PROCEEDINGS of ISMA 2019
International Symposium on Music Acoustics

13 - 17 September 2019 in Detmold, Germany

Damping of waves at the walls of a conical tube

Cornelis J. NEDERVEEN[1]; Timo GROTHE[2]; and Johannes BAUMGART[3]

(1) Acacialaan 20, 2641AC Pijnacker, The Netherlands
(2) Hochschule für Musik Detmold Neustadt 22, 32756 Detmold, Germany
(3) Dresden, Germany

Abstract

Resonators of reed wind instruments are tubular ducts with one open and one closed end. The ratio of pressure response to flow excitation at the closed end is the input impedance. Resonance frequencies of the duct are near to peaks in the impedance spectrum. Damping due to visco-thermal effects at the walls influences the frequency and the magnitude of the impedance-spectrum peaks, which influence intonation, playing behaviour and timbre. For cylindrical instruments theory to account for wall losses is available and experimentally confirmed. The wave equation in a conical tube while accounting for dissipative effects at the walls appears to be complicated. Four approximative solutions are compared: (1) Nederveen (1969) presented an approximate analytical solution while neglecting some higher order terms. (2) a transmission line method mimicking the conical pipe as a series of short conical (or cylindrical) pipes, (3) directly solving the equation with a Runge-Kutta procedure, (4) applying a finite difference method. For a “simplified bassoon” (a perfect cone of 3000 mm length, input diameter 4.2 mm, output diameter 46.9 mm) the four methods give different results. Measurements are planned, but the narrow tube entrance and smoothness requirements make a high accuracy difficult. Suggestions are welcome.

[1] cjnederv@xs4all
[2] grothe@hfm-detmold.de
[3] research@johannes-baumgart.eu