

Vehicle Models for EV Charging: Towards an Energy-Aware Mobility and Innovative Charging Systems

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The Special Session focuses on vehicle-oriented virtual and physical models able to improve the design and operation of next-generation EV charging systems in renewable-integrated mobility. Contributions referred to modeling the EV as a virtual and physical system, including battery, powertrain, battery thermal dynamics or degradation and user/route behavior, and connect these models to charging infrastructure (plug-in fast charging and wireless power transfer, including static and dynamic WPT) are suitable for this session. Great emphasis is set on modeling and validation, real-time state estimation, applications for simulation and decision-making for efficient, reliable and sustainable charging under practical constraints such as renewable variability, station capacity, mobility schedules. Also grid interaction topics are welcome when they are charging-driven (load management, flexibility services), with V2G/V2X considered as an optional advanced capability, not the main focus. The session aims to bridge high-fidelity vehicle twins with scalable deployment in smart mobility hubs and fleets.

Suggested topics for the Special Session are:

- **Digital twin of vehicle subsystems: multi-physics battery, powertrain, thermal, degradation models;**
- **Data-driven AI calibration and hybrid modeling for EVs;**
- **Real-time state estimation: SoC and SoH, internal resistance, thermal and aging indicators;**
- **EV charging behavior modeling: user patterns, routes, fleet dynamics;**
- **WPT applications: Dynamic, in-motion and static WPT; safety, control, interoperability, efficiency under motion; alignment/gap estimation, coupling variability, power transfer control;**
- **Uncertainty-aware operation: stochastic scenarios, Monte Carlo, robust optimization;**
- **Mobility & fleet charging hubs using vehicle twins.**

