Introduction

Wireless Power transfer (WPT) can be classified into capacitive power transfer (CPT), inductive power transfer (IPT) and far-field radiative power transfer. IPT working at resonance is called resonant inductive coupling, which is suitable for mid-range WPT (e.g., indoor electronics charging and WPT for biomedical implants).

Computational Methods

First, the Eigenfrequency simulation was used to compute the fundamental resonant frequency of the WPT model. Secondly, a Frequency Domain simulation was used to compute the response of the model subjected to a time-harmonic excitation driving-port at the frequency obtained from the first step.

Transmit/Receive coil

Transmit and receive coils are placed close (< 3 cm) to the corresponding resonators to enhance the mutual inductance. Impedance matching is done at both transmit and receive coils.

Results of the Proposed Ellipsoidal Helix WPT

![Magnetic field distribution (20*log(|H|)) of the ellipsoidal helix WPT at (a) 53.45 MHz (at resonance) and (b) 40.95 MHz (off resonance)](image)

Power Transfer Efficiency

\[ \eta = \frac{|S_{21}|^2}{1 - |S_{11}|^2} \]

where \( S_{21} \) and \( S_{11} \) are the transmission and reflection coefficients respectively.

Table 1. Resonant frequency and bandwidth of two systems

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<thead>
<tr>
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<th>Ellipsoidal helix</th>
<th>Cylindrical helix</th>
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<tbody>
<tr>
<td>Resonant frequency (MHz)</td>
<td>53.45</td>
<td>47.10</td>
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<tr>
<td>90 %-efficiency-bandwidth</td>
<td>15.0 %</td>
<td>2.3 %</td>
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Conclusions

An ellipsoidal helix coil is proposed as the resonator for a resonant inductive coupling WPT system. The bandwidth of the system is increased while a high transfer efficiency is maintained, which is verified by COMSOL Multiphysics® simulation.

References