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Special Session 06

AI-Enabled Reliability, Lifetime Prediction, and Fault Diagnosis of Power Electronic Converters

Introduction and Topics

With the global transition toward low-carbon and sustainable energy systems, photovoltaic generation, high-power conversion systems, and grid-connected as well as grid-forming converters are being deployed on an unprecedented scale. As essential interfaces for energy conversion, power regulation, and flexible system support, power electronic converters play an increasingly critical role in modern power systems. Under such trends, the reliability of power electronic converters has become a key concern in both device-level design and system-level operation, especially as long-term service performance is increasingly affected by complex mission profiles, harsh operating environments, cyclic loading conditions, and multi-physics coupling effects.

Typical reliability challenges include junction temperature fluctuation, thermo-mechanical stress accumulation, packaging degradation, solder fatigue, and fault evolution in semiconductor devices and converter subsystems. These issues not only influence converter lifetime and maintenance cost, but also affect system availability, operational security, and overall energy efficiency. Meanwhile, recent advances in artificial intelligence, data-driven modeling, physics-informed learning, digital twins, and intelligent condition monitoring have created new opportunities for converter health assessment, lifetime prediction, and fault diagnosis. By integrating AI techniques with reliability theory and degradation mechanisms, it is possible to improve prognostics, identify incipient faults, optimize maintenance strategies, and support reliability-oriented operation of power electronic equipment.

Topics including but not limited to:

1. Reliability modeling and evaluation of high-power power electronic converters
2. Lifetime prediction of IGBT, SiC, and GaN devices and converter subsystems
3. Junction temperature fluctuation, thermo-mechanical stress, and degradation analysis
4. Packaging reliability, solder fatigue, and failure mechanisms of power devices
5. AI-assisted fault diagnosis for power converters and inverters
6. Physics-informed and data-driven prognostics for converter health management
7. Condition monitoring and remaining useful life estimation of power electronic equipment
8. Reliability studies of photovoltaic inverters, modular multilevel converters, and grid-connected or grid-forming converters

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* Submit your paper through the website or QR code
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Important Dates

Submission Deadline	May 25, 2026
Notification Deadline	June 10, 2026
Early-bird Registration Deadline	June 15, 2026
Author Registration Due	June 15, 2026

Publication

Submissions to IEEE I&CPS 2026 will be peer reviewed on the basis of technical quality, relevance to conference topics, originality, significance, clarity, etc. Accepted papers will be submitted for inclusion into IEEE Xplore subject to meeting IEEE Xplore's scope and quality requirements.

Excellent papers will be recommended for review by **IEEE Trans on Industry Applications** (proportion can reach up to 50%), **Global Energy Interconnection** and **DeCarbon**.

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