

Dual Energy GUIs

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Introduction

The klystron complement displays at LCLS are currently out of step with the system's new ability to host dual beam energies. In this project, we focus on two pre-existing graphical interfaces for displaying and modifying klystron statuses in the linac, and we update them to be compatible with both "beamcodes" of the new system. Our goal is to facilitate operators' joint use of hard and soft x-ray beamlines at LCLS through an intuitive system of applications operating in real-time. This project is also undertaken in the interest of transitioning from MATLAB 2012 to MATLAB 2020 in the production system. Keywords: klystron complement, MATLAB 2020a, App Designer, dual energies

Research

The first step in our project was meeting with operators for feedback on the pre-existing interfaces and ideas for new interfaces. This led to strategic choices for both the EDM "mini" klystron display and the MATLAB GUI, from minor details such as color selection to major details such as the ability to make the HXR complement mimic the SXR complement and vice versa.

Finding efficient ways to convert between MATLAB 2012's "GUIDE" and MATLAB 2020's "App Designer" was central to both the execution of and motivation for these changes. MathWorks does provide a GUIDE to App Designer migration tool; however, preliminary investigations showed that it cannot handle certain properties that were essential to the original app, such as pop-up windows, figure output, and editability of default code blocks. Therefore, rather than attempting to reproduce, pixel-for-pixel, the MATLAB 2012 GUI in App Designer, we dove into the App Designer workflow, re-creating the GUI "from scratch." This also enabled us to gain a deeper understanding of App Designer as a tool that can be used for creating new GUIs.

Thus, small popup windows were replaced by within-window alert boxes, and large popup windows by pages accessed with tabs. Output figures previously used for logbook storage were replaced with axes objects, which can be exported as jpegs. The App Designer axes object also proved invaluable in creating patterns such as the triangles and asterisks in Fig 5. Finally, while many of the code blocks remained identical, the overall organization of the code was restructured.

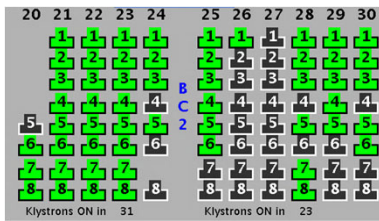


Fig 1. LCLS complement in MATLAB 2012 (incompatible with dual energies).

The rest of this panel provides an overview of the new klystron complement app.



Fig 2. Page navigator. In the "Display" tab, the user can load klystron status history for a given time window, represented by the "history" slider.

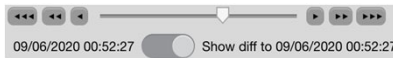


Fig 3. History slider and "Show diff" toggle. Turning the toggle off displays the complement at the slider date. Turning the toggle on displays the current complement, with asterisks indicating the status at the slider date.



Fig 4, 5. A subset of the klystron complement, displayed with "Show diff" toggle off (left) vs. on (right). Blue color = klystron on beamcode 1 Pink color = klystron on beamcode 2

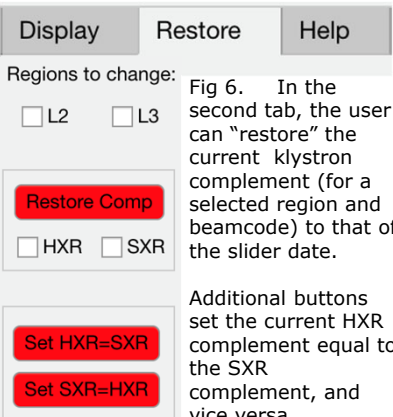


Fig 6. In the second tab, the user can "restore" the current klystron complement (for a selected region and beamcode) to that of the slider date.

Additional buttons set the current HXR complement equal to the SXR complement, and vice versa.

Readers should note that, while the EDM dual energy display (Fig 7) has been released and is already receiving positive feedback from operators, testing for the MATLAB dual energy GUI is still in progress, as certain functions used to access process variables, such as "control_phaseGet", "getHistoryWfm", and "getHistory", are still being adapted for dual energies, and the application must be updated accordingly.

Once the PVs have been finalized, we plan to test the GUI opportunistically with the assistance of control room operators, since the GUI causes substantial changes to the linac.



Fig 7. EDM "mini" klystron display, updated for dual energies. Pink bars correspond to the SXR beamline, and blue bars to the HXR beamline.

Conclusions

Recreating GUIs from scratch is an unexpectedly efficient way to convert from GUIDE to App Designer, due to App Designer's intuitive "drag-and-drop" workflow. It remains to be seen whether App Designer will easily allow for "auto-update" functionality using threaded subroutines, and whether its processing time competes with that of GUIDE, but it has already proved to be an intuitive tool that can enable rapid GUI creation.

Suggestions for future work include a manual or forum for GUIDE-to-App-Designer migration in order to help SLAC developers learn from each others' experiences.

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