A result on controllability with constrained controls

Jean-Baptiste Pomet

INRIA and Université Côte d'Azur,
Sophia Antipolis, France

ABSTRACT

This talk will be about local controllability of a system of the form

$$\dot{x} = f_0(x) + \sum_{k=1}^{m} u_k\, f_k(x)\,, \quad u = (u_1, \ldots, u_m) \in U$$

(with reasonable smoothness assumtions on the vector fields f_i in $\mathbb{R}^n$) along a solution $t \mapsto \overline{x}(t)$ corresponding to zero control, in the case where *the zero control is on the boundary of U*.

We present a sufficient condition for the reachable set in time T from $\overline{x}(t)$ (with U-valued controls) to be a neighborhood of $\overline{x}(T)$. If U was a neigborhood of the zero control, it would be nothing but the first order condition stating that $\overline{x}(.)$ is not a singular solution. When the zero control is on the boundary, it relies on convex inequalities rather than a mere Lie Brackets computation, but the proof is still first order in essence.

In the case where the drift vector field has only periodic solutions, this yields local controllability over one period, and global controlability in long time.

The motivation for this work was about control of solar sails. We will explain how this allows, for these devices, to prove controllability under some properties of the reflectivity/absobtion parameters of the sail and disprove controllability (at least local controllability over one period) for other values. Note that checking the condition has to be done numerically and involves a non trivial translation into convex optimization.

This is a joint work with *Alesia Herasimenka*, *Jean-Baptiste Caillau* and *Lamberto Dell'Elce*, also from *INRIA* and *Université Côte d'Azur*.