

Quasi-Wireless Capacitive Power Transfer for Rapid Modularity in Robotic Systems

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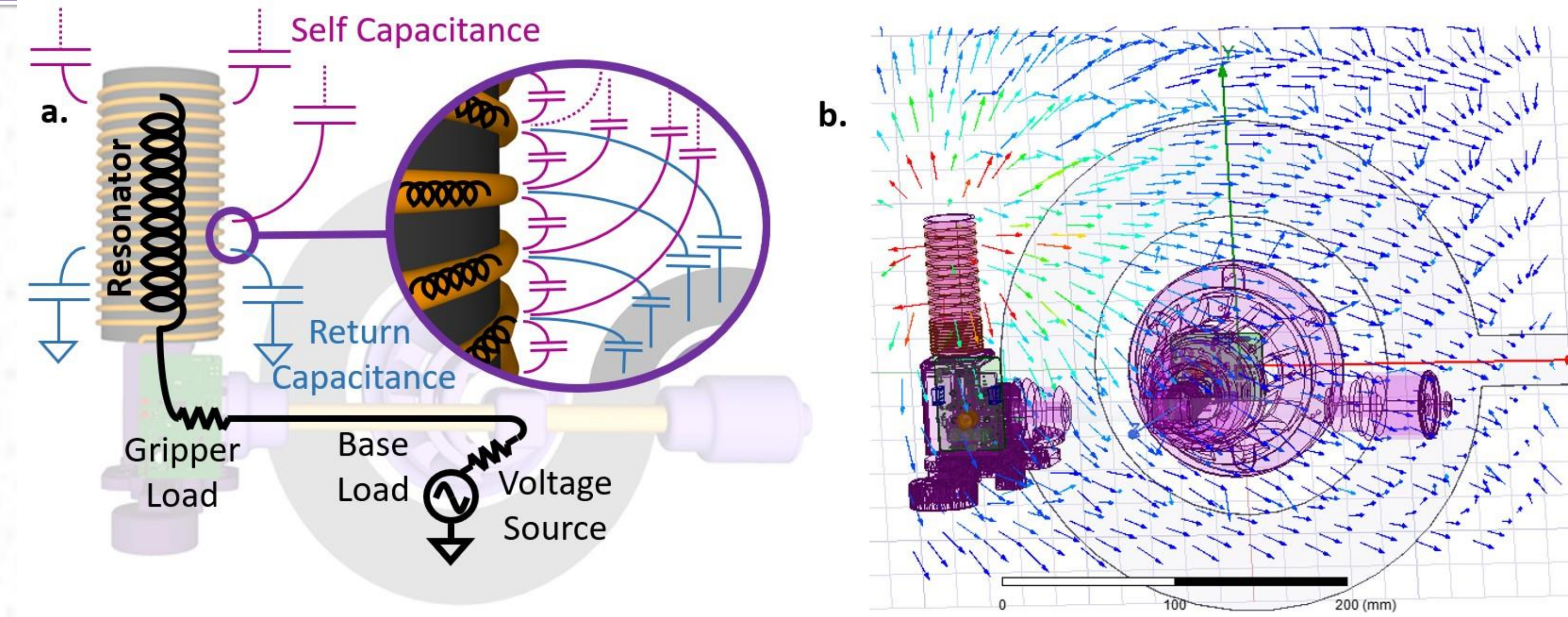
Introduction

Space exploration is dependent on robotic systems that utilize end-effectors to collect samples, probe surfaces, and manipulate objects. To reduce tradeoffs, we present a first-of-its-kind robotic linkage that has no wiring between the joints. Instead, quasi-wireless capacitive (QWiC) power transfer is used to send energy over the robot's chassis without a return wire. This enables the system to be completely modular, allowing rapid alterations in joint kinematics and/or the changing of end-effectors.

