Piezoelectric transformers: Control

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Piezoelectric transformers: Control

Gabriel Zsurzsan, Michael A.E. Andersen, Nils Axel Andersen, Zhe Zhang
DTU will develop and create value using the natural sciences and the technical sciences **to benefit society.**

*H.C. Ørsted, founder of DTU in 1829*
Technical University of Denmark - DTU

- DTU Electrical Engineering
- DTU Lyngby Campus
- DTU Ballerup Campus
- DTU Risø Campus
- Arctic Technology Centre (ARTEK)
- Hirtshals
- Østerild
- Mors
- Silkeborg
- Høvsøre
- Copenhagen
- DTU LYNGBY CAMPUS (main campus)
- Charlottenlund
- Frederiksbjerg
- Mørkhøj
- Lindholm
- DTU Risø Campus
Technical University of Denmark - DTU

5,895 human resources (FTEs)

- 21% researchers and educators (VIP)
- 43% in support functions
- 36% PhD fellows*

11,031 full-time students

- 28% BEng
- 32% MSc
- 40% BSc

*Employees only
DTU Electrical Engineering

Power engineering
Automation, control, and robotics
Biomedical engineering, CMR, ultrasound
Antennas & microwave tech.
Acoustics
Hearing systems
Power electronics & IC design
Electronics group
Electronics group

• Is research leader within:
  – Switch-mode (class D) Audio power amplifiers
    • 3 spin-off’s: B&O ICEpower & TI Denmark & Merus Audio
    • Highest output power IC class-D amplifier chip ever
  – High efficiency fuel cell power converters
    • Has the **highest efficiency** (> 98%) fuel-cell power converter ever
  – VHF power converters

• Provides **unique solutions** to the collaborating companies
• One of the most **innovative groups** at DTU:
  – 46 inventions
  – Start-up companies:
    • ICEpower (former Bang & Olufsen ICEpower)
    • Texas Instruments DK (former Toccata)
    • Upcon Technology
    • Merus Audio
    • Nordic Power Converters
    • Senserna
    • Nordic Firefly
Electrical behaviour of piezos

- Capacitive behavior
- Inductive behavior
- Resistive behavior
Inductive behaviour of piezos

- Intro
- Capacitive behavior
- Inductive behavior
- Resistive behavior
- Conclusions
Piezoelectric transformers
Self-oscillating PT-based SMPS
Control block
SO Principle
Bidirectional operation
Modular design
Why inductorless?
MRI testing
MRI testing

SNR degradation of 10dB


Conclusions

*PT-based SMPS control method:*

- Simple method for minimizing hard-switching losses
- Fast control to track and maintain self-oscillation
Thank you for your attention!