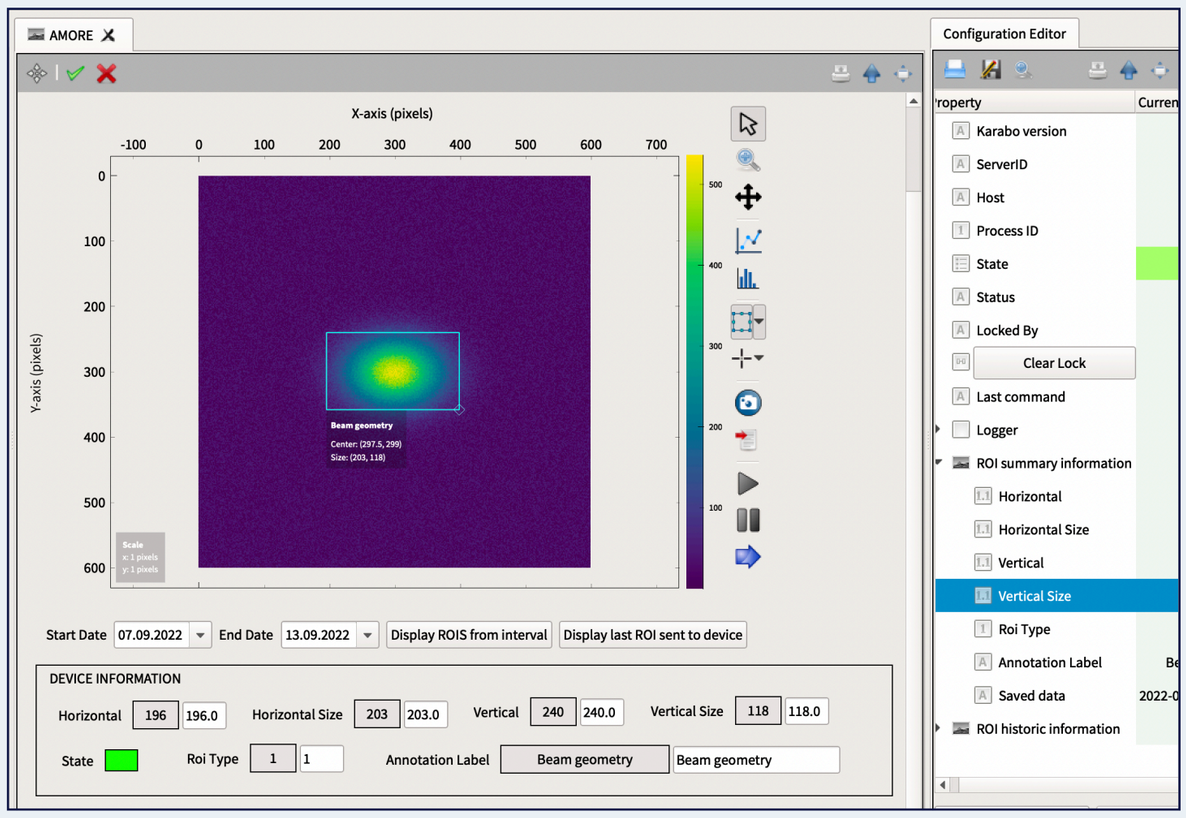

Fig.1: Overview of the image annotation tool at the European XFEL.

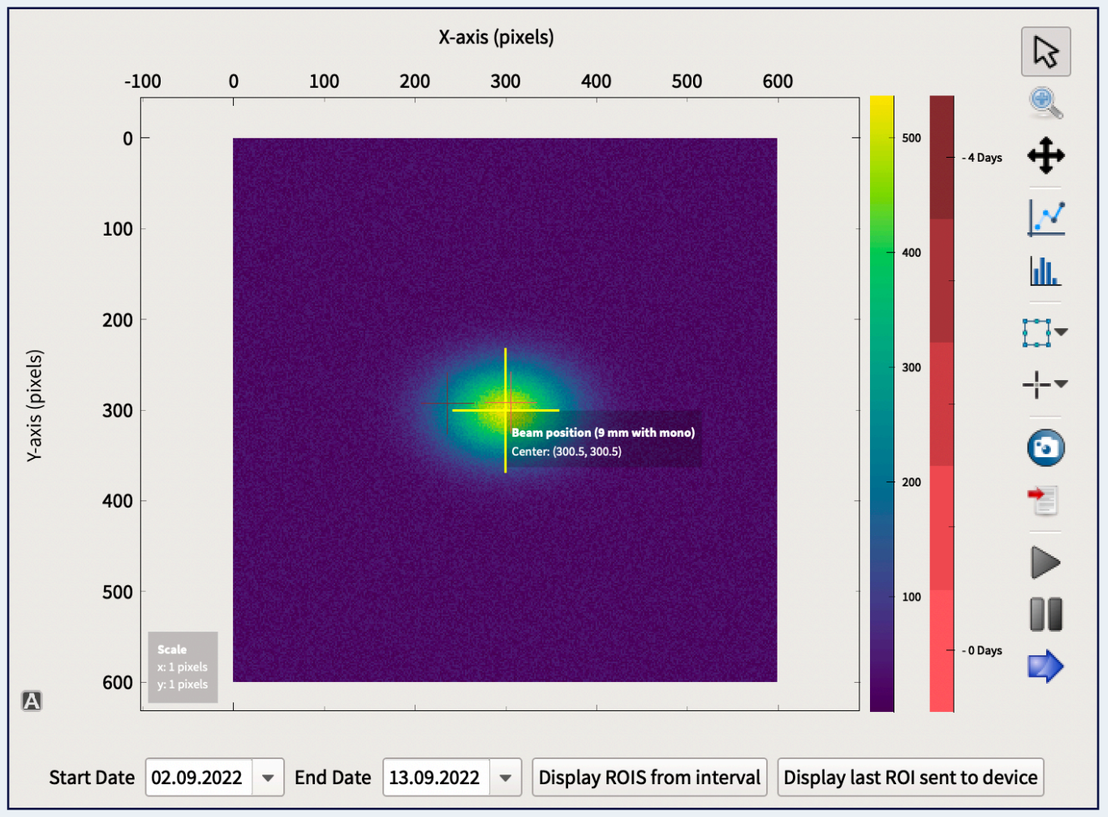

Fig. 2: ROIs annotated within a given time period, are displayed on the image with a colour corresponding to the date they were saved, in days relative to the current date, shown in the time look-up table.