Research Purposes

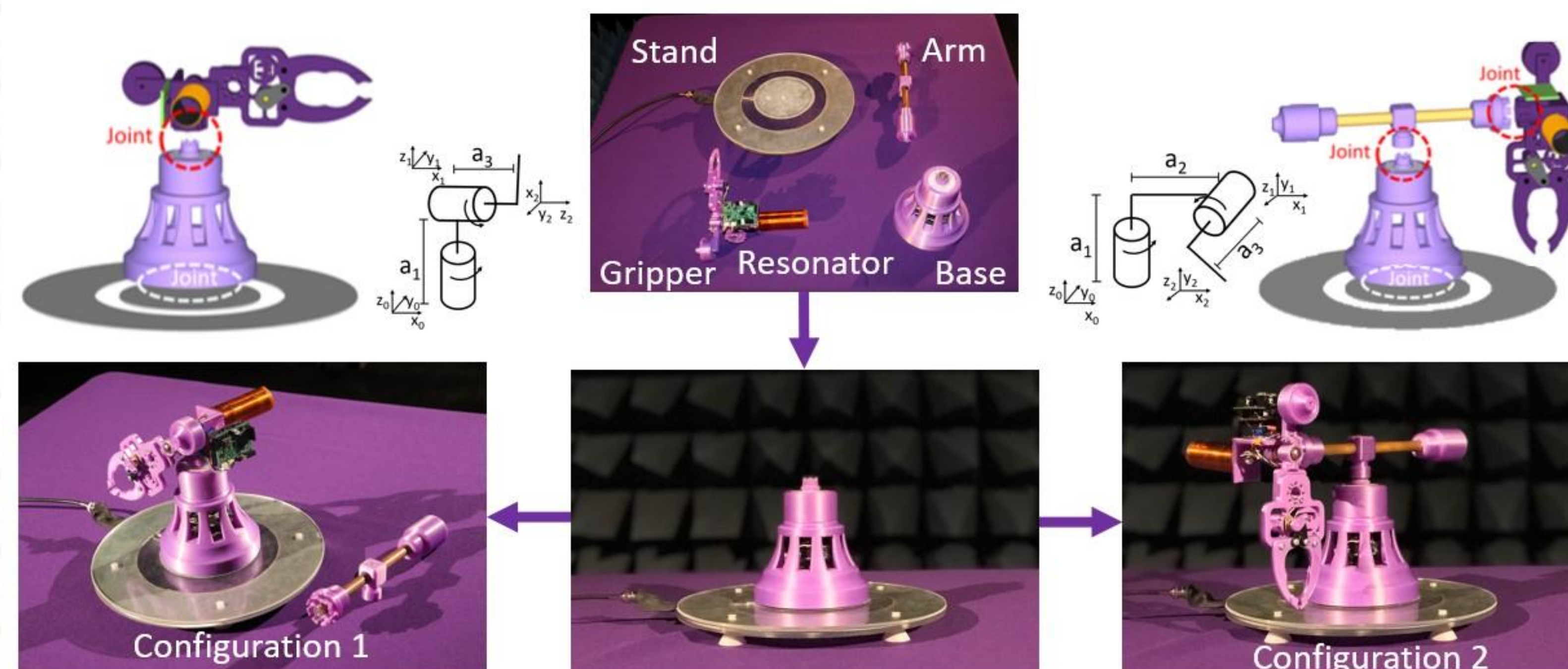
1. Can a conducting chassis be used as a solution to wireless power transmission?
2. What are the effects of changing the orientation of the receiver?
3. How much power is absorbed by each joint?

