

**DEVELOPMENT OF A COMPUTER INTERFACING TECHNIQUE
FOR THE STUDY OF MAGNETIC FORCES OF
SUPERCONDUCTOR AND PERMANENT MAGNET**

By

ARIFFIN BIN ABAS

**Thesis Submitted to the school of Graduate Studies, Universiti Putra Malaysia, in
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DEDICATION

The author wish to dedicate this thesis report to his parents,

Especially his wife, Noor faizah

Children, ye, farhana, farseha, fartihah. apis

And

His Fellow Course mates and

Friends

Who had been his source of flames of inspiration and perspiration.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

DEVELOPMENT OF A COMPUTER INTERFACING TECHNIQUE FOR THE STUDY OF MAGNETIC FORCES OF SUPERCONDUCTOR AND PERMANENT MAGNET

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Chairman: Professor Abd Halim Shaari, Ph.D.

Faculty: Science

The Computer together with the LABVIEW software can be used as automatic data acquisition system. The electronic balance with RS232 port is used for measuring the force exerted by the magnetic field strength. Knowledge of how to use DAQ PCI 6025E card combined with opto isolator chip RS307-064 are useful to amplifier 5V TTL signal from computer to 12V and make two stepper motors works with a step resolution of 0.08 mm and 0.009mm respectively. This project deals with the development of a computer interfacing technique for the study of magnetic forces of superconductor and permanent magnet, using the above system, which has been developed. It consists of two parts: the setting up of that automated experimental rig uses computer, together with the LABVIEW software, the electronic balance and the stepper motor and finally measuring the levitation force for the $\text{Bi}_{1.6}\text{Pb}_{0.4}\text{Sr}_2\text{Ca}_{2-x}\text{Cd}_x\text{Cu}_3\text{O}_{10}$ system (where $x=0.00$ (pure), $x=0.02$, $x=0.05$, $x=0.07$ and $x=0.1$) and magnetic forces for NdFeB permanent magnet. Graph of magnetic force as a function of distance were obtained. The magnetic force between two permanent magnets, NdFeB of different shapes and configurations were

also studied. The Interactive LABVIEW Programming were developed so as to enable the calculation of either the repulsive or attractive forces between two cylindrical permanent magnets and the data are compared with the results obtained via experiment. Hysteresis loop were obtained for superconductor system, however it was not observed in the permanent magnet system. This phenomenon occurred in superconductor because it allows partial flux penetration in the vortex state, which are absents in the permanent magnet system. Magnetic forces for two permanent magnets obey the inverse square law of the distance between the two magnets, however it failed to describe the variation of levitation force as a function of distance for all superconductor samples. It was observed that the levitation force displayed exponential behavior, $F = F_0 e^{-az}$. The system that has been developed can be used as an affective teaching aid as it incorporates the interactive component.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

**PEMBANGUNAN TEKNIK ANTARAMUKA COMPUTER UNTUK
MENGKAJI DAYA MAGNET BAGI SUPERKONDUKTOR DAN MAGNET
KEKAL**

Oleh

ARIFFIN BIN ABAS

Disember 2004

Pengerusi: Professor Abd Halim Shaari, Ph.D.

Fakulti: Sains

Sebuah komputer bersama program software LABVIEW boleh digunakan untuk sistem pengambilan data secara automatik. Sebuah alat penimbang elektronik yang disambung menggunakan liang RS232 bertanggungjawab untuk mengukur daya yang dihasilkan oleh kekuatan medan magnet. Pengetahuan tentang bagaimana penggunaan kad DAQ PCI 6025 E yang digabungkan dengan chip opto isolator RS 307-064 berguna untuk menguatkan isyarat 5V TTL dari komputer kepada 12 V bagi mengerakkan dua motor pelangkah dengan hanya resolusi sebesar 0.08mm dan 0.009mm masing-masing. Projek ini adalah bertujuan mengkaji pembangunan teknik antaramuka komputer untuk mengkaji daya magnet bagi superconductor dan magnet kekal menggunakan sistem software diatas dimana telah dibangunkan. Ia mengandungi dua bahagian iaitu penyusunan eksperimen secara automatik bersama penggunaan komputer digabungkan dengan software LABVIEW, alat penimbang elektronik dan motor pelangkah dan akhirnya untuk mengukur daya magnet dan sifat apungan bagi sistem $\text{Bi}_{1.6}\text{Pb}_{0.4}\text{Sr}_2\text{Ca}_{2-x}\text{Cd}_x\text{Cu}_3\text{O}_{10}$ (dimana $x=0.00$ (tulen), $x=0.02$, $x=0.05$, $x=0.07$ dan $x=0.1$) dan daya magnet untuk magnet kekal NdFeB. Graf daya magnet sebagai fungsi kepada jarak telah

diperolehi. Daya magnet diantara dua magnet kekal, NdFeB bagi berbagai bentuk dan konfigurasi juga telah di kaji.

Satu program interaktif LABVIEW telah dibangunkan seterusnya membolehkan pengiraan samada daya tolakan atau tarikan diantara dua selinder magnet kekal dan membandingkan dengan keputusan melalui eksperimen. Gegalung histerisis telah diperolehi bagi sistem superkonductor, bagaimanapun ini tidak diperhatikan dalam sistem magnet kekal. Fenomena ini berlaku kerana dalam keadaan vortek, superconductor membenarkan sebahagian penusukan fluks dimana ia tidak hadir pada sistem magnet kekal. Daya magnet bagi dua magnet kekal mematuhi hukum songsang kuasadua, bagaimanapun ini tidak diperolehi bagi semua sampel dalam bahan superkonductor. Ia diperhatikan bahawa daya keapungan mempamerkan bersifat eksponen, $F = F_0 e^{-\alpha z}$. Sistem yang dibangunkan boleh digunakan sebagai alat bantu mengajar yang berkesan dimana ia bergabung dengan komponen interaktif.

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I certify that an Examination Committee met on 29th December 2004 to conduct the final examination of Ariffin Bin Abas on his Master of Science thesis entitled “Development Of A Computer Interfacing Technique For The Study Of Magnetic Forces Of Superconductor And Permanent Magnet” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

Azmi Zakaria, Ph.D.

Associate Professor.
Faculty of Science
Universiti Putra Malaysia
(Chairman)

Norhana Yahya, Ph.D.

Faculty of Science
Universiti Putra Malaysia
(Member)

Zulkifly Abbas, Ph.D.

Faculty of Science
Universiti Putra Malaysia
(Member)

Muhamad Mat Salleh, Ph.D.

Professor
Institut Kejuruteraan Mikro dan Nanoelektrik
Universiti Kebangsaan Malaysia
(Independent Examiner)

GULAM RUSUL RAHMAT ALI, Ph.D.

Professor/Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirements for the degree of Master of Science. The members of the Supervisory Committee are as follows:

Abdul Halim bin Shaari, Ph.D.

Professor
Faculty of Science.
Universiti Putra Malaysia
(Chairman)

Ionel Valeriu Grozescu, Ph.D.

Associate Professor
Faculty of Science.
Universiti Putra Malaysia
(Member)

Zaidan Abdul Wahab, Ph.D.

Associate Professor
Faculty of Science.
Universiti Putra Malaysia
(Member)

AINI IDERIS, Ph.D.

Professor/Dean
School of Graduate Studies
Universiti Putra Malaysia

Date :

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

ARIFFIN BIN ABAS

Date:

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