Modeling and Optimization of a Through-metal Acoustic Wireless Power Transfer System for UAVs

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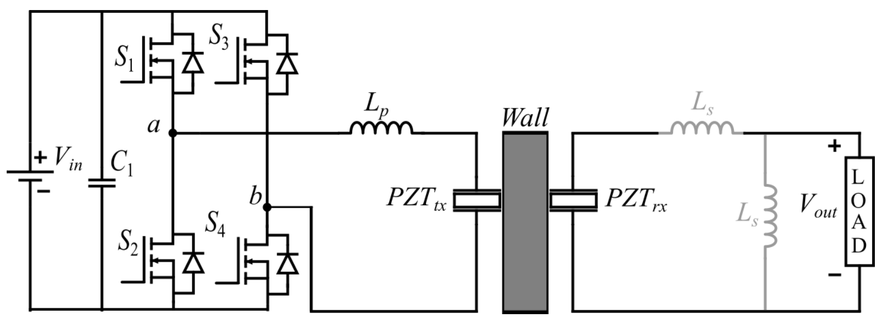
MOTIVATION FOR ACPOUSTIC WIRELESS POWER TRANSFER SYSTEM

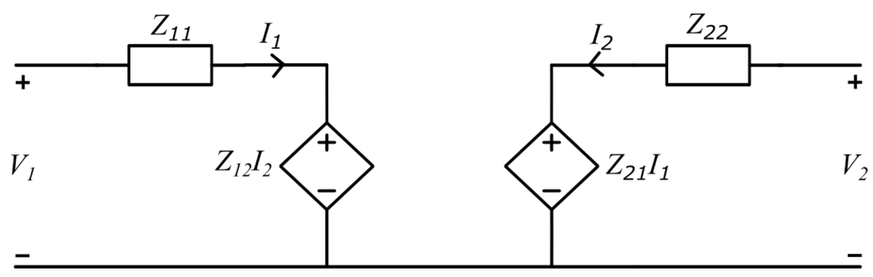
- Wireless power transfer through sealed metal containers: Attractive for applications where feed-through wires are not desirable such as aerospace, pipelines, and nuclear waste storage
- High power density: Piezoelectric transducers have shown high power density as an energy storage element compared to traditional elements like capacitors and inductors

SYSTEMATIC DESIGN METHOD

Circuit Schematic for full AWPT system

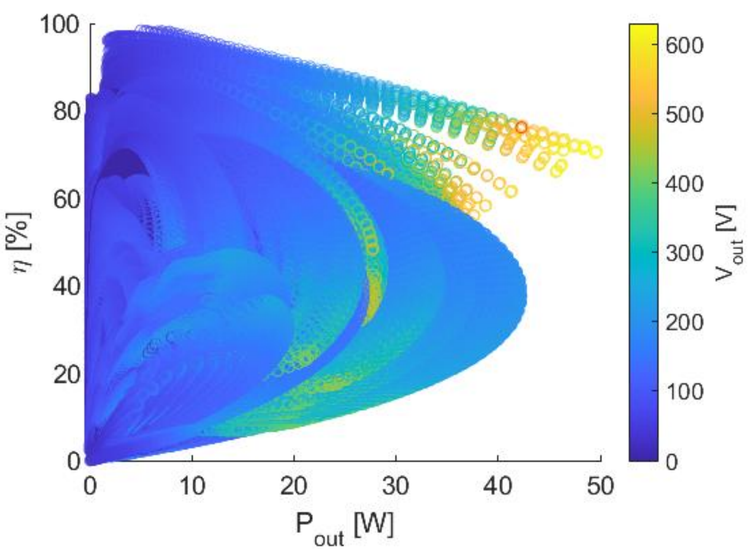


Z-parameter model for AWPT System

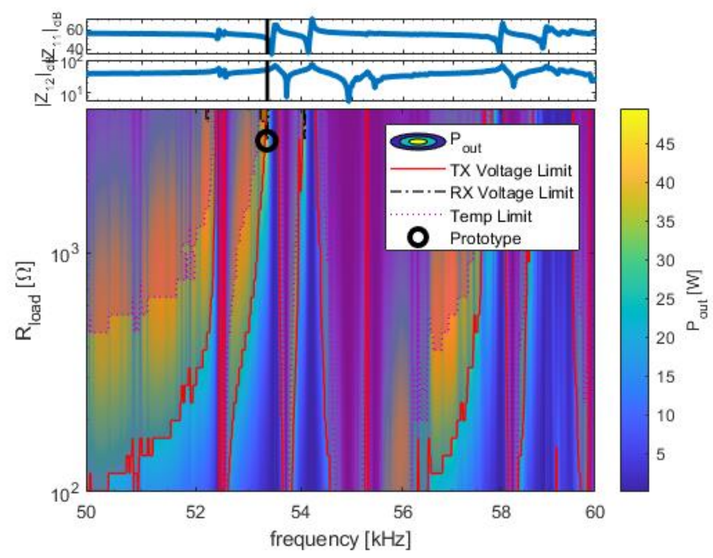


System Optimization

- Using Z parameters, design system based on different compensation levels and load resistance combinations for all frequencies in measured range



