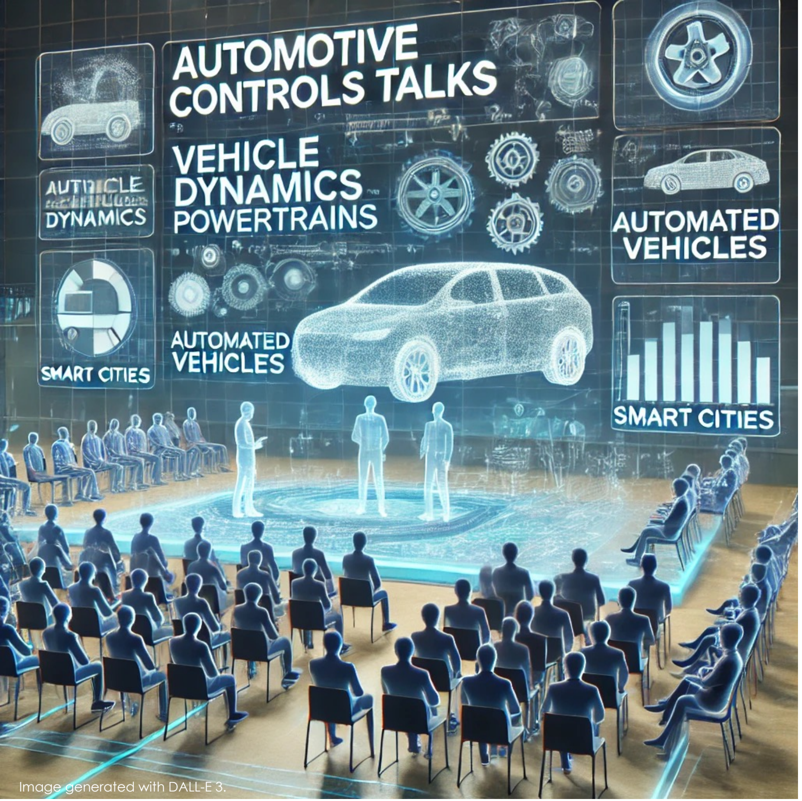

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Automotive Controls Talks

IEEE Control Systems Society

When: 21 Jan. 2026, 16:00 – 17:00 CET (Berlin, Brussels)
10:00 – 11:00 EST (US East Coast)

Where: Click to join Teams meeting

Scope: "Automotive Controls Talks" is a **new lecture series**, organized by the **IEEE TC on Automotive Controls**. The talks shall bring together academia and industry to discuss challenges, recent advances and collaboration opportunities related to automotive controls topics.

This session focuses on **battery systems** (40min talk given by 2 speakers + 20min joint discussion):

Data-driven Modeling and Control of Battery Energy Storage Systems

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Data-driven Modeling and Control of Battery Energy Storage Systems

Abstract: With increased electrification, the efficient utilization of energy storage systems is becoming critical. A key parameter in battery management is the state of charge (SOC), which indicates the remaining energy but unfortunately not measured directly. This work presents two approaches for controlling SOC: 1) indirect data-driven control, focused on creating a high-fidelity data-driven model, and 2) direct data-driven control for fast charging of Battery Energy Storage Systems (BESS).

1) Indirect data-driven control: We present a data-driven modeling technique and co-estimation framework that models and estimates SOC, eliminating the need for a pre-trained SOC-voltage map or initial SOC measurements. The methodology employs a physics-inspired sparse identification to discover the battery's governing equations. We show several methods to improve the accuracy and performance of data-driven modeling for complex systems such as BESS. These include: i) utilizing a physics-informed library instead of generic library terms, ii) formulating the sparsification to include tunable hyperparameters for improved performance in unseen scenarios, and iii) using a Monte-Carlo Library Search method for efficient pruning of numerous candidate terms. We demonstrate the effectiveness of this approach for modeling both SOC and voltage dynamics. Such models are then used simultaneously within a Joint Unscented Kalman Filter (JUKF) for closed-loop SOC co-estimation.

2) Direct Data-Driven Control: We present an aggressive yet efficient charging strategy using an adaptive controller that learns the closed-loop system's Jacobian from input/output data and optimizes the response based on the learned dynamics. To avoid accelerated cell aging, we optimize the electrical current for minimum battery charge time while respecting constraints such as maximum cell temperature and voltage.