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Convex-analytic techniques for constrained reachability of linear control problems

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Even in a linear setting, determining whether a given target is reachable (from a fixed initial condition and at a given final time) can be difficult, especially in the presence of control constraints. I will first discuss the case of bounded convex constraints, introducing a method to establish that a target (or more generally, a set of undesirable states) cannot be reached. The approach relies on a dual functional, explicit fine estimates for time (and possible, space) discretisation errors, and interval arithmetic. I will then present a general recipe tailored to treating (unbounded) conic constraints. I show how it generalises the HUM method; as such, it is constructive and provides necessary and sufficient conditions for constrained conic convex reachability. Furthermore, it can be used to tackle nonconvex conic constraints as well, upon relaxation. Throughout the talk, I will highlight how these techniques heavily rely on convex analytic machinery. Examples of applications will be both finite and infinite-dimensional.

The presentation is based on collaborations with Ivan Hasenohr, Yannick Privat, Emmanuel Trélat and Christophe Zhang.

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