Investigation of adaptive matching by the frequency tracking method for wireless power transfer

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The researches on the resonant coupling wireless power transfer were reported recently (A. Kurs, A. Karalis, R. Moffatt, J. D. Joannopoulos,P. Fisher, and M. Soljacic, Sciencexpress, June 7, 2007). At close range, it is required to achieve highly efficient power transfer using the resonant coupling. But many issues remain unclear to design a highly efficient wireless power transfer system. One of the major issues is the matching problem when the distance of the antennas is changed. It is hard to realize the adaptively simultaneous matching on both transmitter and receiver when distance between the antennas is varied. It is desired to transmit power with high efficiency anywhere in near field range. Therefore the adaptive matching method is required for the variation of distance. In this paper, we investigate the matching problem of the wireless power transfer system, and suggest the frequency tracking method to achieve the adaptive matching when distance of the resonators is changed.

The adaptive matching method for wireless power transfer system is investigated by FEKO simulator. The helical coil fed in the center is used in this paper. When the two antennas are getting nearer, the optimum impedance for the maximum power transfer is varying quite drastically with the distance so that it is very difficult to compensate in the T/R circuit at the fixed frequency.

We notice that the input impedance at resonant frequency is almost equal to the load impedance (Y. Kim, H. Ling, Electron. Lett., vol.43, no.23, Nov. 2007) even though the resonant frequency is changed from the isolated case when they are strongly coupled in this region. Therefore, the matching and the efficient power transfer can be achieved without change of the impedance by adjusting the frequency of source to the corresponding resonant frequency.

This study makes a comparison between power transfer efficiency of conventional simultaneously conjugate matching method and that of the frequency tracking method. It is found that the adaptive matching can be achieved by using frequency tracking method in the coupled mode region. The power is transmitted with the maximum efficiency when the system is using the frequency tracking method.

In the presentation, we will show and compare the wireless power transfer performance of the proposed adaptive matching method and the conventional simultaneously conjugate matching method. Almost maximum power transfer efficiency is achieved by the proposed frequency tracking method in the strongly coupled mode region.