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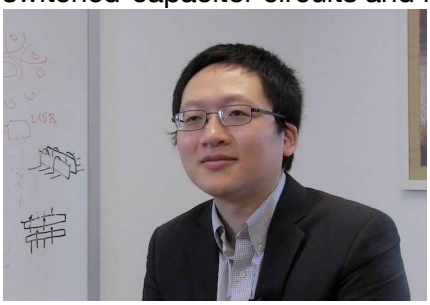
# Hybrid Switched-Capacitor Circuits and Magnetics for High-Performance Power Conversion

**Speaker:** Prof. Minjie Chen, Princeton University

**Abstract:** Power electronics is a core technology for future energy systems including data centers, telecommunication, and distributed energy resources. These are important and high-impact applications demanding high performance and advanced functions. To leverage the advances in semiconductor devices and the scaling laws of passive components, a promising trend is to minimize the power conversion stress and maximize the passive component utilization through hybrid switched-capacitor power conversion and magnetics integration. In pursuit of this vision, this talk first presents the recent developments in hybrid switched-capacitor power architectures for high current CPU voltage regulators. Various design considerations for the hybrid converter will be discussed, including the architecture benefits, magnetics coupling, control techniques, 3D packaging, and the dynamics of the switching cells. A few recent 48V-1V CPU voltage regulator examples will be compared to showcase the benefits. We will then introduce a large-scale open-source power magnetics research platform – MagNet (mag-net.princeton.edu) – to transform the modeling and design of power magnetics with data-driven methods, such as machine learning. MagNet enables the development of a unified modeling framework for modeling power magnetics with arbitrary excitation waveforms, temperature variation, and dc-bias and provides a transparent platform for academia and industry to share research data and compare results. Finally, we will discuss the synergy between flying capacitor multilevel converter (FCML) and coupled magnetics to unlock the potential of hybrid switched-capacitor circuits and magnetics co-design.



**Biography:** Minjie Chen received his Ph.D. degree in Electrical Engineering and Computer Science from MIT in 2015, and his B.S. degree in Electrical Engineering from Tsinghua University in 2009. Since 2017, he has been an Assistant Professor of Electrical and Computer Engineering and the Andlinger Center for Energy and the Environment at Princeton University. His research interests include high-frequency power electronics, power architecture, power magnetics, and the design of high-performance power electronics for important applications.

He is a recipient of the Princeton SEAS E. Lawrence Keyes, Jr./Emerson Electric Co. Junior Faculty Award (2022), three IEEE Transactions Prize Paper Awards (2016, 2017, 2020), a COMPEL Best Paper Award (2020), an OCP Best Paper Award (2021), the NSF CAREER Award (2019), a Siebel research award (2018), a C3.ai research award (2021), the D. N. Chorafas Ph.D. Thesis Award (2015), and many other awards from the IEEE Power Electronics Society. He was listed on the Princeton Engineering Commendation List for Outstanding Teaching for multiple times. He has published over 70 papers in IEEE journals and conferences and holds 7 issued patents.

The lecture is open to the public. The event takes place within the scope of the Swiss Chapter of IEEE Power Electronics Society, https://pels.ieee.ch