

MIDDLE EAST TECHNICAL UNIVERSITY

Electrical and Electronics Engineering Department

EE568 Selected Topics on Electrical Machines

PROJECT 4

DESIGN AN INDUCTIVE POWER TRANSFER INDUCTANCE AND ANALYSIS of MISALIGNMENT

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# 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 some 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.

In many applications (Electric vehicle, portable chargers), IPT system is used for multiple loads. For these applications, the position of transmitter and receivers are variable. Thus, the loosely coupled IPT’s have a variable mutual inductance between transmitter and receiver. The different mutual inductance affects the output power, output voltage and the efficiency of the system. In general, the small changes on mutual inductance can be tolerated by using frequency or phase shift control. However, small position changes on loosely coupled systems led the mutual inductance change drastically. Thus, transmitter and receiver coils should be designed to be misalignment tolerant. In literature, misalignment tolerant IPT systems are investigated in the papers. There are different misalignment conditions as show figure X. The misalignments can be also changed with respect to coil shape.

In this work, the misalignment analysis and mutual inductance calculations will be conducted. Firstly, the mutual inductance calculation and misalignment analysis in literature will be examined. Secondly, a coupled coil is designed and the mutual inductance between coils are calculated analytically. Thirdly, the design is simulated by FEA. Finally, the analytical and FEA model are compared and the design will be optimized.

# Literature Review

In literature, misalignment analysis is well investigated. Misalignment tolerant system design is expected to provide stable output voltage and power. The misalignment tolerant system come into view in two points. One of them is that the misalignment tolerant system is done with control methods. Other one is that the misalignment tolerant system is done with designing misaligned tolerant coils. Second method is investigated in the literature in this papers. The coil structures depends on application of the IPT and it is imported to design misaligned tolerant coils.There are some

# Analytical Calculation and Sizing

In this part, we chose inductor shape which are suitable to our applications. Then, the inductance values and mutual inductances are calculated analytically by using vector potential approach.

Shape of the inductors is chosen circular shape which are used in vertical misalignment tolerant as shown in figure X.