Applications of the Scenario Approach

Proseminar

In control theory a designed controller should retain properties like stability and constraint satisfaction despite the presence of uncertainty. Proving that these properties are maintained for all possible, typically infinite, realizations of the uncertainty is in general challenging. The scenario approach is an approach that allows to reduce the problem by only considering several possible realizations of the uncertainty. If the desired properties hold for all of the observed scenarios, probabilistic guarantees can be provided. The goal of this work is to illustrate the idea of the scenario approach, present an overview of its applications (beyond control) and show limitations of the approach.

The report must be written in English. Meetings during the project can be in English or German.

Requirements:

- Must: strong mathematical understanding
  Beneficial: optimization, control theory

Your tasks will be:

- Present the idea of the scenario approach

- Illustrate applications of the approach with examples

- Evaluate, compare and present the results

$$\min_{\gamma \in \mathbb{R}^d} c^T \gamma$$
$$\text{s.t.} \quad f_{\delta(i)}(\gamma) \leq 0, \; i = 1, \ldots, N.$$

References:
[1] Marco C. Campi, Simone Garatti. Introduction to the Scenario Approach.
https://doi.org/10.1137/1.9781611975444

[2] Marco C. Campi, Simone Garatti, Maria Prandini. The scenario approach for systems and control design. Annual Reviews in Control.
https://doi.org/10.1016/j.arcontrol.2009.07.001

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