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Experimental modal analysis, model correlation, and tuning for synchrotron storage rings applications

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The ALS-U project will deliver a beam 100x brighter than the existing ALS beam. In order to achieve this, the RMS displacement levels above 10 Hz for all magnets in a sector of the storage ring, shall be < 200 nm along the electron beam direction and < 35 nm in both transverse directions. A prototype storage ring raft was built to undergo vibration measurements and inform on the expected performance of the production rafts. This paper details the approach chosen to tune the prototype FEA model using specific measurements. First, the modal behavior of the model was tuned using multiple impact multiple output hammer measurements. Through the iterative updating of selective spring constant parameters representing the stiffness of the storage ring supports, the mode frequency, shape and damping coefficient were then determined to closely match the experimental results. Random vibration FEA predicted levels at the magnets were validated with measured magnet motion on the prototype raft. With the validated modeling and updated parameters, the production raft types are predicted to meet the displacement level requirements.

Footnotes

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