An Intelligent Approach to Access Building Occupancy for Cooling Load Prediction

Kwok Sai Kwong

DEGREE OF ENGINEERING DOCTORATE
City University of Hong Kong
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CITY UNIVERSITY OF HONG KONG
香港城市大學

An Intelligent Approach to Access Building Occupancy for Cooling Load Prediction
藉樓宇使用率進行冷負荷預測的智能方法

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Kwok Sai Kwong
郭世剛

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Abstract

Building cooling load prediction is one of the key factors in the success of energy-saving measures. Many computational models available in the industry today have been developed from either forward or inverse modeling approaches. However, most of these models require extensive computer resources and involve lengthy computation. This thesis discusses the use of the multi-layer perceptron (MLP) model — an artificial neural network (ANN) model widely adopted in engineering applications that offers unique characteristics such as adaptability, nonlinearity, and arbitrary function mapping ability — to predict the cooling load of a building.

Although it is common knowledge that the presence and activity of building occupants have a significant impact on the required cooling load of buildings, practices currently adopted in modeling the presence and activity of people in buildings do not reflect the complexity of the impact occupants have on building cooling load. In contrast to previous ANN models, most of which employ a fixed schedule or historic load data to represent building occupancy in simulating building cooling load, this thesis introduces a stochastic model of occupants’ presence and activity and uses it as one of the input parameters to mimic building cooling load.

The training samples used include weather data obtained from the Hong Kong
Observatory and building-related data acquired from two existing grade A mega office buildings in Hong Kong with tenants including many multinational financial companies that require 24-hour air conditioning seven days a week. The dynamic changes that occur in the occupancy of these buildings therefore make it very difficult to forecast building cooling load by means of a fixed time schedule. The paper also discusses the practical difficulties and limitations encountered in obtaining building-related data, particularly those faced in acquiring dynamic data.

The performance of simulation results for the two mega office buildings examined demonstrate that building occupancy data play a critical role in building cooling load prediction and that their use significantly improves the predictive accuracy of cooling load models.

*Keywords: Artificial Neural Network, Cooling Load, Building Occupancy.*
Chapter 1 Introduction

1.1 The need to predict building load
1.2 Building energy audits & cooling load prediction
1.3 An intelligent approach to building load prediction
1.4 Why ANN models can be used for load prediction
1.5 Applications of building load prediction via ANN
1.6 The need for and difficulty of gaining access to building occupancy data for load prediction
1.7 Objectives and Scope
   1.7.1 Objectives
   1.7.2 Thesis Outline

Chapter 2 Load Forecasting Review

2.1 Overview
2.2 Type of Load Forecasting
2.2.1 Short Term Load Forecasting
2.2.2 Medium Term Load Forecasting
2.2.3 Long term Load forecasting

