Hybrid Modeling of Cristal Baschet Sounds

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ABSTRACT

The Cristal Baschet is a musical instrument created in the fifties by F. and B. Baschet. The produced sounds are resulting from friction-induced vibrations due to the interaction between the wet fingers of the player and a large number of glass rods called glass bows. Each glass bow is connected to a resonator consisting in an assembly of two beams linked by a mass which is tuned in order to reach a targeted pitch. Vibrations are then transmitted to thin plates acting as sound radiators. Analysis of the glass bow instability using an High speed Camera (7000 frames per second) shows that a slick-slip mechanism occurs at the finger/rod interface: sliding and sticking phases follow each other while the glass rod exhibits a solid body motion coupled to the bending motion of the resonator. An hybrid model is proposed to describe the instability: the finger/rod interaction is described analytically by a simplified friction law while the motion of the resonator (beam assembly) is described by its measured input mobility. The musician gesture is described by the velocity of finger and the shear force applied on the glass bow. Such characteristics are used to provide time domain simulations of the sounds produced by a Cristal Baschet. Cristal Baschet makers are sometimes reporting the fact that when the mobility of one beam assembly is too low, the sound is difficult to produce. Such configurations are investigated: the model is used to investigate the role played by the input mobility of the resonator. The analysis of the conditions needed to reach periodic oscillations is performed using the time domain simulations and a linear stability analysis, which permits a Schelleng type diagram for the Cristal Baschet to be proposed.