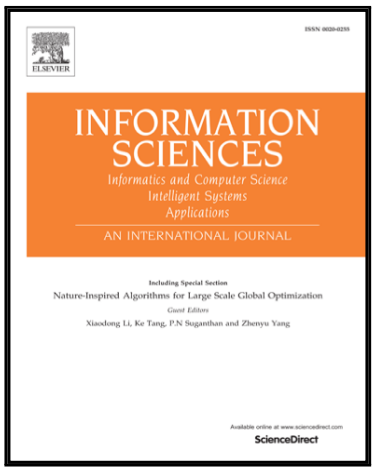

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Group Sparse Optimization for Learning Predictive State Representations

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Abstract

Predictive state representations (PSRs) are a commonly used approach for agents to summarize the information from history generated during their interaction with a dynamical environment and the agents may use PSRs to predict the future observation. Existing works have shown the benefits of PSRs for modelling partially observable dynamical systems. One of the key issues in PSRs is to discover a set of tests for representing states, which is called core tests. However, there is no very efficient technique to find the core tests for a large and complex problem in practice. In this paper, we formulate the discovering of the set of core tests as an optimization problem and exploit a group sparsity of the decision-making matrix to solve the problem. Then the PSR parameters can be obtained simultaneously. Hence, the model of the underlying system can be built immediately. The new learning approach doesn't require the specification of the number of core tests. Furthermore, the embedded optimization method for solving the considered group Lasso problem, called alternating direction method of multipliers (ADMM), can achieve a global convergence. We conduct experiments on three problem domains including one extremely large problem domain and show promising performances of the new approach.

Keywords:
Predictive state representations, group sparse, alternating direction method of multipliers

1. Introduction

In the past decades, a number of representations for modeling dynamical systems under uncertainty have been proposed for designing a rational, autonomous agent. However, challenge still exists for learning dynamical systems particularly for a partially observable domain with a large observation space. Currently, one of the most popular modeling frameworks, namely predictive state representations (PSRs), has been investigated as a general framework for offering an effective approach to model partially observable systems [11]. Unlike the latent state approach of partially observable Markov decision processes (POMDPs) [15],

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