Development of computer vision and image processing at the National Synchrotron Light Source – II

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The beamline microscopes at the National Synchrotron Light Source – II (NSLS-II) at Brookhaven National Laboratory utilize X-ray imaging to enable the study of material properties and functions with nanoscale resolution. Along these beamlines are hutches that contain detectors and cameras to monitor the state of the beam and samples. Since the hutch must be sealed during operation, robots help to automate the process of sample transfers and camera movement without human interference. However, in order to automate these processes, the development of computer vision and image analysis software is required. By building a general purpose computer vision module with the support of OpenCV, an open-source computer vision library, computers now have the ability to determine if a robot has improperly mounted a sample or pin, and can warn users and scientists of potential errors within the hutches. This wrapper module allows users to simplify computer vision processes and programs with succinct code. Computer vision also allows computers to determine the positon, spread, and intensity of the x-ray beams automatically from images provided by cameras on the beamline. By integrating computer vision to the Experimental Physics and Industrial Control System (EPICS), an open source control system for scientific instruments, computers can, in real-time, observe and report of the status of a beamline without human interference or control. This will help prevent improper mounting of samples and possible collisions that will result in downtime and damage to the beamline. This will also allow for automated error checking, beam analysis, and robotic experimentation without input from beamline scientists. The library has potential for more applications to other beamlines. As a result, I have added computer vision to my repertoire of computer techniques. Additionally, I am now familiar with EPICS and the OpenCV library implemented in the Python programming language.