









Prediction of the dynamic oscillation threshold of a clarinet model : Comparison between analytical predictions and simulation results

B. Bergeot^a, A. Almeida^a, C. Vergez^b, B. Gazengel^a — ANR project SDNS-AIMV : Transient processes in self-sustained instruments ^aLUNAM Université, Université du Maine, UMR CNRS 6613, Laboratoire d'Acoustique, Avenue Olivier Messiaen, 72085 Le Mans Cedex 9 ^bLMA, CNRS, UPR 7051, Aix-Marseille Univ., Centrale Marseille, F-13402 Marseille Cedex 20, France

Abstract. Simple models of clarinet instruments based on iterated maps have been used in the past to successfully estimate the threshold of oscillation of this instrument as a function of a constant blowing pressure. However, when the blowing pressure gradually increases through time, the oscillations appear at a much higher value than what is predicted in the static case. This is known as bifurcation delay, a phenomenon studied in [1] for a clarinet model. In numerical simulations the bifurcation delay showed a strong sensitivity to numerical precision. This work presents an analytical estimation of the bifurcation delay of the simplified clarinet model taking into account the numerical precision of the computer. The model is then shown to correctly predict the bifurcation delay in numerical simulations.

The clarinet model

The system Reed channel

Control parameters

 γ : pressure inside the mouth of the

Assumptions





Problem statement



*Precision : number of decimal digits use by the computer

Analytical work presented in [1, 2] is based on a general method proposed by Baesens [3]

References:

[1] B. BERGEOT, A. ALMEIDA, C. VERGEZ et B. GAZENGEL : Prediction of the dynamic oscillation threshold in a clarinet model with a linearly increasing blowing pressure. Nonlinear Dynamics, 73(1-2):521–534, 2013.

[2] B. BERGEOT, A. ALMEIDA, C. VERGEZ et B. GAZENGEL : Prediction of the dynamic oscillation threshold in a clarinet model with a linearly increasing blowing pressure : Influence of noise. Nonlinear Dynamics, 2013.

[3] C. BAESENS : Slow sweep through a period-doubling cascade : Delayed bifurcations and renormalisation. Physica D, 53:319–375, 1991.