AUTOMATION & CONTROL INSTITUTE
INSTITUT FÜR AUTOMATISIERUNGS-
& REGELUNGSTECHNIK

4DIAC Framework for Distributed Industrial Automation and Control

TU WIEN

4DIAC Workshop:
Embedded Energy Efficiency Industrial Controller Platform (E3ICP)

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VOIGT+WIPP

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klima+ energie fonds

Agenda

- Motivation
- Project Idea
- Approach
- Infrastructure for Control Applications
- Summary and Conclusion
- Project Consortium

Motivation

- More than 1.000 Biomass Power Plants in Austria
- Save produced energy by controlling the plant with Model Predictive Controllers (MPCs)
- Lacks of Commercial MPC Tools:
  - Matricon, INCA-IPCOS, ...
  - Ongoing costs: Licence costs, maintenance effort
- Searching for industrial solution:
  - MPC on PLCs (FORTE)

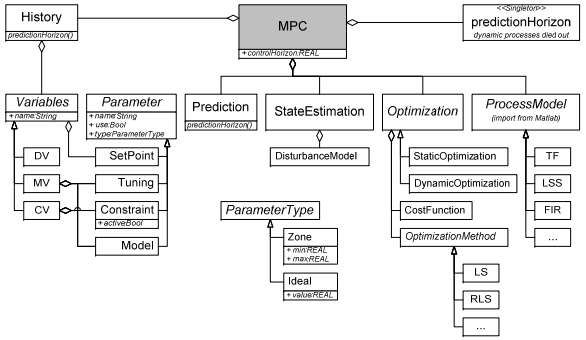
➔ Use of MPC also for smaller Power Plants (<3MW) efficient

Project Idea

- Implementation of a MPC in FORTE
  - IEC 61499 allows platform independent modeling
  - Reduction of involved systems and interfaces
  - Easier engineering and maintenance
  - Improved control performance
- 4DIAC Implementation
  - MPC applied on a “Biomass Power Plant“

Approach

Model Predictive Controller Model



Controller Library

- IEC 61499 Library
- OSCAT Library
- Customer Library

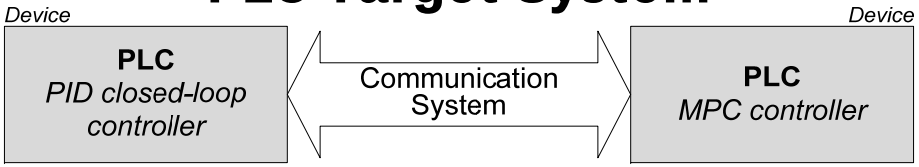
OSCAT
Open Source Community for Automation Technology

DIAC
Framework for Distributed Industrial Automation and Control

Mathematical Library

- Matrix Manipulation
- Problem Solver
- Open Source Library

PLC Target System



Basis Infrastructure for Control Applications

- Requirements for FORTE Adaption
  - Porting FORTE to Bachmann M1 - included in FORTE 1.2 (open source)
  - I/O Access in FORTE for Bachmann hardware (M1)
  - Visualization of the Process in Bachmann Solution Center using SVI Variables
- Developed Control Function Block Library
  - OSCAT Library (open source in 4DIAC – continuously extended)
  - Custom Library for E3ICP (e.g., PIDT1, PT1, Delay, Limit) (not open Source)

MPC Infrastructure for Control Applications

- Mathematical Library:
  - Matrix Manipulation:
    → Armadillo (open Source Library)
  - Problem Solver:
    → qpOASIS (open Source Library)
  - Mathematical Library for Control Applications:
    → ACADO (open Source Library)

➔ Port of the mathematical library (including the integration into FORTE) is NOT open source

Summary and Conclusion

- Contributions to 4DIAC
  - IEC 61499 version of OSCAT library (e.g., FBs for control applications, Math)
  - FORTE Port for Bachmann M1 Hardware
- MPC for FORTE
  - Integration of open source libraries (Win32 + Bachmann M1):

    Armadillo (matrix manipulation)

    ACADO (supporting control solutions)

    qpOASIS (problem solver)
- Implementation
  - Control of a Biomass Power Plant (energy efficiency)

Project Consortium of E3ICP

- Automation and Control Institute
  - Project Leader: Reinhard Hametner
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  - Monika Wenger
- VOIGT+WIPP Engineers GmbH
  - Andreas Voigt
  - Richard Wipp
  - Matthias Stickel
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