Flatness approach for the control of PDEs

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Abstract

A control system is *differentially flat* if every trajectory can be expressed in terms of a function (called a *flat output*) and its derivatives. The flatness approach, introduced by Michel Fliess, Jean Lévine, Philippe Martin and Pierre Rouchon in 1995 for ODEs, was next applied to PDEs by Béatrice Laroche, Philippe Martin and Pierre Rouchon in 2000 to derive some approximate controllability results. In this lecture, we will show how the flatness approach can be used to derive the null controllability of the heat equation and the Schrödinger equation by providing explicitly both the control and the trajectory as series. We will also investigate the null controllability of the heat equation with variable (possibly discontinuous, singular or degenerate) coefficients, the issue of the determination of the space of reachable states, and the exact controllability of a semilinear heat equation in appropriate spaces of holomorphic functions.