Prageeth Jayathissa
Assessment of Adaptive
Photovoltaic Envelopes

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ASSESSMENT OF ADAPTIVE PHOTOVOLTAIC ENVELOPES

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ASSESSMENT OF ADAPTIVE PHOTOVOLTAIC ENVELOPES

A dissertation submitted to attain the degree of DOCTOR OF SCIENCES of ETH ZURICH (Dr. sc. ETH Zurich)

presented by

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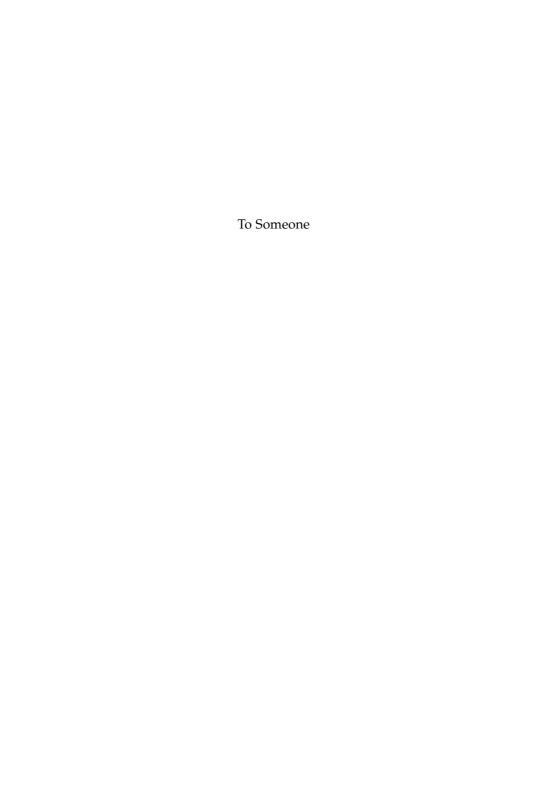
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ABSTRACT

English abstract here.

ZUSAMMENFASSUNG

Deutsche Zusammenfassung hier.

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I would like to thank ...

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NOTATION

FREQUENTLY USED SYMBOLS

E energy

m rest mass

p impulse

PHYSICAL CONSTANTS

c speed of light in vacuum, $c = 299792458 \,\mathrm{m\,s^{-1}}$

(CODATA 2014 [1])

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INTRODUCTION

- The potential of Adaptive Architecture
 - The CO₂ demand of the built environment
- Ways in which adaptive architecture, combined with BIPV can mitigate these losses
 - Previous Research
- Introduction to the ASF to be used as a case study throughout the paper

1.1 RESEARCH QUESTIONS

The four questions addressed in this research are

- How can complex architectural components, such as the ASF be designed and constructed?
- How can a photovoltaic envelope be controlled to be adaptive?
- What is the energy saving potential of an adaptive photovoltaic envelope?
- How does the energy saving potential vary for different building types?
- What is the life cycle CO₂ saving potential of an adaptive photovoltaic facade?

1.2 ORGANISATION OF THE THESIS

The remainder of this thesis is composed of three journal papers and one conference paper. Chapter 2 introduces the parametric design environment, which was created for rapid iterative development of the ASF. This chapter also introduces some of the design elements of the ASF. Chapter 3 introduces the model predictive control strategy to allows for adaptive control. This chapter first introduces the simulation methodology, and then discusses the energy saving potential of an ASF system. Chapter 4 takes

2 INTRODUCTION

on the model from Chapter 3 and runs an evaluation on eleven different building use types spanning six construction periods. Chapter 5 then takes the results of the energy simulation methodology and assesses the carbon life cycle cost. Finally Chapter 6 concludes the thesis.

PARAMETRIC DESIGN ENVIRONMENT FOR KINETIC PHOTOVOLTAIC ARCHITECTURE

OPTIMISING BUILDING NET ENERGY DEMAND WITH DYNAMIC BIPV SHADING

SENSITIVITY OF BUILDING PROPERTIES AND USE TYPES FOR THE APPLICATION OF ADAPTIVE PHOTOVOLTAIC SHADING SYSTEMS

LIFE CYCLE ASSESSMENT OF DYNAMIC BUILDING INTEGRATED PHOTOVOLTAICS

CONCLUSION

Summary here.



APPENDIX

Here be dragons.

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CURRICULUM VITAE

PERSONAL DATA

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PUBLICATIONS

Articles in peer-reviewed journals:

- . Jayathissa, P., Caranovic, S., Hofer, J., Nagy, Z. & Schlueter, A. Parametric Design Environment for Kinetic Photovoltaic Architecture. *In Production* (2017).
- . Jayathissa, P., Luzzatto, M., Schmidl, J., Hofer, J., Nagy, Z. & Schlueter, A. Optimising Building Net Energy Demand with Dynamic BIPV shading. *Applied Energy* (2017).
- . Jayathissa, P., Jansen, M., Heeren, N., Nagy, Z. & Schlueter, A. Life cycle assessment of dynamic building integrated photovoltaics. *Solar Energy Materials and Solar Cells* **156**, 75 (2016).

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- . Jayathissa, P., Nagy, Z., Offedu, N. & Schlueter, A. Numerical Simulation of Energy Performance and Construction of the Adaptive Solar Facade in. 2 (TU Graz, 2015), 52.
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