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Impulsive control of systems with network structure describing spread of political influence.

Summary: We study a particular class of singular optimal control problems and corresponding impulsive control problems, which can be interpreted in terms of spread of a certain information impact (political influence) in a certain “social network” represented by a weighted directed graph. First, we give a statement of the “prototypic” extremal problem with unbounded input signals. Next, we discuss an impulsive trajectory extension of the prototypic model in an appropriate coarse topology of the space of right continuous functions with bounded variation. For an equivalent classical problem (obtained by a discontinuous time reparameterization of the extended system) we present a detalization of the Maximum Principle. As an illustration, we exhibit some results of numeric implementation of a toy model case and perform their practical interpretation. Finally, for the case of complete graph with equal weights we study the limit structure of the model as the power of the network tends to infinity: we show that the limit system is described by a nonlocal continuity equation with “unbounded” velocity field. This equation can be transformed by a discontinuous reparameterization to an equivalent equation with a regular vector field, which gives (as well as in the finite-dimensional case) a correct impulsive trajectory extension of the original continuity equation. The derived optimal control problem for the distributed system is thus, a relaxation of the original extremal problem for “large” networks.

MSC:
49N90 Applications of optimal control and differential games
91D99 Mathematical sociology (including anthropology)

Keywords:
trajectory relaxations of control systems; impulsive control; optimal control; control of multi-agent systems

Software:
GraphBase

Full Text: DOI Link

References:


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