Time delay impulsive systems in optimal control

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We introduce discontinuous solutions to nonlinear impulsive control systems with state time delays in the dynamics and derive necessary optimality conditions in the form of a Maximum Principle for associated optimal control problems. In the case without delays, if the measure control is scalar valued, the corresponding discontinuous state trajectory, understood as a limit of classical state trajectories for absolutely continuous controls approximating the measure, is unique. For vector valued measure controls however, the limiting trajectory is not unique and a full description of the control must include additional 'attached' controls affecting instantaneous state evolution at a discontinuity. For impulsive control systems with time delays we reveal a new phenomenon, namely that the limiting state trajectory resulting from different approximations of a given measure control needs not to be unique, even in the scalar case. Correspondingly, our framework allows for additional attached controls, even though the measure control is scalar valued.

This talk is based on a joint work with Giovanni Fusco and Richard Vinter and is part of an ongoing, wider investigation of time delay impulsive systems in optimal control.

[1] Fusco G., Motta M., Vinter R. B. *Optimal impulsive optimal control for time delay systems*, accepted for publication in SICON, `http://arxiv.org/abs/2402.11591`.

[2] Fusco G., Motta M., *Impulsive optimal control problems with time delays in the drift term*, to appear on Mathematical Control and Related Fields, `http://arxiv.org/abs/2307.12806`.

[3] Fusco G., Motta M., *No infimum gap and normality in optimal impulsive control under state constraints*, Set-Valued Var. Anal., vol. 29, no. 2, pp. 519–550, 2021.