# Introduction

Inductive power transfer (IPT) has become more popular in recent years. It is used in range area from low power applications to high power applications. Cordless design and spatial flexibility of IPTs led them to be used in applications such as portable chargers, biomedical implements, etc. Also, providing electrical safety and galvanic isolation make them the future of the electric car chargers and energy harvesting systems, etc.

Besides the advantages, the IPT system also allows the multiple transmitters (Tx) and receivers (Rx). Multiple Tx-Rx systems are investigated and analyzed for various applications in the literature. Multiple Tx coils are implemented to obtain higher power ratings. Thus, voltage or current ratings of the system can be increased without changing the ratings of the semiconductors. Moreover, multiple Tx can be used to avoid misalignment. A misalignment can decrease the output power drastically and a misalignment tolerant system can be designed by using more than one Tx coupled with a Rx. Another use of multi Tx is to meet requirements of the multiple loads such as electric car charger and consumer electronics. On the other hand, coupling between Tx coils raise an issue and it is unavoidable in some application due to insufficient space. In the literature, the effect of coupling between Tx coils on resonance frequency, output power and efficiency are analyzed and they bring some solutions to avoid the effects.

Also, multiple Rx coils are implemented for the similar aims of multiple Tx. For example, multiple Rx coils increase the fault tolerance for some IPT topologies since Tx side draws short circuit current if there is no load on the receiver (open circuit Rx coils or zero coupling coefficient between Tx and Rx). Moreover, multiple Rx can be used to obtain higher power ratings. For this usage, either the load of each Rx may be separate or unified. For unified load conditions, Rx’s can be connected series or parallel to each other’s.

In literature, parallel-connected Rx’s are analyzed and sharing power between Rx’s, or can be named as load balancing, raises a problem. In the literature, either the problem is solved by replacing passive rectifiers with active rectifiers and implementing control algorithm or by applying post-regulation by a DC-DC converter (Buck, Boost, Buck-Boost, etc.). However, the solutions are hard to implement and cause excess components and cost.

In this paper, we propose that we can share the power between Rx’s equally with by adjusting the coupling between Rx coils. Although the coupling between Rx coils affect the output power, efficiency and frequency as in the Tx coils, we can use the couplings for load balancing and design the system considering the couplings. In first section, ….

# Rectifier effect and load distribution

In the section 1 and 2, we find the required circuit parameters to operate without bifurcation by making some assumption that the coupling coefficient between Tx and Rx's are same, the coupling coefficient between Rx's zero and load is shared equal to Rx's.