TRANSMISSION LINE MAGNETIC FIELD MINIMIZATION VIA PARTICLE SWARM OPTIMIZATION

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To my beloved
Mother,
Rahmah Abdul Rasid

To my wife and daughters,
Nordiah binti Abdul Hamid,
Amirah Humaira and Amirah Maisara

To my supervisor,
Prof Ir Dr Mohd Wazir bin Mustafa

To all my supportive members,

Thank for your support and sacrifices

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ABSTRACT

Recently, many people fear about the radiation exposure from the transmission line in Malaysia. There are very few people who can differentiate between ionizing and non-ionizing radiation. "Radiation" from the high-voltage transmission line consists of a magnetic field and electric field. In this project, the magnetic field from transmission line was calculated using MATLAB programming. The calculations are base above one meter from the ground and across the transmission line. The new positions of conductors were determined using Particle Swarm Optimization technique to get the minimum value of magnetic field. The technique is represents the movement of organisms such as bird flock or fish school. Particle swarm consists of 'n' particles and the position of each particle stand for the potential solution in 'D' dimensional space. The particles change its condition according to the following principles; to keep its inertia, to change the condition according to its most optimist position, and to change the condition according to the swarm's most optimist position. The magnetic field was calculated with several design of transmission line and then the new positions of conductors with lowest magnetic field were determined. The results have been compared with Table 5.1 in this report and found that it meets the magnetic field value at a voltage of 400kV. As the magnetic field produced became lower, the magnetic field exposure to the public nearby the transmission line also will be low. Hopefully, this will be useful for the designers or engineers to design the lower exposure of magnetic field from the transmission lines hence will be able to meet the safety limit exposure to the public.

ABSTRAK

Kini, terdapat ramai yang bimbang mengenai pendedahan radiasi daripada talian penghantaran di Malaysia. Masih lagi ramai yang tidak dapat membezakan antara sinaran mengion dan sinaran tak mengion. "Sinaran" dari talian penghantaran voltan tinggi terdiri daripada medan magnet dan medan elektrik. Di dalam projek ini, medan magnet dari talian penghantaran dikira dengan menggunakan pengaturcaraan MATLAB. Pengiraan adalah berdasarkan satu meter dari tanah dan merintangi talian penghantaran tersebut. Kedudukan baru konduktor ditentukan menggunakan teknik Pengoptimuman Kerumunan Zarah untuk mendapatkan nilai minimum medan magnet. Teknik ini mewakili pergerakan organisma seperti kawanan burung atau sekumpulan ikan. Kerumunan zarah ini terdiri daripada zarah 'n', dan kedudukan setiap zarah mempunyai penyelesaian berpotensi dalam ruang dimensi 'D'. Zarah berubah keadaan mengikut prinsip-prinsip berikut; untuk mengekalkan inersia, untuk menukar keadaannya mengikut kedudukan yang paling optimis, dan untuk mengubah keadaan pada kedudukan yang paling optimis dalam kerumunan zarah. Keputusan kajian ini telah dibandingkan dengan Jadual 5.1 di dalam laporan ini dan didapati ianya menepati nilai medan magnet pada voltan 400kV. Medan magnet dikira mengikut beberapa reka bentuk talian penghantaran dan kemudian kedudukan baru konduktor dengan medan magnet terendah ditentukan. Dengan medan magnet yang dihasilkan menjadi lebih rendah, pendedahan medan magnet kepada orang ramai berdekatan talian penghantaran juga akan menjadi rendah. Semoga ianya akan berguna untuk perekabentuk atau jurutera untuk merekabentuk talian penghantaran dengan pendedahan daripada medan magnet yang lebih rendah, oleh itu akan dapat memenuhi had pendedahan kepada orang awam.

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LIST OF SYMBOLS

PSO	-	Particle Swarm Optimization
ICNIRP	-	International Committee on Non Ionizing Radiation Protection
SIL	-	Surge Impedance Loading
MW	-	Megawatts
RLC	-	Resistance, Inductance, Capacitance

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CHAPTER 1

INTRODUCTION

1.1 Background

The transmission line produce magnetic field. It is come from the current flow in transmission line. Exposed to the magnetic field is believed to cause biological effects to human [4]. Electric field is easier to absorb rather than magnetic field. As electric field can absorb by the surrounding objects, magnetic field only can blocked using special material but the cost is very high. Others method must be used to reduce the magnetic field. There are several methods to reduce the value of magnetic field such as mitigation loops [3]. Also, some of evolutionary programming methods are used to get the minimum value. Hopefully with all these technique, the engineers can design the transmission line with low magnetic fields produced.

1.2 Problem Statement

The concerning of public health effect from magnetic field exposure has result this title to be selected. As the transmission line is used the 50Hz frequency, it categorize in Extremely Low Frequency. The magnetic field is not easily to shielding and for the transmission line case it is not the suitable technique to be used. Shielding for magnetic field in this range of frequency require very thick and high permeability material for make the shielding effective [6]. Some technique for example mitigation

loop is use to reduce the level of magnetic field [3], but in this project PSO is used to arrange the location of transmission line to reduce the level of magnetic field.

1.3 Objectives of Project

The main objective of this project is to minimize the value of magnetic field produced by transmission line. In order to ensure the achievement of the main objective, several sub-objectives has to be divided:

i. to calculate the magnetic field from several design of transmission line using MATLAB programming;
ii. to analyze the minimum value of magnetic field by arranging the location of conductor using Particle Swarm Optimization (PSO) technique;
iii. to compare the fields with international safety standards, either within the permissible limit for the public or not.

1.4 Scopes of Work

The project is to simulate the value of magnetic field from the transmission line using MATLAB programming. The simulation is based along 1 meter above the ground [7]. Several design of transmission line will be identified. Then, the arrangement of transmission line will be modified to have the minimum exposure of magnetic field. The PSO technique will be used to get the new arrangement of transmission line.

Next, the value of magnetic field will be compared with the permissible limit for the public from the international safety standards. The rated voltage use only for typical uncompensated 400kV line because of reference using for Surge Impedance Loading (SIL) level in MW only for that rated voltage [11]. In this project also, the calculations are not included the RLC effects for the transmission line.

1.5 Report Outline

This project report are consists of six chapters. In the Chapter 1, it discusses on the problem statement, objective and the scope of this project.

Chapter 2, it will be discussed on the literature review of transmission line, magnetic and electric fields and also about Optimization Technique. The Particle Swarm Optimization will be discussed in the whole of Chapter 3.

In the Chapter 4, it will be discussed on methodology of this project. It is include on determine the value of magnetic field, PSO and also the comparing on the ICNIRP standard.

The results of the projects and discussions on the results are on Chapter 5, and the last but not least, the conclusion on this project and recommendation for the future works will discuss in the Chapter 6.

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