Data Analysis and Visualization at LCLS

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Introduction

Every experiment conducted in each LCLS instrument generates massive amounts of data. It is crucial then, to be able to efficiently parse this information in a way that extracts data of utmost relevance. In particular, I worked with tutorial data from CXI and XPP to work towards this goal. This project addresses the need for quick and efficient data analysis and visualization techniques at LCLS. We use an array of statistical tools built into software packages, especially in Python.

Programs

All of my work this summer was done using Python. In particular, I made use of pandas, a Python package that incorporates statistical functionality from R with convenient visualization and plotting methods.

One thing I worked on was figuring out a way to find appropriate Gaussian fits to curves with multiple peaks while subtracting irrelevant noise. I wrote a Python script to find inflection points in graphs and translate their indices to split the graph into several graphs and then do Gaussian fits accordingly. Another thing I worked on was using mathematical plotting tools in Python to generate nice plots. I tested code from run summaries to generate basic plots, then modified them.

Python Tools

- scikit-learn
- matplotlib
- PyDataSource
- xarray, pandas
- NumPy, SciPy

Applications

After figuring out how to manipulate data appropriately, I have been attempting to create run summary reports for most of the publicly available tutorial data to make it easier for users to generate plots.

Future Directions

There are many directions in which data analysis could be furthered. One such direction would be to consolidate correlations across different groups of data to see which relations are more consistent in the big picture.

Another direction could be to make analysis methods generalizable to different types of data. Machine learning tools could also be applied to data analysis to predict useful information.

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