Plot showing all points calculated in optimization



Contour plot showing feasible operating space for AWPT system with operating limits highlighted

PROTOTYPE VERIFICATION

Coil formers for T_x & R_x coils

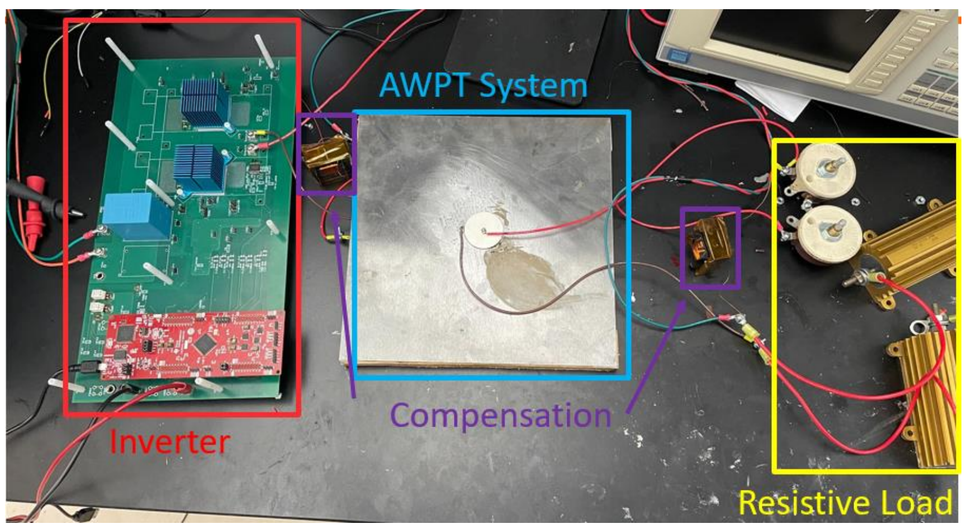
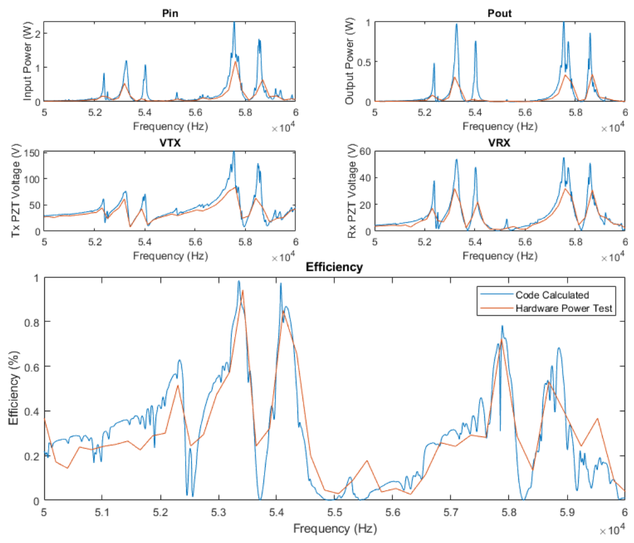
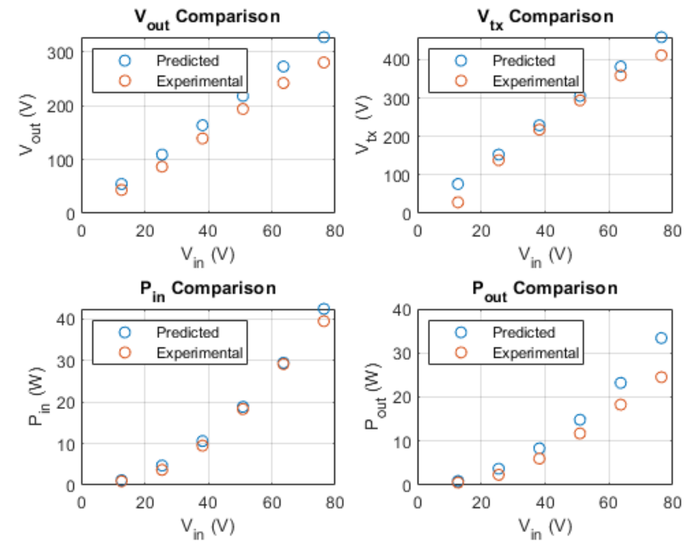


Image showing the setup for the AWPT system in hardware



Power Comparison at low voltage verifying the prototype in hardware matches with the model



Varying input voltage comparison at the optimized frequency point

CONCLUSIONS

- Optimized AWPT system for optimal power transfer within a fixed frequency range
- Fabricated the optimal system and verified the model with hardware experiments

FUTURE WORK

- Complete hardware tests at higher input voltages
- Investigate larger frequency range to see if higher resonant modes are feasible operating points
- Design DC/DC converter and rectifier for AWPT system output