Workshop on RACT beta 0.6

Randomized Algorithms Control Toolbox: A Tutorial Introduction

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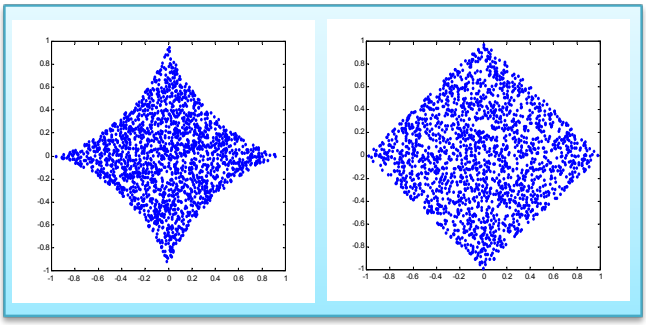

Scope: Probabilistic and randomized techniques for analysis of uncertain systems and design for robustly performing control systems have attracted considerable interest in recent years, and a significant amount of theoretical and algorithmic results have appeared in the literature. The starting idea in the probabilistic approach to the analysis of uncertain systems is to characterize the uncertain parameters as random variables, and then to evaluate the system performance in terms of probabilities. In an analogous sense, probabilistic synthesis is aimed at determining the design parameters so that certain desired levels of performance are attained with high probability. This probabilistic approach is complementary to the mainstream methods in robust control, which seek worst-case performance guarantees and consider the uncertainties as deterministic unknown-but-bounded quantities. Specific randomized algorithms (RA) have been developed for solving a large class of probabilistic analysis and synthesis problems arising in control. These algorithms may help in overcoming the conservatism and computational complexity limitations of worst-case methods, due to conservatism and computational complexity, especially in real-world situations where a large number of uncertain parameters enter the system description in a possibly nonlinear way. The goal of this workshop is to introduce the recently released MATLAB Randomized Algorithms Control Toolbox (RACT).

Workshop schedule

MORNING: A Tutorial Introduction to RA for Control

- ✓ Setup and philosophy of probabilistic versus deterministic (worst-case) approach to design and performance verification
- ✓ Estimation of performance violation probabilities: Monte Carlo methods and tail probability inequalities
- ✓ Random sample generation techniques
- ✓ Randomized algorithms for probabilistic robust control synthesis
  - The method of random gradients
  - Probabilistic localization methods, randomized ellipsoid and cutting plane algorithms
  - The scenario approach to robust convex optimization

AFTERNOON: The RACT Toolbox

- ✓ The RACT toolbox: description of features, main philosophy and principal commands
- ✓ *Let's play with RACT*: the toolbox will be demonstrated on specific case studies and numerical examples
- ✓ *An outside view of RACT*: the application of RACT to specific design problems will be discussed from an end-user point of view
- ✓ Concluding remarks and future extensions (Hit and Run Methods, distributed RAs, fixed-order probabilistic design)
- ✓ Open discussion: *What would you like to see in RACT?*

RACT features include:

- ✓ Definition of a variety of uncertain objects: scalar, vector and matrix uncertainties, with different density functions
- ✓ Easy and fast sampling of uncertain objects of almost any type
- ✓ Randomized algorithms for probabilistic performance verification and probabilistic worst-case performance
- ✓ Randomized algorithms for feasibility of uncertain LMIs using stochastic gradient, ellipsoid or cutting plane methods
- ✓ Optimal design methods using scenario approach

RACT has been developed at IEIIT-CNR and at RAS Institute for Control Science, by A. Tremba, G. Calafiore, F. Dabbene, E. Gryazina, B. Polyak, P. Shcherbakov, R. Tempo. RACT can be freely downloaded at http://ract.sourceforge.net

http://conferenze.dei.polimi.it/msc08/msc_workshop.htm