# Physical Modelling and Sound Synthesis of a Viola Caipira

*Guilherme Paiva,*[1,2†] *Frédéric Ablitzer,*[2] *François Gautier,*[2] *Mathieu Sécail-Géraud,*[2]
*José Maria Campos Dos Santos*[3]

[1]University of Campinas
[2]Laboratoire d'Acoustique de l'Université du Maine
[3]LVA-UNICAMP
[†]pitupaiva@gmail.com

**ABSTRACT**

The Viola Caipira is a folk guitar played in traditional and modern Brazilian music. In general, it has ten metal strings arranged in five courses of two strings with the thinnest string located in the middle. Two pairs have identical strings tuned in unison and three pairs have strings with different thicknesses tuned in an octave. This work presents an experimental study of the Viola Caipira pluck by means of a high speed camera (5000 frames per second), which allowed to reveal some specificities of the instrument. It is found that the instrument is characterized by a double pluck excitation : The two strings of a given course are plucked sucessively and rapidly. Sympathetic phenomena and collisions between strings are also identified. A physical modelling based on a hybrid modal approach including string/string collisions is developped for the sound synthesis of the viola caipira sounds. Such approach is hybrid since it combines two different ways for describing strings and body dynamics: Analytical expressions of mode shapes, natural frequencies and damping factors are used to obtain the modal basis for each string while body modal parameters are extracted from mobility measurements at the bridge. In order to couple both strings and body, a finite difference scheme is used to calculate the coupling forces at each time-step, which permits a set of sound simulations. It is found that the model reproduces the main features of the Viola Caipira sounds, among which the sympathetic string resonances and the string/string collisions observed in the video analysis.