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Digital Twins for Battery Cell Production and Their Possible Interfaces with Battery Management Strategies

3rd Expert Workshop on Design and Operation of Digitalized Sector-Coupled Energy Systems

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Distributed Control in Interconnected Systems

Stockholm, Sweden

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Digital Twins for Battery Cell Production

– **Flexible and scalable digital-twin platform for enhanced production efficiency and yield in battery cell production lines**

BATTwin

– 42-month project receiving funding from the European Climate, Infrastructure and Environment Executive Agency under grant agreement No. 101137954

– Start: 12/2023

Funded by the European Union

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Digital Twins for Battery Cell Production

Objective: Support the high demand for battery manufacturing equipment in Europe, by developing a novel **Multi-level Digital Twin platform** towards **Zero-Defect Manufacturing** in battery production, that will reduce defect rates in battery production lines.

4 Main pilars:

- a **multi-sensor data acquisition and management layer**, supported by data semantics through a **Digital Battery Passport** data model,
- **process-level digital twins**, modelling critical stages of electrode manufacturing, cell assembly and conditioning through multi-physics, data-driven and hybrid approaches,
- **system-level digital twins**, based on simulation and analytical modelling,
- user-centric, **goal-driven digital twin workflows**, increasing the explainability of digital twins and driving the user in system design and control.

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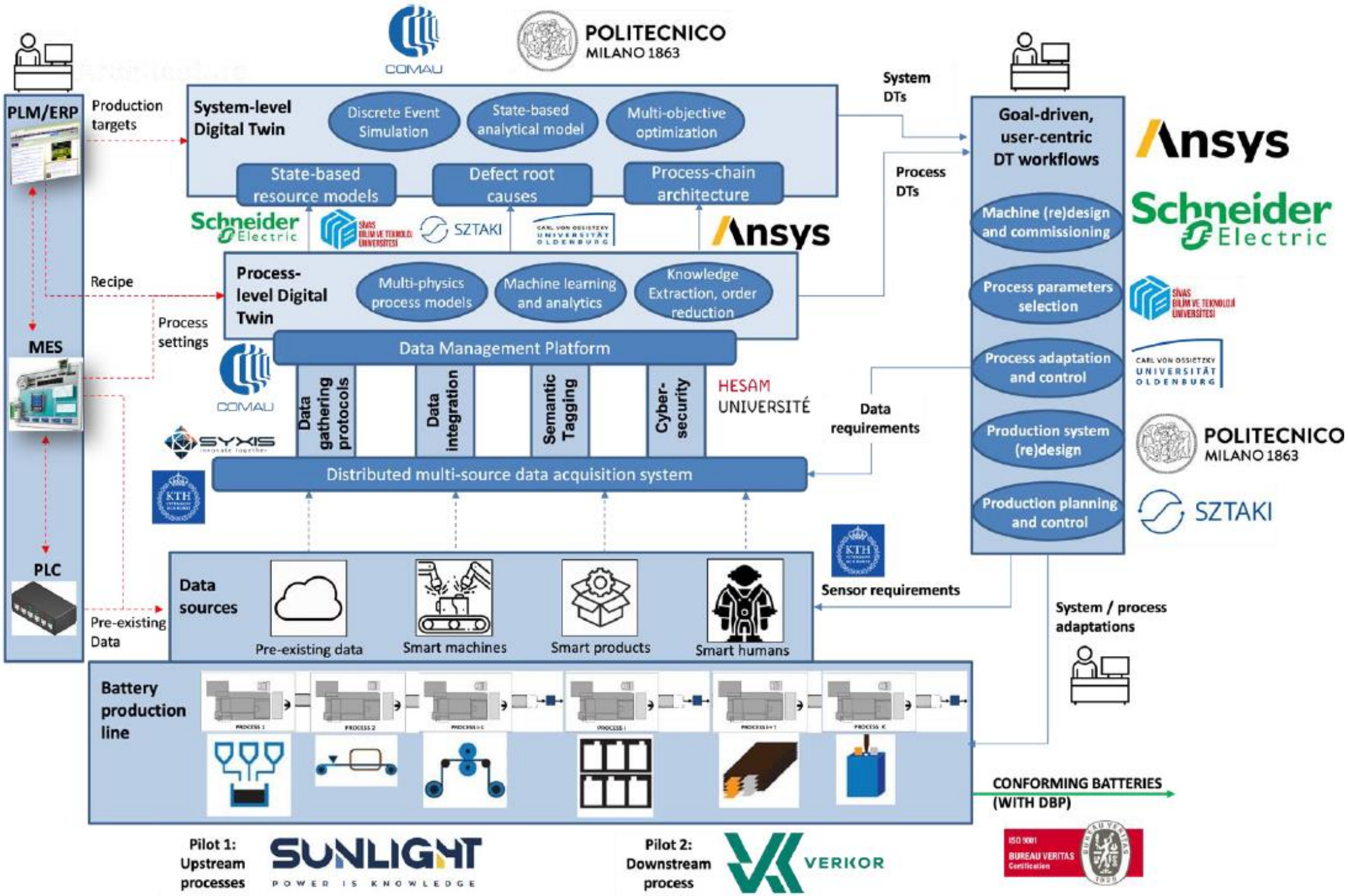

