Article

Study of Methods for Calculation of Self and Mutual Inductance

DB Ahire[1], Vitthal J Gond[2]

[1]Research Scholar, Matoshri College of Engineering and Research Centre, Nashik, Maharashtra, India.
[2]Professor, MET, Institute of Engineering, Bhujbal Knowledge City, Nashik, Maharashtra, India.

I N F O

A B S T R A C T

Calculation of Self and mutual Inductance of coil of any shape and geometry has been proposed by various authors in literature. This paper reviews the various techniques for calculation of self and mutual Inductance of coil of any shape and geometry and similarly explores the numerical technique using Electromagnetic Simulation software tools for comparing the values obtained by analytical, Approximation (Empirical) and Handbook method. Calculation of Self-inductance of Multilayer coil, Single layer helical and Spiral (Pancake) coils are proposed by Wheeler's Empirical formula, Lundin's handbook formula, Nagaoka's formulas, Rosa and Grover's Correction formulas are discuss and xplored.

Calculation of Mutual inductance of two Coaxial Circles by Maxwell's formulas in Elliptic Integral, Nagaoka's formulas are discussed and explored.

The results of Electromagnetic Simulation software tools for calculation of self and mutual inductance of Spiral (Pancake) coil is compared with the different techniques of calculation like analytical, empirical and approximate of mutual and self inductance the results are in close agreement with the simulated values.

Keywords: Self Inductance, Mutual Inductance, Wireless Power Transfer, Coupling Coefficient, Helical Coil, Spiral (Pancake) Coil

Introduction

Accurate calculation of self and mutual inductance of any coil shape and Geometry is very difficult task. Many authors in the literature[1,3] explored different methods for calculation of self and mutual inductance.

Complexity in Analytical method is more while Approximation (Empirical) and handbook method is based on the simplification of medium level formulas or on the basis of a set of measurements of the actual coils.

Numerical Method involves Numerical Electromagnetic Analysis solver such as FEM, BEM and use electromagnetic simulation software such as, Ansys Maxwell, Comsol Multisystem with RF module, Ansys HFSS, etc. gives accurate calculations of self and mutual inductance of any coil shape and Geometry.[13]

Application of exact calculations of self and mutual inductance of coil is used in transformer design, wireless power transfer system for Electrical Vehicle battery and biomedical implant battery charging. Coupling Coefficient between two coils is depends on self and mutual inductance values of a coil to obtain the maximum power transfer efficiency and deliver more power to the load.