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Author(s): Temple, Brian A.
Armstrong, Jerawan C.

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LANL12-RS-107J
Interfacing the X-Ray Toolkit and the PYTHON Radiography Analysis Tool
Final Report for FY12

Brian Temple and Jerawan Armstrong

This document is the final report for the X-Ray Toolkit (XTK) and the PYTHON Radiography Analysis Tool (PyRAT) merger for project LANL12-RS-107J in FY12. This project involves merging the radiography analysis capabilities in PyRAT with the image processing capabilities of XTK. The merger is the focus of project LANL12-RS-107J at Los Alamos National Laboratory (LANL) and SNL12-RS-107J at Sandia National Laboratory.

The deliverables for project LANL12-RS-107J were the following:

- 1) Outline XTK and PyRAT capabilities to coordinate interfacing between codes
- 2) Create and modify PyRAT Python Windows executables for XTK
- 3) Provide mid-year review
- 4) Release code and related (final) report/manual

A summary of each deliverable is given below.

1) Outline XTK and PyRAT capabilities to coordinate interfacing between codes

The first deliverable required LANL and SNL to outline how the code merger would be implemented. This work was completed by January 2012. SNL and LANL agreed to merge the two codes in a manner that allowed each code to operate independently of each other and allow the user to operate each code simultaneously. This is the same interface approach used in the XTK-SAFIRE interface.

XTK is used as the front end user interface that calls PyRAT to perform image analysis. This approach gives the user the greatest flexibility in processing/analyzing image data and the code developers the greatest flexibility in maintaining and developing software. XTK's role in the merger will be provided by SNL's FY12 report. In general, XTK is used to perform image processing (cropping image, distance measuring capabilities, etc.) and pass the processed/unprocessed image data to PyRAT. XTK will pass the data to PyRAT in an uncompressed *.tif format. If the image data is in another format, XTK will convert it into an uncompressed *.tif format. XTK will also provide some of the information needed by PyRAT for data analysis. The information passed on by XTK to PyRAT is:

- A) Uncompressed *.tif image file (cropped or unprocessed)
- B) Magnification factor (Mag factor)
- C) Pixel sizes
- D) Center of object pixel values
- E) Radii of layers
- F) Initial guesses for materials
- G) Angles for calculating 1-D data

Since the two codes are designed to work independently and simultaneously, PyRAT will be able to input all information needed to perform image analysis regardless of what information is provided from XTK. This approach allows the user to keep working in their respective code and not have to “jump back” between the two codes in order to perform the needed tasks. If the user passes new images and information to PyRAT from XTK while PyRAT is currently working on other data, XTK will not kill PyRAT. PyRAT will pick up the image data and information once it completes its current work. This method of interfacing the codes takes advantage of the multiple image processing capabilities of XTK and reduces the amount of image processing code development needed in PyRAT.

PyRAT will read in the image data passed along by XTK and a data file containing whatever inputs have been provided by XTK. PyRAT still maintains the ability to read in image files and input all information needed for image analysis separate of XTK. The image data can be the raw image or a cropped image. The image data read in by PyRAT can be further processed by the limited image processing capabilities in PyRAT. Images read into PyRAT from XTK are labeled differently so the user knows where they obtained the image. The data file passed along by XTK is read by PyRAT and checked to determine what information has been provided. PyRAT is now structured to allow the user to accept or reject information provided by XTK so the user can change inputs as needed without jumping back to XTK. All outputs from the analysis are displayed in PyRAT. This allows the user to do all image analysis separate from XTK so image processing can be simultaneously performed while data analysis is being performed. The user may also perform additional analysis on the image in PyRAT so that the user does not need to start over in XTK.

2) Create and modify PyRAT Python Windows executables for XTK

Nearly all of this work has been completed. PyRAT has been modified so that it can read in images and information from XTK. The GUI has been changed to address the most of the modifications listed in the mid-year review. A main feature not inserted into the GUI is the drop down menu for materials input. Since we are now allowing XTK to input image data information, we have discovered that more data consistency checks need to be made. The main issues deal with the consistency between the XTK specified values for the pixel sizes and mag factor, and the information obtained from different sources. We have to put these consistency checks into the code or it will be very difficult for the user to sort out the discrepancies in the information and locate sources of error in the analysis. The new consistency checks we need to implement are:

A) Pixel size consistency: since XTK can now provide information on pixel size, that input needs to be checked with the pixel size determined from the image file.

B) Mag factor consistency: XTK can give a mag factor specification and the GUI now allows the user to input a mag factor along with the source to object distance and the object to detector distance. The source to object and object to detector distances are used to calculate a mag factor. We need to check the consistency of the input from XTK or values entered in PyRAT with the mag factor that would result from calculating the value from the source to object and object to detector distances.

We still need to check operation of both codes when interfacing. Once the consistency checks are developed, the code will be compiled as a Windows executable and passed to SNL to check the interface.

3) Provide mid-year review

A mid-year review was provided and presented.

4) Release code and related (final) report/manual

The original plan to have the final report be the user's manual will not be followed. We are still making changes to the code described above and will provide the manual once the changes are finished. Once the PyRAT GUI and code modifications containing the needed consistency checks are completed, the software will be tested and released to SNL for merging with XTK. The user's manual will be provided with the code once the FY12 modifications are finished.

Delays occurred in the LANL12-RS-107J project due to the uncertain employment status of the main code developer. The code developer is now a permanent staff member that can work on the project again. The project is behind schedule for FY12, but should have the FY12 work completed by the end of October 2012. The main code developer will work the extension of this project in FY13.