SIMULATION OF ELECTRICAL DISCHARGE MACHINES POWER GENERATOR

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To my beloved parents and sister (Iman) for their encouragement and love

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ABSTRACT

Electrical Discharge Machining (EDM) is a non-conventional material removal electro-thermal process EDM able to produce sufficient surface roughness that help in improving implant lifespan. In EDM process, power supply is one of the important elements in providing thermal action between the electrode and the work piece. A device for low discharge energy and current for EDM application is developed. It is essential to develop power supply unit capable of producing required discharge energy for proper machining process, high material removal rate and good surface finish. In this project a new design of power supply will be explored in an attempt to develop a low power generator for biomedical EDM.A new design specification for switching power supply (SMPS) of Electrical Discharge Machining (EDM) is proposed. The circuit design of SMPS is first described. The design of EDM pulse power supply based on switching circuit pulse width modulation current closed-loop principle has been initiated. Therefore, the efficiency of the new system is considerably increased, its weight and size is decreased much. Then, a MATLAB/SIMULINK modeling technique is employed to obtain low discharge energy and current for Micro-EDM biomedical application.

ABSTRAK

Pelepasan elektrik Pemesinan (EDM) adalah pembuangan bahan elektro -terma process.EDM bukan konvensional mampu menghasilkan kekasaran permukaan yang mencukupi yang membantu dalam meningkatkan implan jangka hayat. Dalam proses EDM , bekalan kuasa adalah salah satu elemen penting dalam menyediakan tindakan haba di antara elektrod dan sekeping kerja. Peranti untuk tenaga pelepasan rendah dan semasa bagi permohonan EDM dibangunkan. Ia adalah penting untuk membangunkan unit bekalan kuasa mampu menghasilkan pelepasan tenaga yang diperlukan untuk proses pemesinan yang betul, tinggi kadar pembuangan bahan dan kemasan permukaan yang baik. Dalam projek ini reka bentuk baru bekalan kuasa akan diterokai dalam usaha untuk membangunkan penjana kuasa rendah untuk EDM bioperubatan, spesifikasi reka bentuk baru bagi menukar bekalan kuasa (SMPS) Pelepasan Pemesinan Elektrik (EDM) dicadangkan . Reka bentuk litar SMPS mula-mula diterangkan. Reka bentuk EDM bekalan kuasa nadi berdasarkan beralih litar nadi modulasi lebar semasa prinsip gelung tertutup telah dimulakan. Oleh itu, kecekapan sistem baru adalah lebih meningkat, berat badan dan saiz adalah menurun banyak. Kemudian , satu teknik pemodelan MATLAB / SIMULINK digunakan untuk mendapatkan tenaga pelepasan rendah dan semasa untuk Micro- EDM permohonan bioperubatan.

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LIST OF ABBREVIATIONS

A	-	Unit of current (I) flow
AC	-	Alternating Current
DC	-	Direct Current
F	-	Unit of Capacitance
Hz	-	Hertz
M	-	Unit of 10^6
m	-	Unit of 10-3
µ	-	Unit of 10
Ω	-	Unit of resistance (Ohm)
p	-	Unit of 10-12
P	-	Unit of 10-12
R	-	Resistance
V	-	Voltage
C	-	Capacitor
W	-	Watt
EDM		Electrical Discharge Machines

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CHAPTER 1

INTRODUCTION

1.1 Background

Since 1940's, a revolution evolved in manufacturing field, the materials used in either heavy or light industries had gradually increased. Figure 1.0 shows the ultimate tensile strength of different materials by following each evolving years of development(Singh 2008).

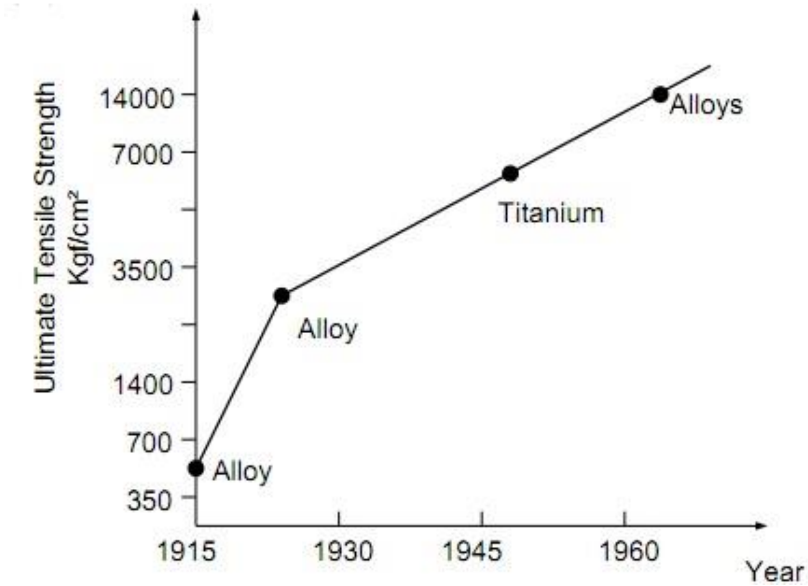

Figure 1.1 Graph of Ultimate Tensile Strength versus Year of Development(Singh 2008)

