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CENTRO DE I&D EM MATEMÁTICA E APLICAÇÕES
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WEBINAR

Grupo de Análise Funcional e Aplicações
Functional Analysis and Applications Group

On existence of solutions for optimal control problems with nonconvex lagrangian

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Abstract

Optimal control theory deals with the problem of how to control, in the best possible way, the state of a system that changes along time with the aim of reaching a given target state. In this talk we consider optimal control problems in which "best" means that one wishes to minimize an integral defined in a class of functions subject to given pointwise constraints in their states. More precisely, we are concerned with existence of solutions to the Lagrange optimal control $(\mathcal{OCP})$ which consists in minimizing the cost (or objective) functional

$$J(x,u) := \int_a^b f_0(t, x(t), u(t))\, dt\,,$$

over all pairs $(x(\cdot), u(\cdot))$ whose trajectories $x(\cdot) \in W^{1,1}([a,b], \mathbb{R}^n)$ satisfy the state constraint $x(t) \in \Omega \subset \mathbb{R}^n \ \ \forall t \in [a,b]$, reach the terminal state $x(b) = B$ and obey the dynamics given by the ordinary differential equation

$$\begin{aligned} x'(t) &= f(t, x(t), u(t)) \\ &:= A_0(t, x(t)) + B_0(t, x(t))\, u(t) \quad \text{for a.e. } \ t \in [a,b] \end{aligned}$$

with $x(a) = A$; the controls $u : [a,b] \to \mathbb{R}^m$ are measurable functions satisfying the constraint $u(t) \in U(t, x(t))$ a.e. on $[a,b]$. Here U is a multifunction defined in $[a,b] \times \Omega$ with values $U(t,s)$ in the class $2^{\mathbb{R}^m} \setminus \emptyset$ of all nonempty subsets of $\mathbb{R}^m$.

Our purpose is to present a result which guarantees existence of solution to the above problem without imposing any kind of convexity on the lagrangian, in which case, as is well known, an optimal pair $(x(\cdot), u(\cdot))$ may fail to exist.

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