Graph models of wind instruments

Georges Le Vey*[1]

[1]École des Mines de Nantes [Nantes] – Ecole des Mines de Nantes – 4 rue Alfred Kastler BP 20722 44307 Nantes cedex 3, France

Abstract

A modelling approach for wind instruments with toneholes is presented. It departs from the classical one, based on the transmission lines analogy with 1D propagation in ducts, in which the impedance is a central concept. The key theoretical idea is to describe the topology of a wind instrument through a convenient graph, leading to a nonstandard vector boundary value problem for the 1D wave equation on a graph. In a second step this last one is transformed into a standard matrix one, giving an efficient numerical solution method as well as the possibility of formal developments that can be useful for either analysis or design of instruments. Results on elementary ducts with/without toneholes illustrate the method and are also used for checking against the usual method. One feature of the approach is to compute natural frequencies and the eigenmodes at once, even for geometries with large discontinuities. A nice byproduct is the answer to a conjecture formulated 20 years ago by Dalmont and Kergomard for stepped cones.

*Speaker