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Optimal control of the principal coefficient in a scalar wave equation

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We consider optimal control of the scalar wave equation where the control enters as a coefficient in the principal part. Adding a total variation penalty allows showing existence of optimal controls, which requires continuity results for the coefficient-to-solution mapping for discontinuous coefficients. We additionally consider a so-called multi-bang penalty that promotes controls taking on values pointwise almost everywhere from a specified discrete set. Under additional assumptions on the data, we derive an improved regularity result for the state, leading to optimality conditions that can be interpreted in an appropriate pointwise fashion. The numerical solution makes use of a stabilized finite element method and a nonlinear primal-dual proximal splitting algorithm.

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