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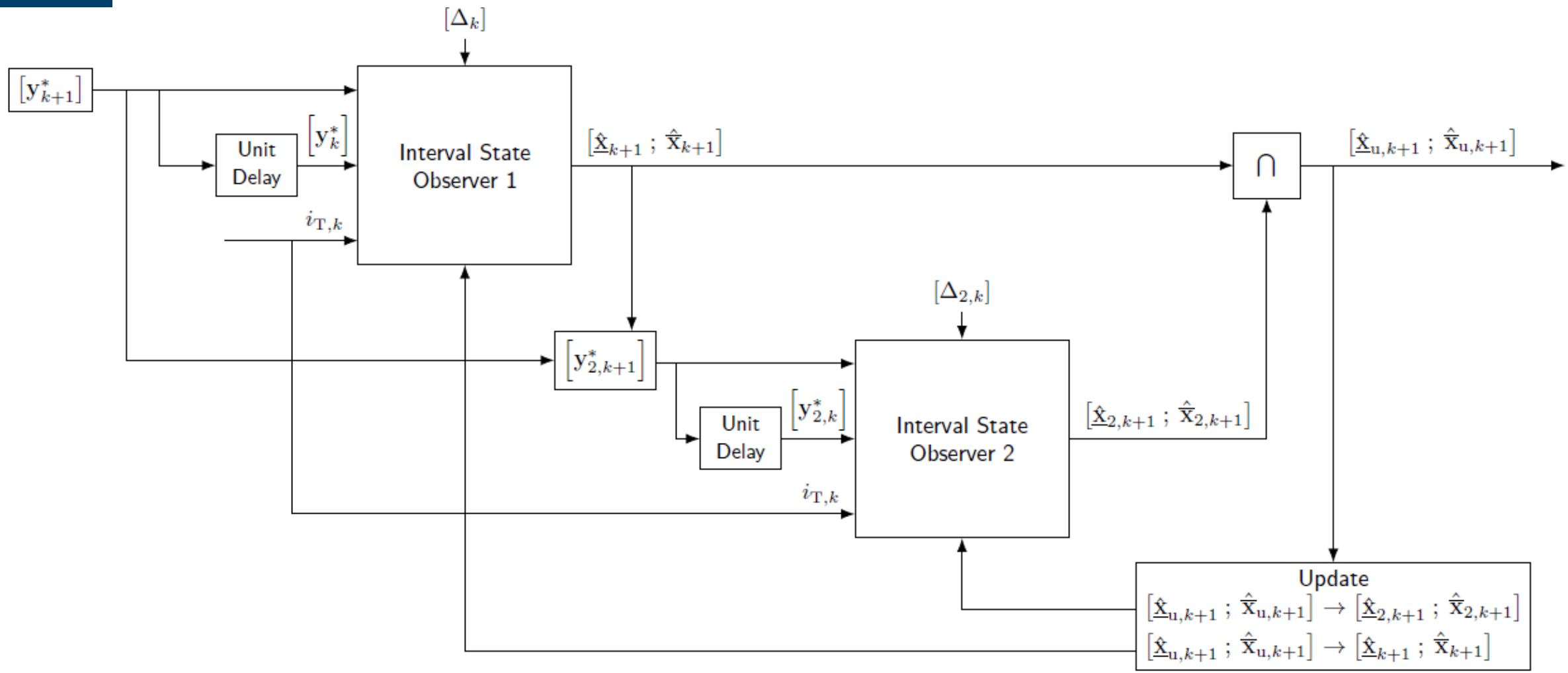
Uncertainty-Aware State Estimation for Battery Systems



M. Lahme, A. Rauh, G. Defresne: Interval Observer Design for an Uncertain Time-Varying Quasi-Linear System Model of Lithium-Ion Batteries, ECC 2024, Stockholm

