Main theme	Sub - Theme	Code Number
Technology	**Electromagnetic research method**	**26**

Study Name	**Artificial Neural Networks Approach to Finite Elements Modeling of Problems in Electromagnetic Engineering**
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Date of Study	2001
Objectives	The need to develop new computational techniques with higher efficiency is considered here in order to solve accurately and inexpensively complex and higher dimensional electromagnetic field problems. In this thesis, a new artificial Neural Network (ANN) model is proposed form the standpoint of the topological relationship analogy between the Finite Element Method (FEM) and ANN, and due to the main property of the Hopfield Neural Network (HNN) to minimize the stored network energy. This type of neural network can easily find applications in FEM analysis.
Output and Recommendation	In this thesis, we have presented a new artificial neural network finite element based model. These model represnts FEM two-dinmensional edge-based problems. This two –dimensional models can be used to generate useful results for a number of a practical problems in electromagnetic. The neural network approach is obtained by equating the derivative of energy function with respect to its unknown variable "edges" to a null vector. The resulting coefficient matrix of each element in the FEM mesh represents the weights or the memories of each neural network node. Also we proved that a neural network can handle the two-dimensional finite element of electric field problems well, due to the fundamental property of minimizing the network energy while the network evolves over time.
Development Aspects	In this thesis, two dimensional electromagnetic applications are presented. Waveguide and scattering problems with different geometries are considered. The electric field is governed by vector wave equation. Ritz and Galerkins formulation techniques are sued to formulate the wave equation and the tangential electric field on the edges is computed. The neural network is trained by the conjugate gradient method which has a very reliable convergence behavior as compared with steep descent (first order) method.
Remarks	Thesis submitted in partial fulfillment of the requirements of the degree of Master of Science in Electrical Engineering, Faculty of Graduate Studies, Jordan University of Science and Technology. https://doi.org/10.1049/iet-map:20060189