Preface

I have written this book to fill a void between theory and practice, a void that I perceived while conducting my own research and development of components and instruments over the last five years. In the chapters that follow I have pulled materials from the technical and patent literature that are relevant to the understanding and practice of polarization optics in telecommunications, material that is often known by the respective experts in industry and academia but is rarely if ever found in one place. By bringing this material into one monograph, and by applying a single formalism throughout, I hope to create a "base level" upon which future research and development can grow.

Polarization optics in telecommunications is an ever-evolving field. Each year significant advancements are made, punctuated by important discoveries. The references upon which this book is based are only a snap-shot in time. Areas that remain unresolved at the time of publication may very well be clarified in the years to come. Moreover, the focus of the field changes in time: for instance, there have been few passive nonreciprocal component advancements reported in the last few years, but PMD and PDL advancement continues with only modest abatement.

The framework used throughout the monograph is the spin-vector calculus of polarization. The spin-vector calculus as applied to telecommunications optics has long been advocated by N. Frigo, N. Gisin, and J. Gordon. The calculus has its origins in the quantum mechanical description of electron spin and in classical dynamics of rotating bodies. While this calculus may be unfamiliar to the reader, the advantage is its inherent geometric nature and its compact form. Spin-vector calculus abstracts the matrix algebra generally used to describe polarization into a purely vector form. Compound operations are evaluated on the vector field before being resolved onto a local coordinate system. Without exception I have found every derivation in this book shorter, more intuitive, and sometimes surprisingly revealing when using spin-vector calculus. Chapter 2 is entirely dedicated to this formalism. I assure the reader that the time invested learning this material will be rewarding.

The monograph is divided into three logical sections: theory, components, and fiber polarization. The three sections can be treated with some independence. Chapters 1–3 present the basic theory of Maxwell's equations, polarization, and the classical interaction of light with dielectric media. Next, Chapters 4–7 detail passive optical components, their design, and the building blocks upon which they are based. Special to this section is Chapter 4, which attempts to bridge theory and practice by tabulating known properties of the most commonly used materials and offering practical explanation of simple optical combinations. Lastly, Chapters 8–10 present aspects of polarization-mode dispersion and polarization-dependent loss.

Even though this monograph is entitled, "Polarization Optics in Telecommunications," the reader should be cognizant of subjects that are missing. Notably absent are, for example, electro-optic effects, used in polarization controllers; liquid-crystal elements, used for switching and attenuation; and interleaver filters, used in wavelength-division multiplexing. These omissions are a measure of my limited experience rather than the fertility of the fields.

I have been fortunate to have a number of experts read various chapters of this book. Their help and dedication have clarified a variety of points and helped prevent mistakes. I am indebted to Dr. C. R. Doerr, Distinguished Member Technical Staff, Bell Laboratories, Lucent Technologies; Dr. N. J. Frigo, Division Manager, AT&T Laboratories; Dr. J. P. Mattia, Co-Founder, Big Bear Networks; Prof. T. E. Murphy, Assistant Professor, University of Maryland, College Park; Dr. K. R. Rochford, Division Chief, Optoelectronics, National Institute of Standards and Technology; Dr. M. Shirasaki, Co-Founder and Chief Scientist, Arasor; and Dr. P. Westbrook, Technical Manager, Photonics Device Research, OFS Labs. Complementing my Readers, Dr. P. A. Williams of the National Institute of Standards and Technology has carefully answered my questions throughout the entire writing of this book – I am pleased to acknowledge his great support.

I have also contacted many other experts when I needed clarification on particular topics. I would like to thank Mr. M. Alexandrovich, Prof. H. Ammari, Dr. N. Bergano, Mr. A. Boschi, Dr. S. Evangelides, Prof. A. Eyal, Dr. V. Fratello, Prof. D. Hagen, Dr. D. Harris, Dr. G. Harvey, Prof. E. Ippen, Dr. P. Leo, Dr. J. Livas, Dr. C. Madsen, Prof. A. Meccozi, Prof. C. Menyuk, Mr. P. Myers, Dr. J. Nagel, Dr. K. Nordsieck, Dr. B. Nyman, Dr. C. Poole, Dr. G. Shtengel, Mr. G. Simer, and Dr. P. Xie.

While I am indebted to these contributors, all mistakes are my responsibility alone. You can contact me at `damask@polarization-optics.com` and I look forward to receiving your feedback.

I wish to thank The MathWorks Company, and especially C. Esposito, for generous support through the MathWork's Authors' program. Many of the code pieces I used to generate the figures will be available courtesy of the MathWorks at `www.mathworks.com`.

The people at Springer, New York, have generously given their time and encouragement over the last eighteen months. In particular, I am indebted to

my editor Dr. H. Koelsch, and to F. Ganz and M. Mitchell. Their professionalism and expertise has made this project a pleasure for me.

I wish also to thank the library services at the Massachusetts Institute of Technology. The M.I.T. technical library is a national resource and is second to none. The professional staff and on-line databases have helped me find original references of all sorts.

I wish to remember M.I.T. Institute Professor Hermann A. Haus, who, over a decade, supported my pursuit into the beauties of optics.

Finally, I am indebted to my family, especially Mary and John, and to my friends, who encouraged me throughout this project. Special acknowledgement goes to my wife D. C.-T., without whose unwavering support this book would not have been written.

New York City *Jay N. Damask*
July 2004

http://www.springer.com/978-0-387-22493-0

Polarization Optics in Telecommunications
Damask, J.N.
2005, XVI, 522 p. 202 illus., Hardcover
ISBN: 978-0-387-22493-0