INTRODUCTION AND MOTIVATION

The Image annotation tool developed in Karabo (fig. 1 and 2) allows adding relevant metadata associated with both images of the beam and the sample.

SELECTED USE CASES

- Annotate the X-ray beam position to e.g. keep track of possible drifts (fig. 3).
- Annotate the beam position and the monochromator configuration for reference.
- Annotate the beam position of the optical parameters for a given energy, to have a reference value.

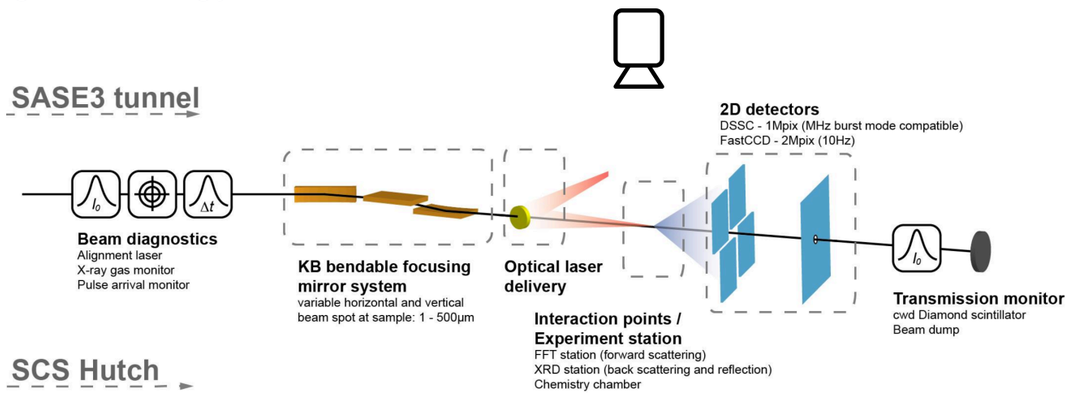

Fig. 3: Example of beam monitoring at the instrument Spectroscopy and Coherent scattering instrument at European XFEL

- Characterization of the target positions within a solid sample in the instrument reference frame (fig. 4).
- Annotate the sample position together with the current settings of motors and actuators to get a “map” of the sample card.

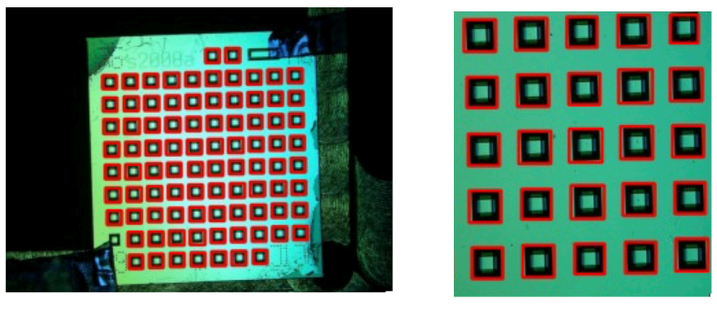

Fig. 4: Example of a frame (set of targets) to be characterized in the instrument

METHODOLOGY

The Image Annotation Tool is a combination of a Karabo GUI (extension) and a “Middlelayer” (MDL) device [2, 3]:

The Karabo GUI extension provides an interface for:

- Annotating the image, either a single point or an area.
- Retrieving annotations from a given time interval (fig. 5).
- Matching the colour corresponding to the date the annotation was saved.

The MDL device saves the annotation and its corresponding parameters- position, size, and date- in Karabo’s data logging system, which is based on the time-series database InfluxDB [4].

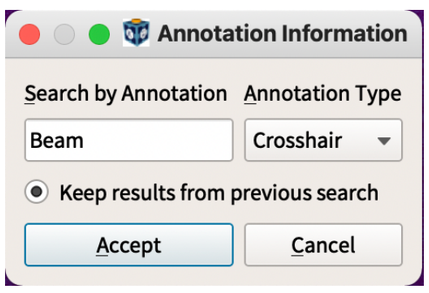

Fig. 5: The Image annotation tool at European XFEL works as a conjunction between the Karabo GUI and the “Middlelayer” API that stores properties in a time series database.

CONCLUSIONS AND FUTURE WORK

- Potential use cases for image annotation have been identified at different instruments at European XFEL; including both beam and simple image annotation.
- A prototype for Image Annotation has been developed and will be tested during the next user operation period, for both beam monitoring and a sample scanner.

REFERENCES

[1] “Why metadata?” L. Gelisio, Data Hub Use Cases for ExPaNDS and PaNOSC, 2021

[2] “The Karabo distributed control system”, S. Hauf et al. JSR, 2019.

[3] “The Karabo Control System: SCADA, Automation & Remote Access” A. Silenzi, SRI 2021.

[4] Experiences with Datalogging to InfluxDB at the European XFEL, G. Flucke NOBUGS 2022.