ON THE GLOBAL CONVERGENCE OF NONLINEAR NONCONVEX ESTIMATORS

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Abstract
The main contribution in this paper is focused mainly in obtaining insight in the requirements of excitation from the geometric properties of a general nonalgebraic nonconvex cost functional for parameter identification when global and local structural identifiability are assumed previously. In this analysis we give a detailed account of the mathematical aspects without assuming a particular estimator or adaptive law. Furthermore the formulation is mainly devoted to continuous-time estimation but the extension to the discrete-time case is straightforward.

1. Introduction

Estimation problems arrive in many areas of control applications and signal processing. For a given model structure that resembles the physics of the system to be identified, it is of main importance to know in which measure the parameters can uniquely converge for a broad region of the initial conditions. Even when this property is *a-priori* determinable, *i.e.*, that the model structure be global identifiable with respect to this region, there is no guaranty of global or local parameter convergence for the applied excitation. Hence for global conditions for identifiability, other necessary conditions must additionally be observed. Such inputs requirements are typically called "persistence of excitation". Properties of the excitation were analyzed mainly as a tool for ensuring and improving parameter convergence for a given estimator or parameter adaptive law.

While for the first issue of structural identifiability there is a substantial literature (*Ljung and Glad*, 1994; *Walter and Pronsato*, 1990; *Godfrey et al.*, 1990; *Chen and Bastin*, 1996; *Campion et al.*, 1992; *Sun*, 1995), the second issue has attracted less attention in the community of system identification. Nevertheless, for a more general class of analytic model structures that are related with nonconvex objective functionals, the problem remains still open and is tackled on a case-by case basis.

Our main contribution in this paper is principally focused to obtain insight in the requirements of excitation from the geometric properties of a general nonalgebraic nonconvex cost functional for parameter identification when global and local structural identifiability are assumed previously. In this analysis we give a detailed account of the mathematical aspects without assuming a particular estimator or adaptive law. Furthermore, the formulation is mainly devoted to continuous-time estimation but the extension to the discrete-time case is straightforward. Estimation problems arrive in many areas of control applications and signal processing. For a given model structure that resembles the physics of the system to be identified, it is of main importance to know in which measure the parameters may be uniquely converge for a broad region of the initial conditions. Even when this property is *a-priori* determinable, *i.e.*, the model structure be global identifiable with respect to this region, there is no guaranty of global or local parameter convergence for the applied excitation. Other than only the global conditions for identifiability must additionally be observed. Such inputs requirements are typically called "persistence of excitation". Properties of the excitation were analyzed mainly as a tool for ensuring and improving parameter convergence for a given estimator or parameter adaptive law.

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