COMPARISONS BETWEEN MEASURED AND PREDICTED VIBROACOUSTICS CHARACTERISTICS OF AN UPRIGHT PIANO SOUNDBOARD

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ABSTRACT

The piano soundboard is an orthotropic plate made of spruce, ribbed by multiple stiffeners (the ribs) parallel to the grain direction of the main panel's wood and two addition beams (the bridges) nearly in a perpendicular direction. This complex structure transforms the piano string vibration (coupled to the soundboard at the bridge) into sound; its vibrations and radiations are therefore of primary importance for the sound characteristics of the instrument. Several vibroacoustics models have been developed these last decades using different methodologies: finite element / numerical modeling (Berthaut et al., Applied Acoustics, 2003 ; Chaigne et al., JASA, 2013 ; Chabassier et al., JASA, 2013) or reduced models using global descriptors (Boutillon and Ege, JSV, 2013). An analytical model recently developed at LVA (Trévisan et al., ISMA 2014 / NOVEM 2015) is particularly well-adapted for a parametrical study and appears as an alternative to time-consuming numerical methodologies. The model is based on a variational approach that takes into account plate and superstructures energies. The soundboard vibration is decomposed on the corresponding orthotropic simply supported unribbed plate modes. The aim of this analytical tool is ultimately to help piano manufacturers to predict the influence of structural modifications of the soundboard (number/dimensions of ribs/bridges…) on the sound of the instrument. In order to validate the methodology and hypotheses done in the analytical model, we present and compare in this communication measured/predicted vibroacoustics quantities obtained for a same structure and under same (supposed) conditions: a Pleyel P131 upright piano soundboard fixed on its wooden rim. The quantities compared are modal basis in the low-frequency domain [0-400Hz] and point mobility along the bridge for a larger frequency band [0-5kHz]. Results on vibrations are very satisfying demonstrating the validity of the model. Experimental radiation results (soundboard radiated power) will also be given and compared to predicted quantities.