

**FAST DEMAND RESPONSE CONTROL STRATEGY  
FOR DECENTRALIZED AIR-CONDITIONING  
SYSTEMS IN MICROGRIDS**

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Degree of Master of Science by Research

Department of Electrical Engineering

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## DECLARATION

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## **ABSTRACT**

Distributed energy systems are essential to integrate renewable energy sources to the modern electric grid. Microgrids are a distributed energy system that enables the integration of the intermittent renewable energy sources. Microgrids can operate in islanded mode without the support of the main grid in case of emergency. In this operation mode there must be a wide range of controls to operate the Microgrid until the main grid is available. A microgrid that consists of distributed air conditioning units is considered in this research. This research focuses on developing a control strategy to support the islanded operation of Microgrids using Fast Demand Response and Direct Load Control. The controller developed is a feedback controller with an Integer Linear Programming optimizer that optimizes the thermostat setpoint population of the air conditioners in the control loop. It is showed that the developed controller can be used in achieving power reserve margins, emergency load reduction and cold load pickup mitigation in an islanded Microgrid using simulations.

*Keywords— Islanded Microgrid; Fast Demand Response; Direct Load Control; Distributed Air Conditioners; Inverter Air Conditioners; Thermostat Setpoint Control; Integer Linear Programming; Power Reserve Margins; Emergency Load Reduction; Cold Load Pickup;*

## **ACKNOWLEDGEMENT**

Foremost, I am deeply indebted to my supervisor Professor K.T.M.U Hemapala of the Department of Electrical Engineering, the University of Moratuwa for his constant guidance, encouragement, and support from the beginning to the end. It is my pleasure to acknowledge all the other academic staff members of the Department of Electrical Engineering of the University of Moratuwa for their valuable suggestions, comments, and assistance which were beneficial to achieve the project objectives.

I am grateful to the University of Moratuwa for the financial grants under the Senate Research Committee (SRC) Grant scheme and the Faculty of Graduate Studies for the given administrative support to conduct the research.

Moreover, I would like to extend my gratitude to my family for their encouragement, understanding, and patience throughout my academic pursuit. Finally, I am grateful to my colleagues and friends for showing interest in my work and giving constructive ideas towards the success of the research.

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## **LIST OF ABBREVIATIONS**

PV: Photovoltaic

AC: Air Conditioning

Fast DR: Fast Demand Response

IoT: Internet of Things

DLC: Direct load control

FSCAC: Fixed speed compressor AC units

VSCAC: Variable speed compressor Air Conditioner

Inverter AC: Inverter Air Conditioner

DG: Distributed Generator

DSM: Demand Side Management

IPS: Isolated Power Systems

DR: Demand Response

AS: Ancillary Services

ADR: Automated Demand Response

TCL: Thermostatically Controlled Load

ACP: Autonomous Control Protocol

ACCP: Advanced Communication and Control Protocol

ADS: Automatic Dispatch System

DRAS: Demand Response Automation Server

EMCS: Energy Management and Control Systems

CDMA: Code Division Multiple Access

HAN: Home Area Network

BAN: Building Area Network

EMS: Energy Management System

DRMS: Demand Response Management System

HEMS: Home Energy Management System

WAN: Wide Area Network

MPC: Model Predictive Control

B&B: Branch and Bound

ILP: Integer Linear Programming