Docket #: S21-346

Method for Avoiding Spurious Modes in Piezoelectric Based DC-DC Converters

Researchers at Stanford have developed the first known fixed-frequency control method to enable piezoelectric based power converters to avoid spurious mode and operate across a full output power range while maintaining high efficiency. The method decouples frequency and output power in piezoelectric DC-DC converters. It leverages the high-quality factor of piezoelectric devices to efficiently circulate current within the device, allowing power modulation at a fixed frequency. Piezoelectric based DC-DC converters are well suited for miniaturization and integration, and are especially promising for applications that prohibit magnetic material (e.g., MRI machines). However, they suffer from spurious modes, which cause high loss regions and adversely impact the ideal operating frequency range of devices. Existing methods for controlling piezoelectric based DC-DC converters are insufficient, causing output power to depend on switching frequency. Realizing commercial piezoelectric based DC-DC converter necessitates converters that can operate over a full output power range.

Stage of Development
Prototype

Applications

- Commercial piezoelectric based DC-DC converters
- Closed-loop, hysteretic control with fast transients
- Current work has focused on piezoelectric resonators but also could apply to piezoelectric transformers

Advantages

- First known method for avoiding spurious modes in piezoelectric DC-DC converters
- Decouples output power and frequency
- Enables a full output power range
- Can enable new ways of controlling converters in addition to providing better performance

Publications

- E. Stolt et al., "Fixed-Frequency Control of Piezoelectric Resonator DC-DC Converters for Spurious Mode Avoidance." *IEEE Open Journal of Power Electronics,* doi: 10.1109/OJPEL.2021.3128509. (2021)

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