HYCON 2 TOOLBOX

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OUTLINE

• Motivations for the H2T

• Development of the H2T

• Future work and live demo
NEED FOR AN UNIFIED FRAMEWORK

• Variety of tools for large-scale networked systems

• Models can be extremely different
  • Dynamics: linear/nonlinear/hybrid
  • Coupling variables: local inputs/outputs/states
  • Features of communication channels: delays/packet drops
NEED FOR AN UNIFIED FRAMEWORK

• Controllers structure variety
  • Centralised
  • Decentralised
  • Distributed
  • Hierarchical
NEED FOR AN UNIFIED FRAMEWORK

- Largely complementary Matlab toolboxes
- H2T: upper layer to provide interoperability
  - Simple access to low level function
  - Limited learning curve
SUPPORTED TOOLBOXES

- WIDE (Decentralised and Wireless Control of Large Scale system) - IMTL
- MPT (Multi Parametric Toolbox) - ETHZ
- PnPMPC (Plug-and-Play MPC) - UNIPV
SUPPORTED TOOLBOXES

• WIDE (Decentralised and Wireless Control of Large Scale system) - IMTL
  • Centralised, decentralised/distributed control schemes
  • Explicitly accounting for networking effects
  • LMIs based MPC implementation
SUPPORTED TOOLBOXES

- MPT (Multi Parametric Toolbox) - ETHZ
  - High speed centralised explicit MPC
  - Real-time implementation
  - Polyhedral computation tools
  - HYSDEL to MPC
SUPPORTED TOOLBOXES

- PnPMPC (Plug-and-Play MPC) - UNIPV
  - Decentralised MPC for large-scale systems
  - Easily add or remove subsystems
  - Zonotopes handling and invariant sets computation
CANDIDATE TOOLBOXES

• RACT (Randomised Algorithms Control Toolbox) - CNR
  • Robust control for uncertain systems

• MCN (Multi-Hop Control Network Toolbox) - UNIVAQ
  • Wireless multi-hop networks
H2T STRUCTURE

- Unique modelling framework: `lsmodel` WIDE
  - Compositional features
  - Flexibility
  - Compatibility with the Control System Toolbox
H2T STRUCTURE

• Control design common interface
  • Wrappers from *lsmode1* to low-level toolboxes
  • *h2t* class: middleware between the user and the supported toolboxes
H2T WORKFLOW

- Model definition
- Control parameters specification
- Build a controller for the desired low-level toolbox
TOOLBOX INTEGRATION

SYSTEM MODEL
(ls_model)

CONTROL

<table>
<thead>
<tr>
<th>WIDE</th>
<th>MPT3</th>
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<tbody>
<tr>
<td>PnPMPC</td>
<td>MCN</td>
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- Toolbox related fields

Wrappers

h2t class

dclmi()

PnPMPc

pnpmpc()

MPT3

MPCcontroller()

MCN

mcncontroller()
H2T METHODS

• checkParameters(low_level_toolbox)
  • required and optional parameters
  • help page hints

• setParameters(param_label, value)
  • consistency check

• buildController(low_level_toolbox)
  • wrapper function call
FUTURE WORK

• Modular structure to easily support new toolboxes (MCN will be the next)

• Upgrade to define subsystem using the \texttt{ss} function

• Definition of a unified simulation framework (simulation wrapper)