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A Wireless Power Transfer with Low Sensitivity to Lateral Misalignment

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Near field inductive coupling wireless power transfer (WPT) systems suffer from high misalignment sensitivity. The reason behind this sensitivity is the change in the coupling characteristics. In return, the designed immittance inverters become inappropriate to these new coupling characteristics and the efficiency of the WPT system degrades.

Generally, a near field inductive coupling WPT is designed at critical coupling regime. This results in a peak WPT efficiency at perfect alignment. However, the WPT efficiency degrades, monotonically, as soon as a lateral misalignment occurs due to the under coupling regime characteristics [1]. Alternatively, we design the immittance inverters of the WPT system based on a scaled value of the available mutual inductance between the resonators at the perfect alignment position. This design methodology causes an over-coupling regime characteristics at this perfect alignment position, and the WPT efficiency is lower than the peak one. Then, during lateral misalignment, the WPT efficiency improves pending its peak at critical coupling regime. Next, with further lateral misalignment, the WPT efficiency drops due of the system entry to the loose coupling regime. The scaled mutual inductance value is selected based on the WPT minimum acceptable efficiency and the target lateral shift range at which this minimum WPT efficiency is satisfied.

We verify the proposed aporroach by implementing a WPT system at 300 MHz, which shows a peak efficiency of 80% for a size $D_o \times D_o = 40 \times 40$ mm^2 with a transfer distance $d = D_o$. During misalignment, the efficiency is higher than 50% for a lateral shift up to ±0.75 D_o.

1. A. Barakat, K. Yoshitomi, and R. K. Pokharel, "Design Approach for Efficient Wireless Power Transfer Systems During Lateral Misalignment," *IEEE Trans. Microw. Theory Techn*., **66**, 9, Sep. 2018, pp. 4170-4177, doi: 10.1109/TMTT.2018.2852661.