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### **Block based physical modeling for virtual musical instruments**

Rudolf Rabenstein  
University Erlangen-Nürnberg, Cauerstr.7, D-91058 Erlangen, Germany

A variety of methods for physical modeling sound synthesis has been developed so far, mostly for single sound objects like strings, plates, etc. However, complex virtual musical instruments require not only advanced models but also methods for combining one or more sound objects with excitation mechanisms and resonating structures. This presentation shows how to derive modeling blocks from basic physical laws and how to connect them in a physically meaningful way.

The first step is to establish a physical model of a dynamical structure in terms of potential and flow variables, like force and velocity. It is important to observe also the boundary conditions because firstly they shape the spectrum of the vibrating structure and thus the timbre of the sound and secondly they determine the exchange of energy with the environment. The second step is the discretization of the physical model. This procedure is shown for the functional transformation method, which delivers discrete-time models with direct access to the parameters of the physical model and which reproduces the original sound spectrum. In the last step, the resulting modeling blocks are connected by scattering elements which reflect energy back into the model or transmit it to neighboring blocks.