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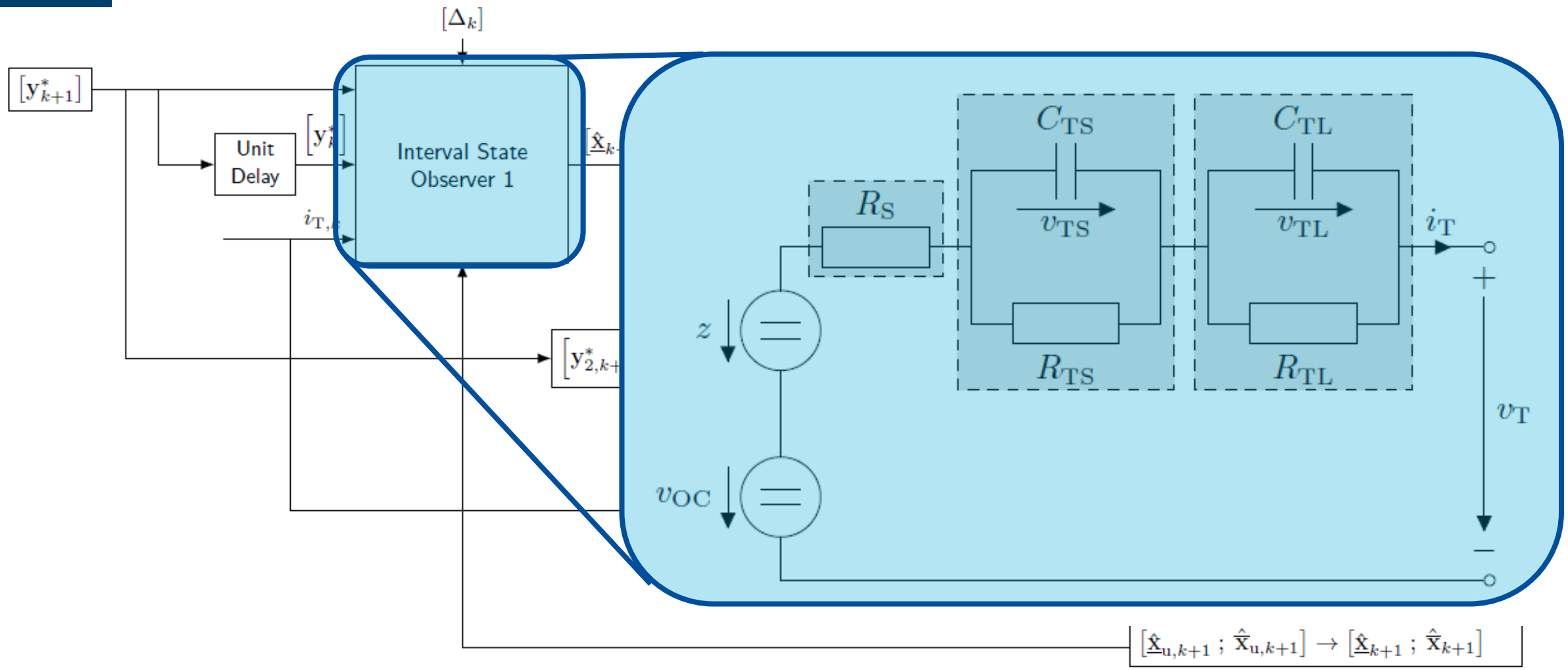
Uncertainty-Aware State Estimation for Battery Systems