Method of Quasi-Wireless Capacitive Power Transfer (QWiC)

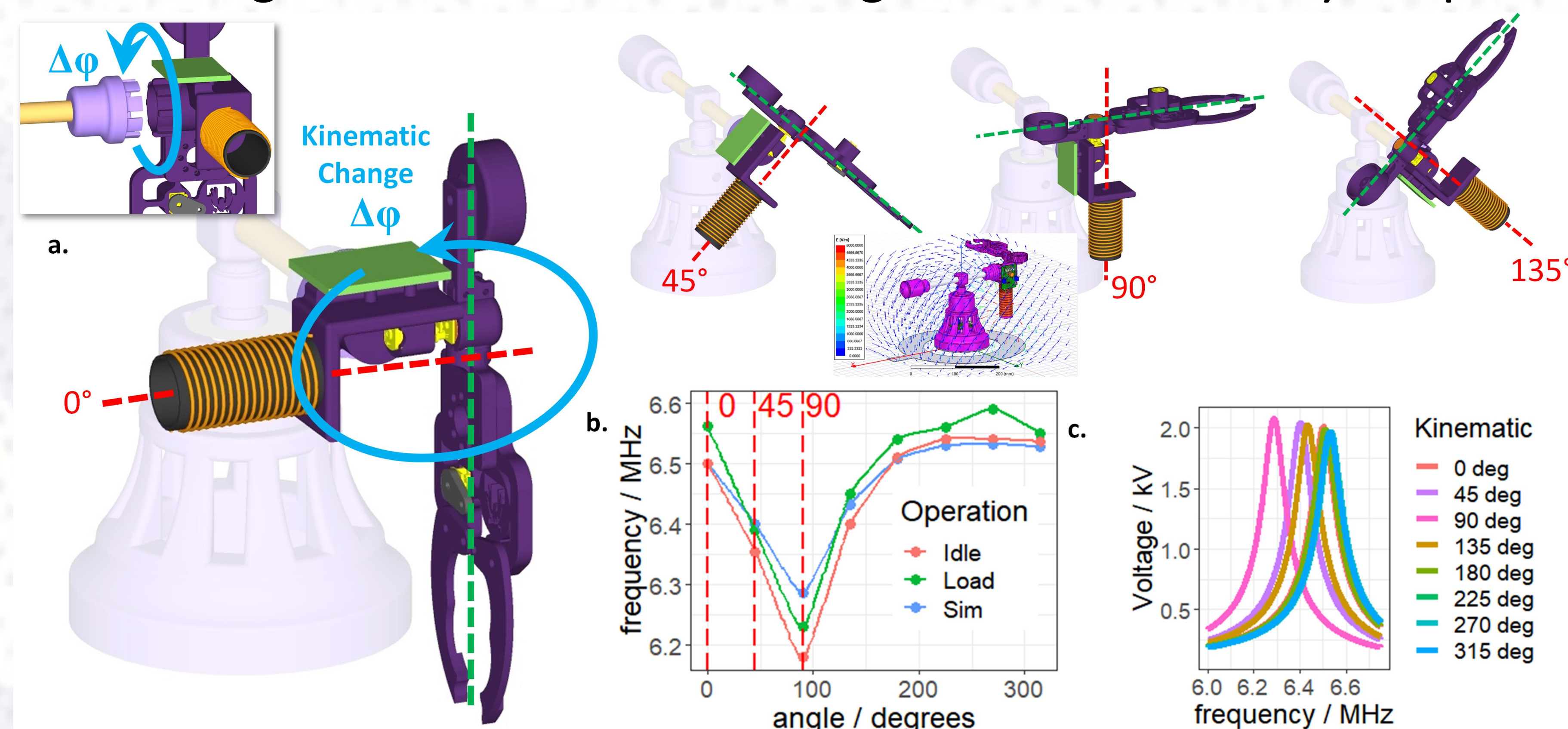


The receiver design allows the current to go through the arm and return to the common point via a capacitive path as shown in the above simulation.

