AUTOMATED MEASUREMENT OF LEVITATION FORCE USING LABVIEW PROGRAMMING LANGUAGE

By

ABDUL MAJEED BIN MOHAMED SHARIFF

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the Degree of Master of Science

November 2006

DEDICATION

In memory of my parents,
Abbah and Bibi,

Special thanks to
My parents-in-law
Gulam Nabi and Mariam

Wife
Khursaid Bebe

Children
Hazim and Nuur Aqilah

fellow course mates and friends.
Who had been a source of flames of inspiration and perspiration.

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

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Chairman: Professor Abdul Halim Shaari, PhD

Faculty: Science

This study deals with the development of an automated system for the investigation of levitation forces through three sets of experiments. The first set is a study of levitation forces between moving superconductors or conductors with a permanent magnet. The superconductors were used in field cooled and zero field cooled states. The second set deals with the study of levitation forces between a moving small discs shaped magnet with a much larger square magnet. The third set deals with the study of levitation forces between two identical magnets with a superconductor placed between them. An automated experimental setup was successfully setup that uses a computer, together with the LabVIEW software, an electronic balance, a DC motor controlled by a PWM circuit, a rpm sensor circuit and an actuator to achieve the stated objectives. The superconductors used were $Bi_{1.6}Pb_{0.4}Sr_2Ca_{2-x}Cd_xCu_3O_{10}$ (where x=0.00(pure), x=0.02, x=0.05, x=0.07 and x=0.1).. The conductors used were copper and aluminium of various thicknesses. The levitation force between a moving conductor and a permanent magnet can be measured and compared to it's calculated values. It was shown that the levitation forces can be used to find the lift off speed of aluminium of thickness 4.75 mm to be 14.88 m/s. The first set of

experiments revealed that levitation forces are depended upon the speed of the moving conductors but not on moving superconductors. It was also found that the levitation forces for superconductors are stronger in the zero field cooled states then the field cooled state. The second set of experiments showed that the levitation force between two magnets varies in a rotating field. The third set of experiments showed that the levitation forces between two identical magnets are not affected by the presence of a disc shaped superconductor. The system that has been developed can be used as an effective teaching aid for the teaching of magnetic levitation principles.

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

PENGUKURAN DAYA APUNGAN SECARA AUTOMATIK DENGAN MENGGUNAKKAN LABVIEW

Oleh

ABDUL MAJEED BIN MOHAMED SHARIFF

November 2006

Pengerusi: Professor Abdul Halim Shaari, PhD

Fakulti: Sains

Penyelidikan ini bertujuan membangunkan suatu sistem automatik untuk mengkaji daya apungan melalui tigi siri experimen. Siri yang pertama iala mengkaji daya apungan diantara konduktor atau superconductor yang sedang bergerak dan magnet kekal.Superkonduktor telah digunakkan dalam keadaan medan magnet beku dan tidak beku. Siri kedua ialah berkenaan daya apungan diantara sebuah magnet berbentuk cakera yang bergerak dan sebuah magnet besar. Siri ketiga ialah mengkaji daya apungan diantara dua magnet yang serupa dengan meletakkan suatu superkonduktor berbentuk cakera diantara mereka. Penyusunan eksperimen secara automatik bersama penggunaan komputer digabungkan dengan software LabVIEW, alat penimbang elektronik, aktuator, pengesan kelajuan serta sistem pengawalan kelajuan motor DC dengan menggunakan litar PWM telah berjaya melakukan semua siri eksperimen tersebut. Superkonduktor $Bi_{1.6}Pb_{0.4}Sr_2Ca_{2-x}Cd_xCu_3O_{10}$ (dimana x=0.00(tulen), x=0.02, x=0.05, x=0.07 dan x=0.1) telah digunakkan. Konduktor yang digunakkan merupakan kepingan kuprum dan aluminium yang berlainan tebal. Daya apungan diantara konduktor yang bergerak dengan magnet boleh diukur dan dibandingkan dengan nilai yang dikirakan. Ia dapat ditujukkan bahawa nilai daya-

daya apungan boleh digunakkan untuk mencari halaju apungan bagi aluminium ketebalan 4.75 mm ialah 14.88 m/s. Siri experimen yang pertama menujukkan daya apungan bergantung kepada halaju konduktor tetapi tidak kepada halaju superkonduktor. Ia juga telah didapati bahawa daya apungan lebih kuat didalam medan magnet tidak beku berbanding dengan medan magnet yang beku.Siri eksperimen kedua telah menunjukkan daya apungan diantara dua magnet berubah dengan putaran magnet. Siri eksperimen ketiga telah menunjukkan daya apungan diantara dua magnet yang serupa tidak berubah dengan kehadiran superkonduktor yang berbentuk cakera. Sistem yang dibangunkan boleh digunakan sebagai alat bantu mengajar yang berkesan untuk mengajar prinsip-prinsip keapungan magnet.

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I certify that an Examination Committee met on …… to conduct the final examination of **Abdul Majeed Bin Mohamed Shariff** on his **Master of Science** thesis entitled "AUTOMATED MEASUREMENT OF LEVITATION FORCE USING LABVIEW PROGRAMMING LANGUAGE " 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:

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

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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.

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ABDUL MAJEED BIN MOHAMED SHARIFF

Date: 27 DECEMBER 2006

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