Due to the hardness, strength or weakness, traditional or conventional manufacturing methods used today are limited in their efficiency and the ability to manage these new materials. Therefore, a new approach was introduced or invented to deal with the materials. New approaches CES Manufacturing Processes are called unconventional manufacturing process. The unconventional Manufacturing Processes can be classified based according to the type energy in the single manufacturing process, using mechanical, chemistry, thermal or magnetic energy. By applying those types of energy mentioned above onto a work piece, some desired shapes of the work piece can be obtained. For instance, the materials that are extremely hard to form before, but now with the new invented method applied such as electro-chemical reaction, the materials are now formed(Singh 2008). Because of these new sophisticated inventions, the efficiency and capability of manufacturers are greatly improved. An Electrical Discharge Machining (EDM) process which will be partly discussed in this thesis is a kind of non-conventional manufacturing process. Figure 1.2 below describes the type of non-conventional manufacturing process.

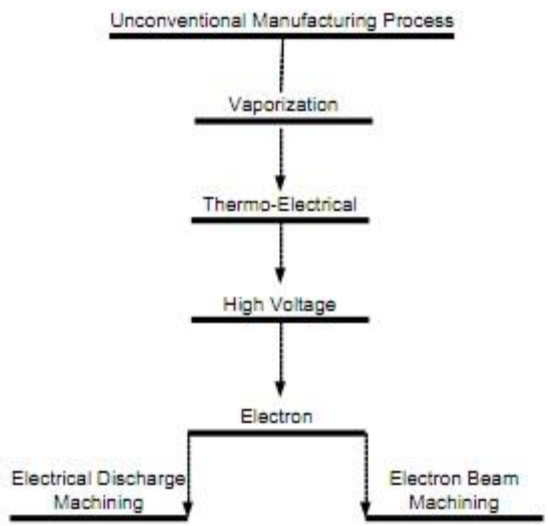

Figure 1.2 EDM – the non-conventional manufacturing process(Singh 2008)

Usually, there are two main considerations before a manufacturer decides to make the manufacturing process. The first consideration will be machining characteristics of the process where the machining characteristics are commonly as follows:

1) Metal Removal Rate (MRR)
2) Surface finished roughness
3) Power Consumption by machining process
4) Tolerance of actual machining surface
5) Depth of the surface damage

For the second review of the manufacturer is usually the main concern entire sector and end user as well, because it involves the cost of the manufacturing process, which covers:

1) Capital cost of manufacturing

2) Tooling cost

3) Power consumption cost

4) Metal Removal Rate efficiency

As the cost of energy is one of the main concerns of the industry, so that the type of power used is an important issue to reduce the energy consumption cost, and increase the efficiency of the power supply. For this reason, a project was conducted to develop a power supply high performance at the same time performing EDM process prototype.

1.2 Problem Statement

The switching power supply promises high efficiency performance over the whole system, so simulation Power Generator in MATLAB/SIMULINK can be used to model all the major type of power supply control ICs the devised SIMULINK behavior models capture almost all the important characteristics of the experimental circuits even if some assumptions are made to simplify the corresponding behavior models. The power generator was a main issue in EDM manufacturing industry, so for convenience, need general simulation power generator model. In RC generator uniform surface finish is difficult to obtain and in RC generator extremely low removal rate from its low discharge frequency, so, we want to develop RC generator. The power consumption cost was a main issue in EDM manufacturing industry, so, in the project, a high efficiency and high performance switch mode power supply (SMPS) will be developed instead of applying mode power supply.

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1.3 Project Objectives

This project have three main objective about design and simulation some of type generator and power supply using in EDM as :

- Simulation and analysis RC generator
- Simulation and analysis Flyback convertor power supply
- Design and simulation of EDM pulse generator

1.4 Project Scope and Limitation

There are some goals in the project that must be fulfilled. In order to obtain the objectives of this project, scopes for this project has been determined. The scope of the project is to use the EDM machine, my project is about EDM power supply, so, focus in two important type power supply generator, RC generator and SMPS generator for SMPS need PWM switching.

1.5 Dissertation Outline

In order to understand the resistance-capacitor generator type power supply (RC), switch mode power supply (SMPS) and the pulse power supply of EDM, the basic knowledge about the RC and SMPS also the pulse power supply should be understood. In this Chapter, there will be an introduction on the reasons to establish this project. Because of the project, there would be a need for a literature review onto the EDM and RC and SMPS in Chapter two. Chapter three explanation methods of implementation of SMPS and RC. Into the bargain, the following Chapter four discusses the results of the works. A conclusion will be made in Chapter five, according to previous chapters and further research works and limitations about the project will be brought out as well in order to ease the reader for further studies and modifications onto the project.

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