Simultaneous Wireless Power and Data Transfer for Optical Positioning Systems

Reliably Powering and Configuring Rotating Systems

Graduate

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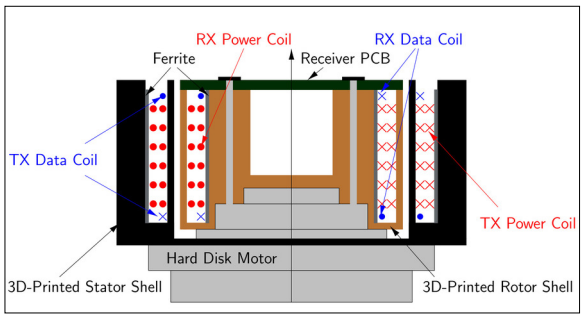
Introduction: Laser-based positioning systems typically employ rotating elements for angular scanning. A common approach is to use a rotating mirror, but mechanical imperfections necessitate periodic calibration. Rotating the laser source itself can improve angular accuracy, but also creates the need for wireless power and data transfer across the rotating interface.

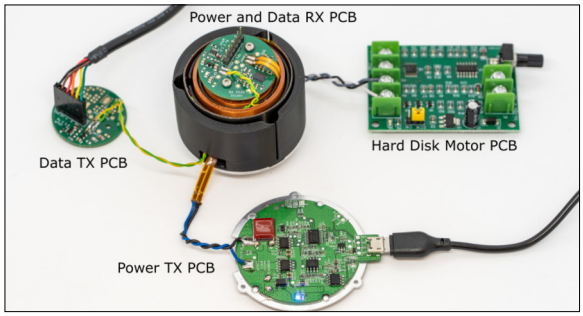
Approach: This thesis project evaluates suitable techniques for simultaneous wireless power and data transfer (SWPDT) in the near field and realizes a functional prototype. An inductive power transfer system based on the Qi standard is combined with a separate inductively coupled data channel, where the coils are arranged to minimize coupling between the two links. The coils are realized using flexible PCBs backed by flexible ferrite sheets. In addition, a compact receiver prototype is developed and integrated into the rotating platform.

Result: The resulting system can be powered by a standard Qi charger and delivers up to 3 W to the rotating unit while maintaining a stable 5 V supply. Bidirectional communication is supported at a data rate of 120 kbit/s, exceeding the specified data-rate requirement by a factor of 100. Measurements show approximately 50 dB isolation between the power and data channels, enabling reliable simultaneous operation when the coils are correctly aligned. The developed prototype has been tested at a rotational speed of up to 5 Hz and demonstrates the feasibility of the proposed approach.

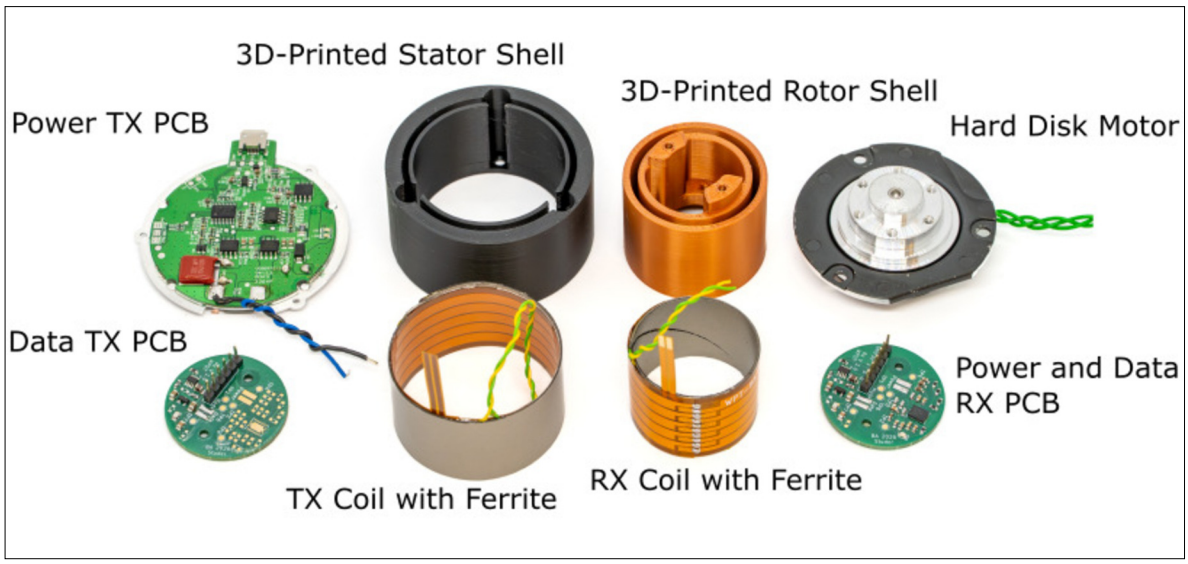
Cross section through the SWPDT system on a hard disk motor: power coils are shown in red and data coils in blue.
Own presentment



SWPDT prototype with separate power and data transmitter (TX) PCBs and a combined receiver (RX) PCB on the rotor.
Own presentment



Arrangement of all components of the SWPDT prototype: motor, coils with ferrites and shells, and TX and RX PCBs.
Own presentment



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