OPTICAL CONSIDERATIONS IN SOLAR CONCENTRATING SYSTEMS

by

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A thesis submitted to
The University of Sydney
for the degree of
Doctor of Philosophy

August 2, 2004

Abstract

To optimise the performance of concentrating solar power systems, a detailed knowledge of the resultant flux distribution in the imaging plane is required. To achieve this, an accurate model of the direct solar beam impinging on the concentrator is essential. This thesis presents an empirical model of the terrestrial solar distribution that has both a high-correlation to observed data and an invariance to a change in location. The model is based on the amount of circumsolar radiation in the direct beam and takes into account the small variations that are due to atmospheric scattering.

A modelling framework is developed to simulate the flux distribution in the imaging plane of a generic solar concentrating system. Algorithms are developed to include the following: the spatial solar energy distribution; the systemic effect of reflecting that distribution off a non-ideal mirrored surface; the spectral energy distribution; the transmission, absorption and reflection characteristics of optical thin films; and the coordinates of the solar vector.

The framework is then used to investigate the performance of anti-reflection coatings on silicon substrates and the performance of linear Fresnel systems. Combined, these algorithms and simulation tools can be applied to create comprehensive optical models of solar concentrating systems.

TO WILLIAM AND LUCY

Acknowledgments

Completing this doctoral work has been a wonderful and often overwhelming experience. It is hard to know whether it has been grappling with the physics itself which has been the real learning experience, or grappling with how to write a paper, give a coherent talk, work in a group, teach, code intelligibly, tolerate computers, stay up until the birds start singing, and... stay, um... focused.

I would like to specifically thank: both my supervisors Dr David Mills and Dr Christopher Dey for their confidence and direction; and Dr Steven Bosi and Dr Tony Monger for their wealth of knowledge. I am gratefully indebted to both Ben Simons and Chris Willing who have given so much of their time and expertise. Without all of these people I would never have been able to complete a PhD in computational physics; their willingness to always help however trivial my concern and competence in their respected fields, is a testament to both their ability and generosity.

The School of Physics contains many talented and dedicated people: Manfred, Tom, Jocelyn, Michael, Anne Gerd, David and Marcela, Nick, Nigel, Ian and of course Leanne. Their ability to handle stressful situations and incredibly stressed people is inspirational.

From my personal life there are so many people I would like to thank it does no justice to name them individually. Your encouragement, hospitality, distraction and your beer has been greatly appreciated.

Finally and especially I would like to thank both my mother and step father who have supported my decision to undertake this body of work and for their ongoing affection.

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