

Control System with Evolving Gaussian Process Models

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Abstract

Control system based on evolving Gaussian process models is an example of self-learning closed-loop control system. It is meant for closed-loop control of dynamic systems where not much prior knowledge exists or where systems dynamics varies with time or operating region. Gaussian process models are non-parametric black-box models which represent a new method for system identification. GP models differ from most other frequently used black-box identification approaches as they do not try to approximate the modeled system by fitting the parameters of the selected basis functions, but rather search for the relationships among measured data. While GP models are Bayesian models, their output is normal distribution, expressed in terms of mean and variance. Latter can be interpreted as a confidence in prediction and used in many fields, especially in control system. Successful control system needs as much as possible data about process to be controlled. If the prior knowledge about the system to be controlled is scarce or the system varies with time or operating region, this control problem can be solved with an iterative method which adapts model with information obtained with streaming data and concurrently optimizes hyperparameter values. While that kind of method for GP models does not yet exist, concepts for *evolving* GP models and control system based on evolving GP models are proposed in the paper. It is flexible approach within which various ways of model adaptations can be used. One of those possibilities is illustrated with a control of a benchmark problem.