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Shape-optimization of several multi-modal resonators accounting for room/resonator acoustical coupling

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Helmholtz resonators are often applied for the sound equalisation of control rooms, through adequate levelling of the low frequency acoustic modal room responses. In several recent papers we proposed to improve the efficiency of such devices by, instead of using basic Helmholtz resonators with uniform cross-section, develop shape optimized multi-modal resonators in order to cope with a larger number of intrusive room modes. We thus showed the feasibility of resonator shape-optimization, in order to obtain a target set of acoustic eigenvalues, within imposed physical and/or geometrical constraints. More recently, we developed an efficient substructure theoretical approach to compute the coupled acoustical modes of rooms fitted with several multi-mode resonators, later also including viscous boundary layer absorption effects at the room/resonator interfaces. In the present paper we extend a further step these results by applying the previously developed optimization techniques to the fully coupled room/resonator model. We thus obtain truly representative results for the optimized complex acoustical problem, which highlight the potential of the proposed corrective methodology.