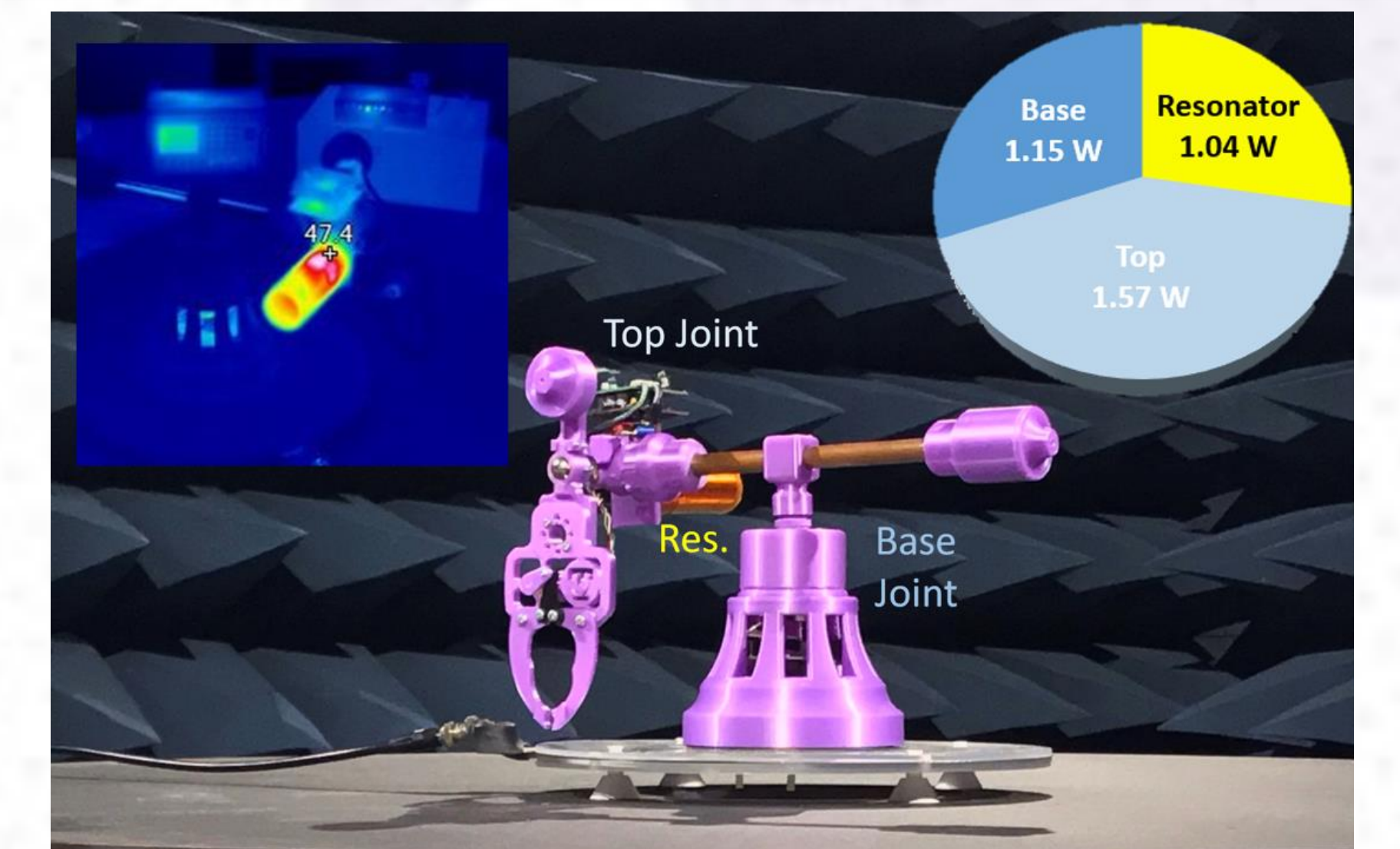
Rapid Kinematic Changes



The preliminary robot design had two kinematic configurations. Configuration 2 has 8 sub-configurations defined by a $\Delta\phi$.



Results and Future Work



- We successfully created a QWiC robot with a modular design.
- The Q factor stayed close to 98.28 for configurations with ranging resonant frequencies (6.2 MHz – 6.5 MHz).
- The efficiency of the system is 72.3%.

The prototype was tested at Marshall's EMI Chamber. The system complies with the Mil-standard 461 at all frequencies except its operating frequency of 6.2MHz-6.5MHz. Future work is ongoing to further reduce the EMI signature at the 6MHz range and improve the modularity of the design.

