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InfoMax Bayesian Learning of the Furuta Pendulum

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Abstract

We have studied the InfoMax (D-optimality) learning for the two-link Furuta pendulum. We compared InfoMax and random learning methods. The InfoMax learning method won by a large margin, it visited a larger domain and provided better approximation during the same time interval. The advantages and the limitations of the InfoMax solution are treated.

Keywords: Online Bayesian learning, D-optimality, infomax control, Furuta pendulum

1 Introduction

In recent years, machine learning methods became more and more accurate and popular, so that the task of learning the dynamics of plants and the learning of reactive behaviours to environmental changes seem to be within reach. Such tasks call for online (i.e., real time) learning methods. For fast learning, one would like to provide stimuli that facilitate the fastest information gain about the changes of the plant and its environment [3, 2].

As an example, consider an industrial robot. Programming of industrial robots is traditionally an off-line task. In typical situations, the trajectory of the robot is generated from a CAD model of the environment and the robot [12]. However, this model holds no information about the unavoidable modelling errors especially if the environment changes. We assume that the environment and the robot have a parametrised representation and that the goal is to estimate these parameters as quickly as possible and possibly on-the-flight.

An attractive route replaces trajectory planning and trajectory tracking with speed-field planning and speed-field tracking. This latter is less strict about the actual path. The difference between the two methods can be described by the example when one is walking on a crowded street. Here, the trajectory should be

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