A Power-balanced Model of a Valve Exciter Including Shocks and Based on a Conservative Jet for Brass Instruments: Simulations and Comparison with Standard Models

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In most of models of brass instruments (and also of the glottis), the jet is governed by an equation of Bernoulli type (with basic, non stationary or lossy versions). In this exciter part, this model is known to be of first importance because it is responsible for the non-linearity which allows the emergence of self- oscillations. However, this model infringes a fundamental physical property: it does not preserve a well- posed power balance between the reed (possibly lip-reed) and the jet. In particular, the energy stored in the reed is not given back to the jet. In the case of brass instruments and of the glottis, a second similar problem is concerned with shocks, when they are modeled by increasing the values of the mass, damper and spring for negative heights. Indeed, at the contact time, both the kinetic and the potential energies are artificially increased. In this paper, we propose a model of a valve exciter which includes shocks, with a special care to a well-posed power balance: first, the modeled of the jet is built for basic assumptions; second, a model of shocks is proposed. These models can be recast in the framework of the so-called ”port-Hamiltonian systems” which guarantees well-posed power-balance. Finally, simulations (that preserve a discrete-time version of the power balance) are performed for these new models and compared with standard models.