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Nonimaging Fresnel Lenses

Design and Performance of Solar Concentrators

With 139 Figures and 44 Tables

Springer

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For Noriko, Nanami, and Moeka

For Ariya

Preface

Nonimaging Fresnel Lenses: Design and Performance of Solar Concentrators; what are we talking about?

It is easy to forget that you, dear reader, may not be one of those who work in *exactly* the same field as we do: nonimaging optics for the concentration of sunlight.

You may be a researcher in some optical science interested in the core subject of this book: the world's first practical design of a nonimaging Fresnel lens concentrator. You may not be too excited about the collection of solar energy, but you would want a full description of the optical performance of the lens. Which you will get, mostly in terms of nonimaging optics, complete with test results, and set against the competition of imaging Fresnel lenses and mirror-based imaging and nonimaging concentrators.

If you are a solar energy professional, you are likely to be interested in reading why nonimaging optics and solar energy collection go together so well. They do so, because the concentration of solar energy does not demand imaging qualities, but instead requires flexible designs of highly uniform flux concentrators coping with solar disk size, solar spectrum, and tracking errors. Nonimaging optics has been developed to perfection since its discovery in 1965, in dealing with solar power conversion. Much of this experience is useful in nonimaging optical design in other fields where the markets already are more rewarding than in solar power generation, such as optoelectronics.

Depending on your speciality, you will find some sections to exactly fit your needs. You will probably wish we had done more on the topic. If, for example, you were to design a test bed for a photovoltaic multijunction device under concentration, you possibly bought this book for the contents of Chap. 9. In a less specialized way, if you always wanted to know how to design imaging Fresnel lenses, this information is assembled here, too.

This book is a research monograph. No matter how hard we tried to make it comprehensive, it would always be a personal account of work related to our own research. We did not attempt to write a solar energy handbook nor a textbook on nonimaging optics, not because that would be repetitive or redundant (not really!), but because our approach is the exploitation of a merger of two most exciting topics.

Our book tries to stay focused on the nonimaging lens; but we enjoy excursions even if they are supplementary to the pure goal of understanding the nonimaging Fresnel lens. Of course, the subtitle *Design and Performance of Solar Concentrators* sets the stage and determines the proper ingredients of the story of the nonimaging lens.

We would like to empower you to fully understand the nonimaging lens and the principles of solar concentration, not just by quoting references or undisclosed methodology, but by consciously following up the properties of the device. We aim to communicate the foundations of nonimaging optics and the framework of concentrators. Our ultimate pleasure would be to hear from you that this book excited your spirits and enabled you to design your own nonimaging system – preferably a solar concentrator, naturally.

We would like to acknowledge the following friends and colleagues, whose inspirations, comments, or support this work depended upon: Atsushi Akisawa, Kenji Araki, Jeff Gordon, Serge Habraken, Tamotsu Hiramatsu, Bipin Indurkhya, Takao Kashiwagi, Ken-ichiro Komai, Yanqiu Li, David Mills, Yohei Mizuta, Juan Carlos Miñano, Isao Oshida, Jose Giner Planas, Ari Rabl, Susana Sainz-Trapaga, Roland Winston, and many others.

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