

**ACOUSTICS2008/3603**  
**Inverse problem: recovering the full-state of a simplified model of  
a trumpet-like instrument from the radiated pressure**

Thomas Hélie<sup>a</sup> and Brigitte D'Andréa-Novel<sup>b</sup>

<sup>a</sup>IRCAM, 1, place Igor Stravinsky, 75004 Paris, France

<sup>b</sup>Ecole des Mines de Paris, 60 Bd. Saint-Michel, 75006 Paris, France

We consider a simplified model of a trumpet-like instrument composed of a valve (including the mechanics of the lips), a jet (coupled with the valve dynamics), and an acoustic pipe excited by the jet and radiating in the air. A special care is devoted to the energy balance of the whole system and its dissipative property. This leads us to introduce a model of a non-stationary jet.

In a second step, the problem of the observation of the full-state (that is, the position and the velocity of the lips, the flow and the pressure in the jet and in the acoustic pipe) from the radiated pressure is analyzed. This problem can be recasted as a problem of control engineering, using a so-called neutral system (differential system including the delayed state and its time derivative). We show how the energy balance can help to solve this problem and define a naturally well-posed observator.

As a last step, this work is recasted in the context of a more general inverse problem: What control input (pressure in the mouth, parameter of the lips, etc) must be used to feed the model in order to recover a target sound?