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12. Dynamic Wireless Power Transfer for Real-time Coordination of Electrical Vehicles Between Distributed Energy Resources and Power Grid

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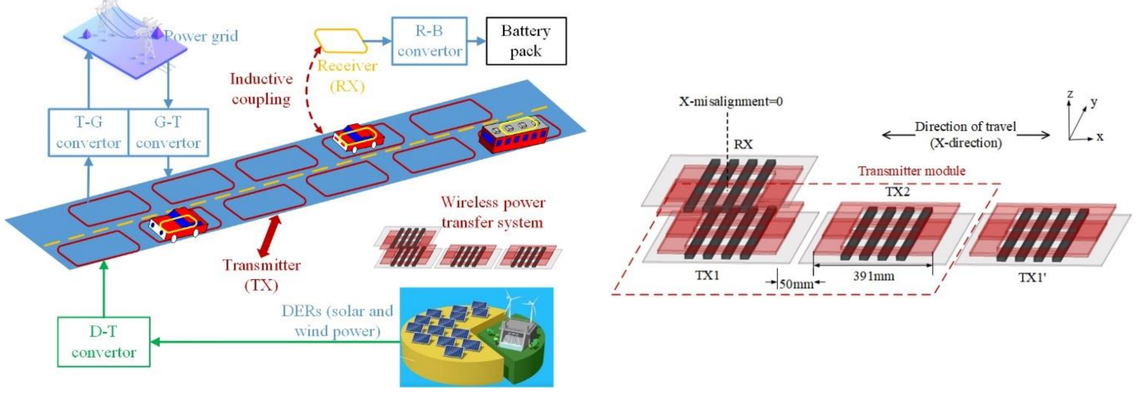
Introduction of your work

A mode featuring charging while moving which is realized by dynamic wireless power transfer (WPT) technology is proposed to meet the need of flexible real-time interaction between grid and DERs. A symmetrical WPT system with transmitter and receiver both constructed by identical bipolar pad (BPP) is proposed to realize a bidirectional power transfer, and a hybrid resonant tank is adopted to stabilize power transfer as well as provide reactive power compensation.

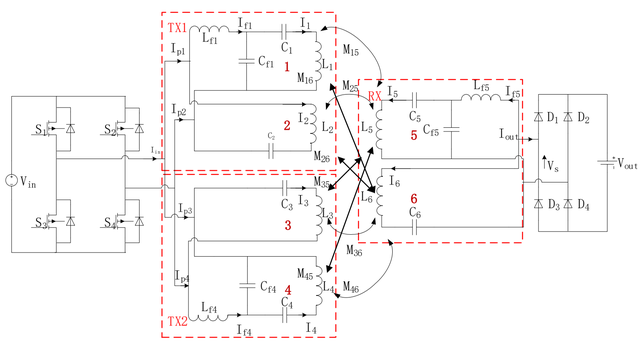
Methods of your work

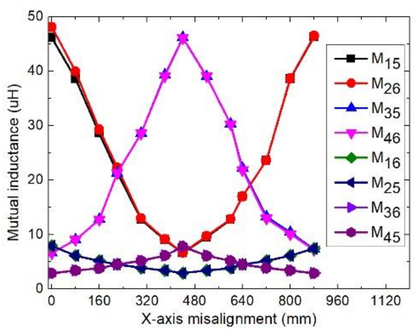
EVs with bidirectional dynamic charging function can act as active distributed coordinators between DERs and power grid, power can be transferred from DERs to battery, or from power grid to battery and vice versa, which effectively relieves grid power quality degradation caused by increasing penetration of DERs and support the operation of grid.



To mitigate the variation of the self-, mutual- and leakage-inductances during the dynamic charging for EVs, a demonstration topology with symmetrical architecture of coplanar double bipolar pads (BPPs) that makes a power transmission continuously to the secondary BPP installed on the chassis of a moving EV.

Results of your work

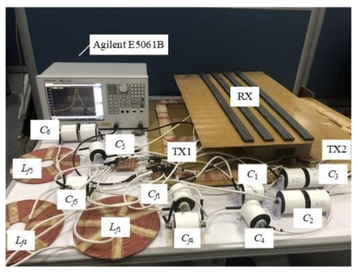


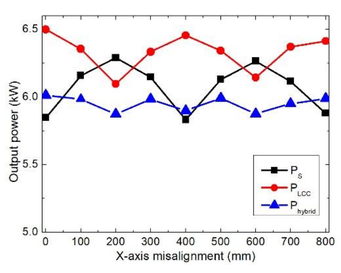


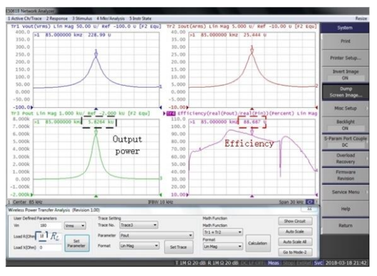
The output power of the system can be obtained as $P_o=P_{t1r}+P_{t2r}$

$$P_{t1r} = P_{15} + P_{26} = \mathrm{Re}\left[V_s \cdot (I_{f5} + I_{f6})\right] = \frac{8V_{in}V_s}{\pi^2\omega}\left(\frac{M_{15}}{L_{f1}L_{f5}} + \frac{L_{f5}}{M_{25}} + \frac{M_{16}}{L_{f1}} + \frac{1}{M_{26}}\right)$$

$$P_{t2r} = P_{35} + P_{46} = \mathrm{Re}\left[V_s \cdot ({I_{f5}}' + {I_{f6}}')\right] = \frac{8V_{in}V_s}{\pi^2 R_L}\left(\frac{L_{f5}}{M_{35}} + \frac{1}{M_{36}} + \frac{M_{45}}{L_{f4}L_{f5}} + \frac{M_{46}}{L_{f4}}\right)$$







	TX1-RX	TX2-RX	Overall
Output power variation	4.8%	7.6%	2.1%
Efficiency	-	-	88.6%

Conclusions of your work

A WPT system featuring transmitter module composed of coplanar double bipolar pads (BPPs) and a corresponding hybrid compensation topology is proposed to stabilize power transmission in dynamic wireless charging for EVs. Theoretical analysis, simulation and experimental results showed that the proposed structure, combined with the hybrid compensation topology can improve the tolerance to misalignments of EVs in motion, with a power deviation of 2.1% and an efficiency higher than 88.6%.