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Systems control theory for sound synthesis: an overview

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The aim of this talk is to present some classical techniques and methods from control theory to deal with the problem of sound synthesis based on physical models.

A first part will be devoted to the case of finite-dimensional state space, illustrated by: 1. Kelly-Lochbaum structure for 1D wave equations; 2. Realization theory for passive impedance of rational type.

The second part considers the infinite-dimensional case. More precisely the authors will present: 1. The operator associated to PDEs in acoustics, its diagonalization leading to "Riemann invariants" useful to study stability properties; 2. A Lyapunov method to elaborate boundary control to ensure stabilization of an equilibrium regime and some kind of robustness; 3. Diffusive realizations of fractional time derivatives, useful when modeling visco-thermal losses in acoustical ducts.

These tools are well adapted to the class of "wind instruments".