IEEE PEMC 2026

22nd International Power Electronics and Motion Control Conference

Sept. 23–25, 2026 — Tallinn, Estonia

Power Electronics and Motion Control Conference

PEMC

Tutorial

Solid-State Transformer Technology - Challenges and Opportunities

Duration: 120 minutes

Abstract. Solid-State Transformers (SSTs) technology continues to excite researchers in academia and industry. Despite many promises of power-dense high-performance conversion, there are significant challenges encountered in the practical design of these highly modular, galvanically isolated power electronics converters. These stem from high power and high voltage aspects of design, insulation coordination, high-voltage magnetic components, thermal aspects, and the complexity of controller hardware and control algorithms. High modularity strongly impacts the reliability and availability of the SST as a whole and has a strong impact on the scalability in terms of voltage, current, and power ratings. Redundancy is often adopted in design, further complicating the realizations of power stages. The tutorial will systematically address numerous technological aspects inside the megawatt-level SST design, present commonly used technologies, as well as some first-hand experiences and solutions used or developed at the Power Electronics Laboratory at EPFL, by the instructors. When appropriate, PLECS models and simulations will be used to support the introduced concepts and methods to the audience.

Content Outline

Duration	Topics covered
55 min	***Introduction*** to the Solid-State Transformer technology and associated practical design challenges. This will cover the problems of modularity and scalability of topology, reliability, availability and redundancy considerations. Problems of need for high-voltage isolation and its implication will be discussed from the aspects of medium-frequency transformer designs. Control hardware and software complexities and need to distribute it over many computational units will be addressed as well. Finaly, an overview of applications currently driving this technology development will be covered.
30 min	***Modular SST:*** The majority of the SSTs are considered to be highly modular. This section will address, by means of many examples, how various technical challenges are addressed in the real industrial designs.
30 min	***Non-Modular (Monolithic) SST:*** An alternative to the modular is SST are monolithic realizations, aiming to address various shortcomings, mainly through a reduction of number of involved elements. This approach has its own pros and cons and will be presented in details.
5 min	Q&A Session with all instructors

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Zhenchao Li and **Amin Darvishzadeh** are currently Ph.D. students at the Power Electronics Laboratory of the Swiss Federal Institute of Technology (EPFL) in Lausanne, Switzerland. Their PhD research projects are directly related to the Solid State Transformer technologies. Emails: zhenchao.li@epfl.ch , amin.darvishzadeh@epfl.ch