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From the electrical shunting of a loudspeaker to active impedance control

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Variable acoustic properties can be obtained on an electroacoustic transducer's voicing face by very basic control strategies, among which are the shunting of the loudspeaker (shortcut, variable electric load, or negative resistance disposals). It is proven that better performances with enhanced controllability can be obtained by way of hybrid feedback control, consisting in a double feedback loop, one on acoustic pressure at the diaphragm and the other on its velocity, leading to a global acoustic impedance control. The present work describes the theory of the hybrid feedback control, by way of block diagrams aiming at visualizing the control principle, starting from the shunted loudspeaker. Simulations of performances obtained on Matlab/Simulink are presented, and compared to experimental results obtained on analog prototypes mounted at the end of a dedicated impedance tube. A last, a discussion on stability issues follows, leading to concluding remarks on the disposal behavior and possible means of enhancements.