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# Acoustic radiation of wind instruments resonators

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Optimization of the acoustic radiation of wind instruments resonators may be based on the study of finite length circular ducts radiating in unbounded medium, as this is a model realistic enough, but which allows advanced analytics developments. Our approach is based on the calculation of resonance frequencies of such a simplified wind instrument. These are the complex frequency singularities of the operator describing the global resonator/external fluid system. A Newton's method is used to search for the singularities of the multimodal Green's function of the duct. This is obtained by the product of impedance matrices which relate pressure and velocity between two abscissae inside the duct. A variable coupling factor is introduced with external acoustic radiation, described by a multimodal radiation impedance based on the Zorumski formulation. Examples of variation of the resonance frequencies with this coupling factor will be given. Surprisingly, regular variations of the coupling lead to non regular evolution of the resonances. Physical interpretation of this behaviour will be discussed.