Seminário em Engenharia Matemática

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Optimization and Control of Sampled-data Dynamical Systems: when should we use Continuous-time Models?

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Abstract:

A sampled-data dynamical system is obtained whenever the variables of a system evolve in continuous-time and are controlled using a digital device.
This is the most frequent situation in applications of control of some physical continuous-time phenomenon requiring an advanced control, which is not easy or practical to implement with an analogue device.
Sampled-data systems are often addressed, in practice and in the literature, using a simplified discrete-time model. In the context of optimization and control of sampled-data dynamical systems, we discuss a few phenomena that are better understood when using continuous-time models (stability, discontinuous feedbacks, bang-bang control, path-following, impulsive systems), even when the actuation is done using a digital device.
We also discuss how nonlinear optimal control problems can be more efficiently solved when a continuous-time model is used until a later stage, by using adaptive grid refinement techniques.
Finally, we address the problem of guaranteeing that the constraints imposed along the trajectory are in fact satisfied for all times. We establish a condition that, when verified on a finite set of time instants (using limited computational power) can guarantee that the trajectory constraints are satisfied on an uncountable set of times.