2.3 Energy modeling approaches

2.3.1 Introduction

2.3.2 Forward model methods
   i) Steady-state forward models
   ii) Dynamic forward models

2.3.3 Inverse model methods
   i) Steady-state inverse models
   ii) Dynamic inverse models

2.4 Intelligence Approaches for load forecasting

2.4.1 Artificial Neural Network (ANN)
2.4.2 Generic Algorithm
2.4.3 Fuzz logic
2.4.4 Expert systems

2.5 ANN for cooling load forecasting

Chapter 3 Load forecasting with Artificial Neural Networks

3.1 Overview

3.2 Model architecture

3.3 Input parameters
   3.3.1 Sources of building cooling load
i) External factors

a) Heat gain through exterior walls and roofs

b) Solar and conductive heat gain through fenestrations

c) Heat gain through partitions, ceilings & interior doors

d) Infiltration of outdoor air into the conditioned space

ii) Internal factors

a) People

b) Electric lights

c) Equipment and appliances

3.3.2 Critical components affect the use of building energy

3.4 Hidden and Output Layers

3.4.1 Numbers of neurons in hidden layer

i) Rule of thumb

ii) Sensitivity test

3.4.2 Output parameter

3.5 Network Training

3.5.1 Backpropagation

3.5.2 Early stop validation approach

3.6 Results validation

3.6.1 Performance measure

3.6.2 Training Schedule
Chapter 4  Modeling Building Occupancy……………………………………67

4.1 Overview

4.2 Occupancy interaction energy consumption

4.3 Modeling building occupancy

4.3.1 Standard profiles and diversity factors

4.3.2 Empirically-based models of people’s presence and actions

i) Background

ii) Light switching

iii) Blind operation

iv) Window opening

v) Light & blind

4.4 Current ANN load forecasting models accessing occupancy

4.4.1 Factors influencing the internal load

4.4.2 Current Approach to address internal loads

i) Time factors

ii) Historic factors

iii) Hybrid factors

4.4.3 Limitation on current approach to access building occupancy

Chapter 5  Intelligent Approach to Access Building Occupancy……………..86

5.1 Overview

5.2 Current approaches

5.3 Occupants’ presence and activity
5.3.1 Background

5.3.2 User interactions with environmental control systems

5.3.3 Stochastic processes of occupants’ presence and activity

5.4 Accessing building occupancy via stochastic process

5.4.1 Pollutions emission and dilution

5.4.2 Metabolic heat gain and removal

5.4.3 Comfort and demand

5.4.4 Enter, exit and inter-floor movement

5.5 Intelligence Approach to access building occupancy data

5.5.1 Total hourly PAU energy consumption

5.5.2 Total hourly AHU energy consumption

5.5.3 Total hourly tenant energy consumption

5.5.4 Total hourly lift & escalator energy consumption

5.6 Stochastic model of occupancy presence and activity inside an air conditioned office building

Chapter 6  Data Acquisition…………………………………………………………111

6.1 Load simulations on existing office buildings

6.2 Difficulties in building data acquisition

   6.2.1 Overview

   6.2.2 Difficulty to gain building data

      i) High initial investment

      ii) No well-rounded system design
iii) No appropriate system maintenance

6.2.3 Requirements for high quality results

i) The range and timing of internal and external loads

ii) The hourly variation in internal and external loads

iii) The response and performance of building equipment

6.3 Measuring of building occupancy data

6.3.1 Existing measuring instruments

i) Building data network

ii) Measuring equipment

6.3.2 Portable measuring instruments

Chapter 7 Application (I) – Apply dynamic operation area & occupancy rate

7.1 Overview

7.2 Description of simulated building “A“

7.3 Model architecture

7.3.1 Overview

7.3.2 Input parameters

7.4 Network training

7.5 Results validation

7.6 Results of Application (I)

7.5.2 Results
i) Sensitive test of no. of hidden neurons

ii) Performance test of simulation results

7.7 Discussions- The importance of building occupancy into building energy simulation

Chapter 8 Application (II) – Apply stochastic model for accessing building occupancy

8.1 Overview

8.2 Description of simulated building “B“

8.3 Model architecture

8.3.1 Input parameters

8.3.2 Hidden layer

8.3.3 Output layer

8.4 Network training and validation

8.4.1 Network training

8.4.2 Network validation

8.5 Results of Application (II)

8.5.1 Overview

8.5.2 Results for Simulation 1 (with external load factors only)

8.5.3 Results for Simulation 2, 3, 4 & 5 (with external load factors plus single occupancy factor)

8.5.4 Results for Simulation 6, 7 & 8 (with external load factors plus two occupancy factors)

8.5.5 Simulation 9 (with external load factors plus all four occupancy...
8.5.6 Performance measures

8.6 Discussions

8.6.1 Employing stochastic model to mimic occupancy for building cooling load simulations

8.6.2 Employing Lift & Escalator traffic rate addressing occupant’s activity

8.6.3 Mimicking occupant’s presence via Conditioned air supply rate

8.6.4 Using Tenant resource consumption rate for accessing occupant’s presence and behavior

Chapter 9 Application ( III )-Alternative ANN Approach for load prediction

9.1 Overview

9.2 Mechanism of ANN model

9.3 Model Training

9.4 Model prediction

9.5 Model Set-up

9.6 Model training

9.7 Results

9.8 The validation of alternative ANN algorithm approach

Chapter 10 Conclusions and Recommendations

10.1 Conclusions

10.1.1 ANN – an effective tool for energy forecasting in existing buildings
i) Sensitivity test for hidden nodes

ii) Training schedule to verify ANN model performance

10.1.2 An intelligence approach to access building occupancy

10.1.3 Challenges of building data acquisition

10.2 Recommendations for future works

10.2.1 Application of the models developed to other types of buildings

10.2.2 Further implement ANN model considering occupancy in practical engineering applications

References ..................................................................................................................................191

Appendix I – Nomenclature .................................................................214

Appendix II – A brief overview of ANN ................................................216

Appendix III – Computer setup .............................................................219

Appendix IV – Training Data of Building Simulation.......................220

   i) Application ( I & III )

   ii) Application ( II)