AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

MECHATRONICS ENGINEERING

Regenerative Anti-Lock Braking System

A Thesis submitted in partial fulfillment of the requirements of the

M.Sc. in Mechanical Engineering

By

Mohamed Nabil Mohamed Mohamed Elghitany

B.Sc., Mechanical Engineering, Mechatronics Engineering Department
Ain Shams University, 2012

Supervised by

Prof. Dr. Farid A. Tolbah.

Prof. Dr. Magdy Abd Elhamid
(May God have mercy on him)

Dr. Adham Mohamed Abd Elkader

Cairo – (2018)

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EXAMINERS COMMITTEE

Name	Signature
Prof.	…….
Prof.	…….
Prof	…….

Date: / / 2018

Statement

This thesis is submitted as a partial fulfillment of M.Sc. degree in Mechanical engineering, Faculty of Engineering, Ain Shams University.

The author carried out the work included in this thesis and no part of it has been submitted for a degree or qualification at any other scientific entity.

Mohamed Nabil Mohamed Mohamed Elghitany

Signature

…….....
...

Date: / / 2018

Researcher Data

Name: Mohamed Nabil Moahmed Mohamed Elghitany

Date of birth: 18 September 1990

Place of birth: Cairo, Egypt

Last academic degree: BSc. in mechanical Engineering

Field of specialization: Mechatronics Engineering

University issued the degrees: AIN SHAMS University

Date of issuing degree: July 2012

Current job: Demonstrator at Mechatronics Department, Faculty of Engineering, AIN SHAMS University

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Abstract

The braking system of vehicles uses the usual technology of hydraulic braking that generates thermal energy out of the loss of kinetic energy which is being resulted from difference in motion of pads and wheels. The Regenerative Braking System (RBS) works on converting the excess kinetic energy into electrical energy that can be used in recharging the car battery during the vehicle deceleration.

The usual RBS has some limitations that are related to the vehicle speed; as in low speed which is less than 10 km/h the system is inefficient to convert the kinetic energy and generate current. Also the RBS is incapable of completely stopping the vehicle regardless of the traveling speed.

The study in this conducted thesis emphasizes the Regenerative Anti-lock Braking System (RABS) in saving energy and reducing energy loss, also enhancing braking performance at low speed rates by detecting the type of terrain surface.

RABS comprehensive model has been constructed on Matlab / Simulink for simulation purposes in order to collect reliable results about system perfomance and calculate the speed ranges of the wheel which differ according to the type of the surface after the first hit on the brakes in a given time to use these speed ranges in terrain detection process in the expeimental test rig.

The experimental test rig has been constructed on a hybrid golf cart in two different modes; one of which is speed reducing mode and the other one is stopping mode and shows multiple conditions of braking such as braking on

non-slippery surfaces as dry-surface (asphalt) and braking on slippery surfaces as wet-surface (asphalt) and oily-surface (asphalt).
It is found from the simulation and test rig that the RABS which is conducted in this thesis provides satisfactory braking performance and recovered energy reaches to 30 % of energy losses in thermal energy.

Key words: Conventional Braking System, Anti-Lock braking System, Regenerative Braking, Hybrid Electric Vehicle, Motor Generator, State Of Charge

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List of Technical terms and abbreviations

RBS **R**egenerative **B**raking **S**ystem

MG **M**otor **G**enerator

ABS **A**nti-lock **B**raking **S**ystem

RABS **R**egenerative **A**nti-lock **B**raking **S**ystem

EV **E**lectric **V**ehicle

HEV **H**ybrid **E**lectric **V**ehicle

SOC **S**tate **O**f **C**harge percentage

EM **E**lectric **M**otor

RPM **R**evolutions **P**er **M**inute

IDE **I**ntegrated **D**evelopment **E**nvironment