Automated Crystal Mounting and Centering Project at CHESS

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Summer, 2001

Abstract

The growing demand for beam time at synchrotron radiation sources throughout the nation as made it a priority to increase the efficiency at which users can conduct experiments at these facilities. One idea being pursued by several labs is automating the process of mounting and centering crystals on x-ray beam lines. Currently, at the Cornell High Energy Synchrotron Source (CHESS), crystal mounting and centering is done by hand, a time-consuming and inexact process. The automated crystal mounting and centering project at CHESS has three goals. The first goal is to allow users to center the crystals from outside the hutch using a computer and video monitor linked to a motorized goniometer head. The second goal is to design an imaging system that will recognize and center crystals at the push of a button. The third goal is to completely automate the process by including a robot that can mount and dismount a series of crystals onto the goniometer head. A digital imaging system and algorithm will then automatically center the crystals for optimal x-ray diffraction. At this level users will not even have to be on site to conduct their experiments. At this point we are pursuing tasks in both goal one and two. Research Support Specialist, Chris Heaton has designed and assembled a motorized goniometer head that offers five axes of movement down to three microns of resolution. Research Associate, Richard Gillalan and I are developing a C program that will allow users to direct movements to the goniometer head by simply pushing arrow keys. For the second goal we are writing code in JavaScript and HTML that will allow us to download a streaming video image of a mounted crystal onto a web page. We then hope to manipulate this image so that the user can center the crystal remotely using a point and click method. The robot can probably be acquired by using off the shelf and technology and then modified to suite CHESS’s needs. This will be investigated further in September starting with a visit to prototype robotic mounting and centering mechanisms at Stanford University and Lawrence Berkeley Laboratory.

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Background

The following paper is a description of the Research Experience in Teaching (RET) project I worked on at the Cornell High Energy Synchrotron Source (CHESS) for six-weeks during the summer of 2001. CHESS is an adjunct to Cornell University’s particle accelerator located at the Wilson Lab. A byproduct of circulating high-energy particle...