Solvability and Controllability for a Coupled System of Wave Equations in Different Dimension

Matthias Eller

Georgetown University
Washington, DC, USA

mme4@georgetown.edu

Abstract: We consider two d-dimensional wave equations in two non-overlapping domains which are coupled with an $(d-1)$-dimensional wave equation along a common interface. A possible setup consists of an exterior region which surrounds an interior region and the two regions are separated by a thin membrane. The material properties in each of the media is characterized by the speed of the wave which may be a different one in all three media.
The unique solvability of various initial-boundary value problems will be established via semigroup theory and the theory of hyperbolic boundary value problems. The problem of approximate and exact controllability is posed as follows. Can one design a control acting only on the boundary or in the interior of the exterior n dimensional region which drives all three waves to a desired state? While approximate controllability can be inferred from the corresponding statement of unique continuation, the problem of exact controllability is certainly more challenging.
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