Vibration and Noise Analysis of the Feather River Bridge

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Abstract

The U.S. Army Engineer Research and Development Center (ERDC) is conducting research using infrasound arrays to detect and monitor structures as well as for dynamic structural characterization of large infrastructure. Previous studies have determined that structures radiate acoustic energy within the infrasonic passband, typically defined as sound below 20 Hz, while propagating several kilometers away from the source with little attenuation. Efforts have been made to use this information to assess and monitor structures at standoff distances.

One such experimental series involves infrasonic detection and monitoring of a bridge in northern California of the main spans of the bridge along with on-structure instrumentation for frequency comparison. This is coupled with finite element models built in Comsol. As a continuation of previous studies investigating the Feather River Bridge, an acoustic model, with air as the medium, of the bridge has been developed in order to better understand the acoustic energy the structure emits while vibrating. This model was implemented with the Comsol Acoustic Module, via the pressure acoustic physics and frequency domain study, using data collected from a vibrational analysis model of the bridge, using the Comsol Structural Mechanics Module. The acoustic model was evaluated for the first few natural frequencies of the bridge to obtain the acoustic radiation and the sound pressure level for each mode.

The energy level generated by the acoustic model were compared with collected infrasound data and on-structure instrumentation. Using this data, propagation ranges for each of the natural frequencies may be estimated. Information on these expected propagation ranges can be used to refine array distances and placements as well as provide insight into expected detection ranges for various types of infrastructure.

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