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# OFFLINE AND ONLINE USE OF INTERVAL AND SET-BASED APPROACHES FOR CONTROL AND STATE ESTIMATION: A REVIEW OF METHODOLOGICAL APPROACHES AND THEIR APPLICATION

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**ABSTRACT.** Control and state estimation procedures need to be robust against imprecisely known parameters, uncertainty in initial conditions, and external disturbances. Interval methods and other set-based techniques form the basis for the implementation of powerful approaches that can be used to identify parameters of dynamic system models in the presence of the aforementioned types of uncertainty. Moreover, they are applicable to a verified feasibility and stability analysis of controllers and state estimators. In addition to these offline approaches for analysis, interval and set-based methods have also been developed in recent years, which allow to solve the associated design tasks and to implement reliable techniques that are applicable online. The latter approaches include set-based model-predictive control, online parameter adaptation techniques for nonlinear variable-structure and backstepping controllers, interval observers, and fault diagnosis techniques. This paper provides an overview of the methodological background and reviews numerous practical applications for which interval and other set-valued approaches have been employed successfully.

## 1. INTRODUCTION

Interval analysis has become an active field of research over the past decades. Its fundamentals can especially be traced back to the works of R.E. Moore and his famous book published in 1966 [57].

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