ISMA 2014

Introducing Modal Analysis to Luthiers through an Experiment without Analyzer or Transducers

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Sound quality of stringed instruments (as violins and guitars) is strongly related to the vibration of their bodies, which has awakened the interest to different people. On one hand, luthiers have explored, majorly through empirical procedures, about how different structural designs cause variations in tonal quality of stringed instruments. On the other hand, scientists have tried to explain the vibrations of stringed instruments; typically using a powerful technique called modal analysis. Trying to link scientific research with instrument making seems adequate, but explaining vibrations using modal terms to luthiers is usually a hard task: applying modal analysis requires a strong background of experimental mechanics. In order to introduce modal analysis during a course of violin acoustics, a classroom activity was implemented in this work. A book separator is clamped at around one quarter of its terminations using rubber bands (resembling the first free mode of a bar), a peg is arbitrarily attached (resembling a transducer) and a finger drives six points (resembling an impact hammer) through the length of the separator. A graph is created using six points in a row as a spatial representation of the measurements in the separator, and extending each point to obtain an arrow of magnitude proportional to the distance of the corresponding point to the nearest rubber band: straight up if the finger and the peg follow the same direction or straight down if both are contraries. After performing the experiment, students were capable of interpreting mobility measurements of a free bar.