OPTICAL CONSIDERATIONS IN
SOLAR CONCENTRATING SYSTEMS

by

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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
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