USC Viterbi
School of Engineering
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Seminar

Power Electronics for a Net-Zero Energy Future

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Date: Thursday, April 4, 2024
Time: 3:00pm – 4:30pm PST
Location: EEB 248

Abstract: One of the most significant challenges that human society faces is producing and distributing clean and affordable energy. Electricity and transportation sectors are dominant sectors for US greenhouse gas emissions and account for 25% and 28% of total emissions in 2021, respectively. To enable a net-zero energy future, renewable energy and energy storage need to be integrated into smart power grids. A paradigm shift from fossil fuel to clean electricity as the energy source of land, sea, and air transportation is also necessary. Power electronics serve as the electronic interfaces between the smart power grids and resources including but not limited to renewable energy, energy storage, and electrified transportation. Recently, the advancement in wide-bandgap semiconductors ignited significant interests in emerging medium-voltage (MV) power electronics, especially solid-state transformers (SSTs). I will discuss my Ph.D. work on new current-source single-stage SST circuits and model-predictive priority-shifting control methods for new stacked low-inertia SSTs. The advantages include significantly reduced size, improved efficiency and reliability, and universality for different net-zero applications. Based on the proposed concepts and customized 3.3 kV silicon carbide reverse-blocking MOSFET modules, a 5 kV DC SST and a 7.2 kV AC SST have been built and tested for MV DC renewable-energy collector and MV AC electric vehicle fast-charging applications, respectively. It is the first time that current-source MV SSTs have been demonstrated and reported, which led to an IEEE Transactions on Power Electronics First Prize Paper Award. My patents from this work have been licensed under the GridBlock startup company for grid-connected transportation electrification and renewable energy products. Finally, I will discuss future research directions for a net-zero energy future research directions for a net-Zero energy future.

Biography: Liran Zheng received the B.S. degree in control engineering from Tsinghua University in 2016, and the M.S. and Ph.D. degrees with the Center for Distributed Energy in electrical and computer engineering from Georgia Institute of Technology in 2018 and 2022, respectively.Liran is currently a Senior Engineer with Tesla. He previously held visiting positions with The University of Texas at Austin, the NSF ERC Center for Power Electronics Systems at Virginia Tech, the General Electric Global Research Center, and the Electric Power Research Institute. His research interests include power electronics and energy systems. Liran is the recipient of 4 IEEE Prize Paper Awards including an IEEE Transactions on Power Electronics First Prize Paper Award and Georgia Tech Best Ph.D. Thesis Award. He holds patents commercialized by GridBlock, a startup company out of Georgia Tech, for grid-connected transportation electrification and renewable energy products. He serves as an Associate Editor for the IEEE Transactions on Industry Applications.