Investigation of characteristics and sources of beam orbit instabilities in modern light sources

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We discuss the analysis and methodologies to characterize the electron beam instabilities in NSLS-II and other storage rings. First, we introduce the experimental methods and the analytic models that we implemented to characterize spectra of the electron beam orbit instabilities. Then we discuss the theoretical analysis and experiments to identify the noise sources, as well as accomplishments in stabilizing the beam by suppressing the noise from the sources. In particular, the BPM data indicated the dominant spectral noise range is located within 100 Hz, which was found to be excited by the water-cooling system. We have also detected and analyzed noise components from other ring subsystems such as RF and top-off injection. We present a development of an application for live monitoring of beam instabilities, which was implemented on the NSLS-II storage ring to monitor real-time orbit performance during beam operations. Finally, we present our studies on integral stability of X-ray beam along 120 m long Hard X-ray Nanoprobe beamline that enables microscopy experiments with the resolution of 10 nm. As a part of the presentation, we will share experience from other accelerator facilities in solving stability problems to increase the beam brightness.