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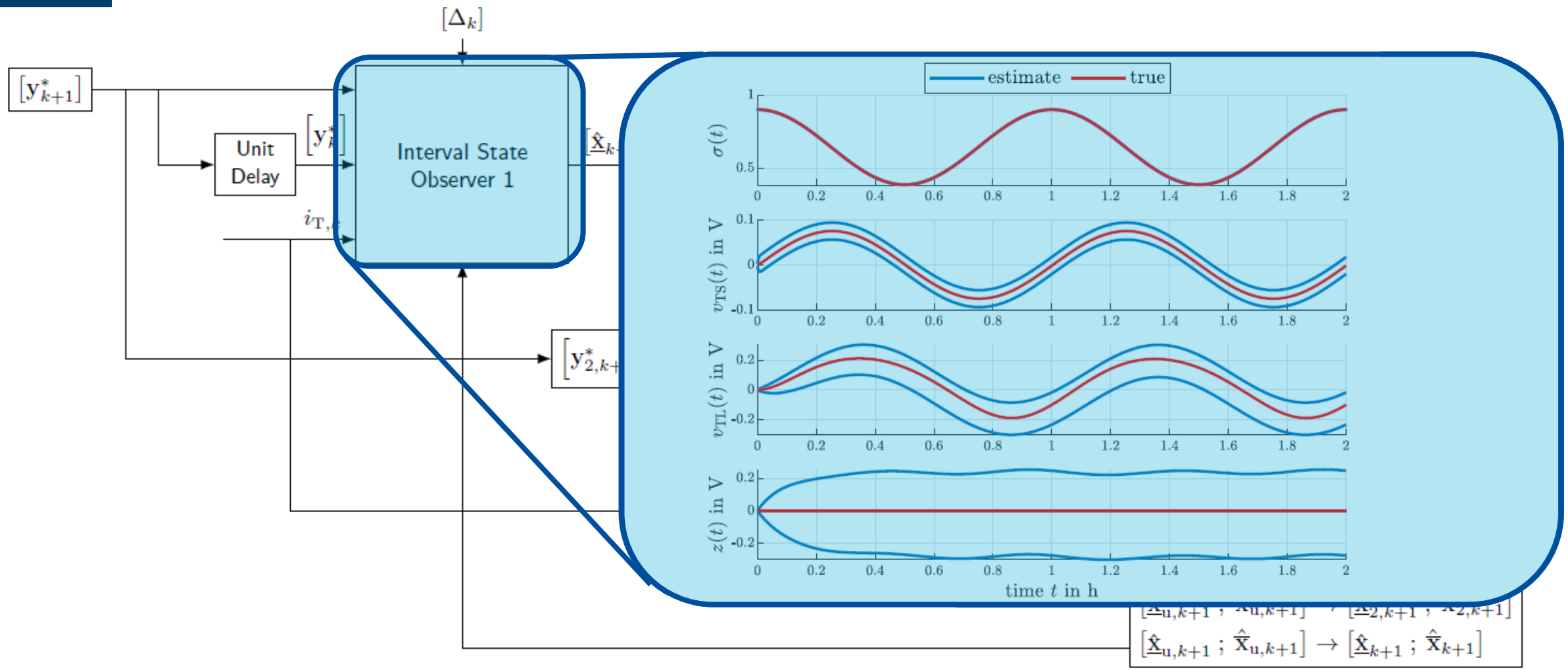

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Related Work

– Lahme, Marit; Rauh, Andreas: Combination of Stochastic State Estimation with Online Identification of the Open-Circuit Voltage of Lithium-Ion Batteries. IFAC-PapersOnLine. 55. pp. 97-102. 2022. DOI:10.1016/j.ifacol.2023.01.055.

– Lahme, Marit; Rauh, Andreas: Online Identification of the Open-Circuit Voltage Characteristic of Lithium- Ion Batteries with a Contractor-Based Procedure. In Proc. of 27th IEEE Intl. Conference on Methods and Models in Automation and Robotics MMAR 2023, Miedzyzdroje, Poland. DOI:10.1109/MMAR58394.2023.10242524

– Lahme, Marit; Rauh, Andreas: Set-Valued Approach for the Online Identification of the Open-Circuit Voltage of Lithium-Ion Batteries. Acta Cybernetica, 2024. DOI:10.14232/actacyb.301185

– Lahme, Marit; Rauh, Andreas; Defresne, Guillaume: Interval Observer Design for an Uncertain Time-Varying Quasi-Linear System Model of Lithium-Ion Batteries. In Proceedings of the European Control Conference ECC 2024, Stockholm, Sweden.

– Rauh, Andreas; Lahme, Marit: Analysis of a Sensor Switching Approach for State Estimation with Applications to Electrochemical Power Converters and Energy Storage Systems. In Proceedings of the 11th International Conference on Systems and Control (ICSC), Sousse, Tunisia, 2023. DOI:10.1109/ICSC58660.2023.10449809. (https://youtu.be/fjUUEARM-t4)

– Rauh, Andreas; Lahme, Marit: A Finite Memory Approach Applied to Verified Pseudo State Estimation of Fractional Models of Lithium-Ion Batteries. In Proceedings of the 12th IFAC Conference on Fractional Differentiation and its Applications, Bordeaux, France. (https://youtu.be/ADfphkQsPkY)

– Rauh, Andreas; Malti, Rachid: Quantification of Time- Domain Truncation Errors for the Reinitialization of Fractional Integrators. Acta Cybernetica, vol. 26, no. 1, pp. 105–128, 2022. DOI: 10.14232/actacyb.296010

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Alliance

A non-profit organisation of strong European actors of the electric battery manufacturing industry, contributing to European industrial autonomy

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Core missions

- Create a strong European network to encourage local economy
- Stimulate innovation to face the environmental challenges
- Promote skills and solutions made-in-Europe, local for local

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