

Approximate control of parabolic equations with on-off shape controls by Fenchel duality

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We consider the internal control of linear parabolic equations through on-off shape controls, i.e., controls of the form $M(t)\chi_{\omega(t)}$ with $M(t) \geq 0$ and $\omega(t)$ with a prescribed maximal measure.

We establish small-time approximate controllability towards all possible final states allowed by the comparison principle with nonnegative controls. We manage to build controls with constant amplitude $M(t) \equiv M$. In contrast, if the moving control set $\omega(t)$ is confined to evolve in some region of the whole domain, we prove that approximate controllability fails to hold for small times.

The method of proof is constructive. Using Fenchel-Rockafellar duality and the bathtub principle, the on-off shape control is obtained as the bang-bang solution of an optimal control problem, which we design by relaxing the constraints.

Our optimal control approach is outlined in a rather general form for linear constrained control problems, paving the way for generalisations and applications to other PDEs and constraints.

This is a work with Camille Pouchol and Christophe Zhang.

Orateur: TRÉLAT, Emmanuel (Sorbonne Université)