VIRTUAL ANALOG MODELLING

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This keynote talk focuses on signal processing techniques for modeling analog audio systems used in music technology. Many analog music systems produce a distinctive and desirable sound, but the original devices may be expensive or hard to access and maintain. Examples include classic synthesizer modules and vintage guitar amplifiers. It is therefore of interest to give such systems a new life as software simulations, which will be accessible to many. Virtual analog modeling approaches can be divided into three categories: 1. reduction of artifacts in digital signal processing, 2. introducing analog 'feel' to digital signal processing, and 3. emulation of specific analog equipment. An example of the first category includes the replacement of discrete unit delays with smoothly varying interpolated delays, and the reduction of aliasing occurring in oscillators and nonlinearities. Analog 'feel' comes from the simulation of typical characteristics or limitations of analog systems, such as limited bandwidth, distortion, parameter drift, and added noise. Emulation is the most demanding task, because it refers to the detailed imitation of the response of a particular device, whose behavior is often nonlinear. Emulation can be based on physical modeling of an analog circuit, or on the black-box method, which models the system based on observing its input and output relations. An overview of recent research in the area of virtual analog modeling will be presented. Topics include antialiasing oscillator algorithms, virtual analog synthesizer filters, modeling of guitar pickups, spring reverberation units, ring modulators, carbon microphones, and audio antiquing. Virtual analog research can also open new opportunities beyond software versions of old technology. This talk will mention some examples of such possibilities.