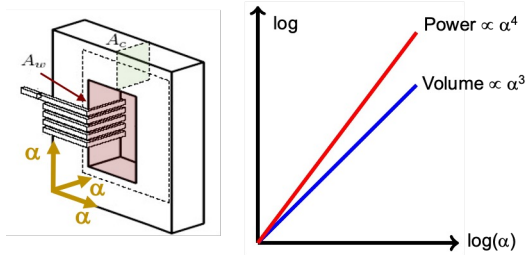


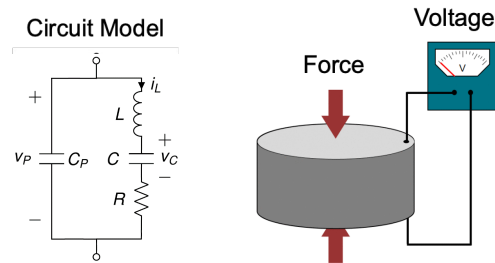
Piezoelectrics as Passive Components

Magnetics present fundamental size and performance challenges at small scales



Piezoelectrics are promising alternative passives for miniaturized power conversion

Piezoelectrics store energy in mechanical compliance and inertia

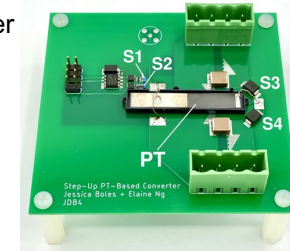
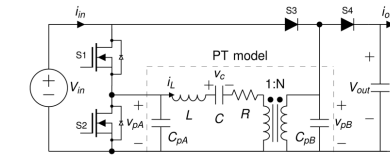


- ✓ High power density
- ✓ High efficiency
- ✓ Isolation
- ✓ Planar form factor
- ✓ Batch fabrication
- ✓ Integration potential

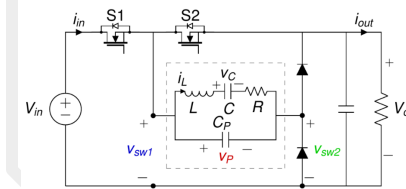
Converter Topologies Based on Piezoelectrics

We develop converter topologies that leverage the advantages of piezoelectrics in a variety of applications

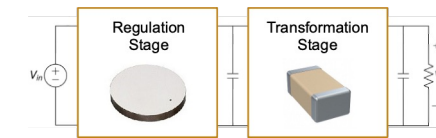
Piezoelectric-transformer-based dc-dc converter



Piezoelectric-resonator-based dc-dc converter



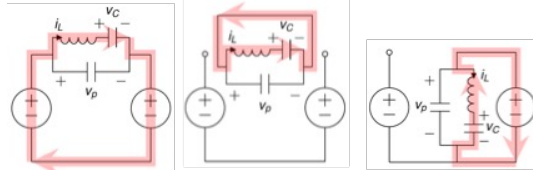
Hybrid piezo / switched capacitor converter



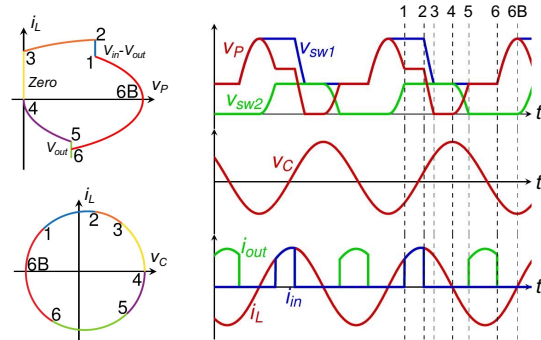
Control for Efficient Utilization of Piezoelectrics

We develop high-performance switching sequences and control strategies tailored to optimal utilization of piezoelectrics

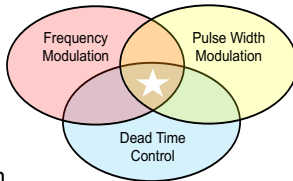
Six-stage sequence fixed voltage states



Six-stage sequence state trajectories and waveforms



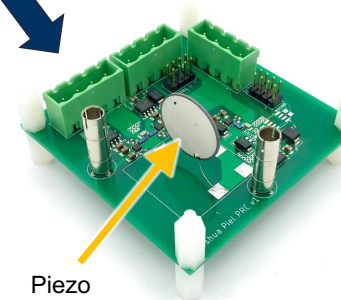
- High-Efficiency Behaviors:
- Soft charging of C_p
 - Soft switching of all switches
 - Minimal charge circulation
- Practical Characteristics:
- Wide voltage gain range
 - Simple switch implementation



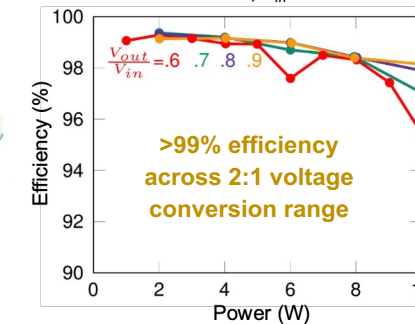
Experimental Demonstration

We experimentally demonstrate the high performance capabilities of piezoelectric-based power conversion

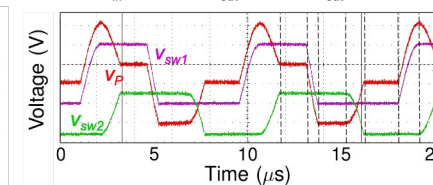
PR-based dc-dc converter



Varied Gain, $V_{in} = 100$ V



$V_{in} = 100$ V, $V_{out} = 40$ V, $P_{out} = 6$ W



J. D. Boles et al., "Enumeration and analysis of dc-dc converter implementations based on piezoelectric resonators," *IEEE TPEL*, 2021.
 J. D. Boles et al., "A piezoelectric-resonator-based dc-dc converter demonstrating 1 kW/cm³ resonator power density," *IEEE TPEL*, 2023.
 J. D. Boles et al., "Piezoelectric-based power conversion: recent progress, opportunities, and challenges," *IEEE CICC*, 2022.

Prof. Jessica Boles
boles@berkeley.edu

