

# Encyclopedia of optical engineering

edited by Ronald G. Driggers.

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# Preface

Optical engineers have made contributions to society to make our lives easier, safer, and more interesting. Many great technological advances in the twentieth century arose because of optical engineering.

- In 1927 Philo T. Farnsworth transmitted the first electronic television picture and Bell Telephone demonstrated the first wireless television transmission between Washington, D.C., and New York. In 1960, it is widely believed that John F. Kennedy won the U.S. presidential election based primarily on his televised performance in the Nixon–Kennedy debates. Today, there are over 1 billion television sets in operation worldwide.
- In the early 1950s, Charles Townes and Arthur Schawlow demonstrated the maser and subsequently described the possibility of the laser. In 1960, Theodore Maiman demonstrated the first laser. Today, lasers are used in surgery, welding, communications, and weapon systems. Diode lasers alone provided for a \$1.2 billion market in the year 2000.
- In the 1960s, the area of fiber optics emerged with the development of glass-clad fibers for guiding light. Today a fiber can carry 200 television channels or more than 200,000 telephone channels.
- In 1990, the Hubble Space Telescope (HST) was launched allowing researchers to investigate far-off galaxies with images previously unobtainable. To date, the HST has taken more than 330,000 separate observations and allows fundamental research on universe expansion.
- In the past few decades, optical systems for precision targeting, intelligence, surveillance, reconnaissance, and night vision have provided huge advantages on the battlefield. Infrared and electro-optical systems have been key instruments in the success of wartime operations such as Desert Storm and Enduring Freedom. Today, these systems are used to protect countries and project military power.

Classical engineering disciplines include electrical, mechanical, civil, and some areas of chemical engineering. Computer engineering, although not "classical," all but exploded in the last quarter century and is now a well-established discipline. I consider an engineering discipline to be an area in which an individual can spend a lifetime of work; it is supported by academia, industry, government, and professional societies. Optical engineering is an engineering discipline but has yet to have individual academic departments devoted to it. It may be that the physics community holds dearly the interaction of light and matter, and, as a result, provides supporting academic programs in the fields of optical sciences and photonics. The graduates of these programs frequently find themselves working in optical engineering.

Before I continue, let me explain why I consider myself an optical engineer. While my formal training is that of an electrical engineer, I have not seen a wire or a transistor for at least 10 years. Both my undergraduate and graduate programs had a number of courses in electro-optics. Many electrical engineering programs around the country have courses in electro-optics, and a couple of schools have created a specialization or concentration in electro-optics. Graduate courses in electro-optics (and laser systems) are usually attended by both electrical

engineering students and physics students. However, the physics programs that include these courses are typically called optical sciences or photonics programs. Before it sounds as though I am biased, let me state that both engineers and physicists make excellent optical engineers.

*Optical engineering* is concerned with the engineering of a device or system in which light is involved, while *Photonics* is concerned primarily with the basic interaction of light and matter. But there is a large overlap between the two. Episodes from television's classic "Star Trek" series show that Scotty the engineer could not get the ship's systems running until Mr. Spock provided some basic science that converted a fundamental problem to a practical solution. Such is the case with optical engineering and photonics.

The purpose of this encyclopedia is to provide an optical engineering reference that can be used by engineers, physicists, and other scientists. The target length for each entry was set at around 6000 words, but many of the entries exceed this length. Authors were asked to review fundamentals of each topic. No derivations were requested. Around 50 areas were identified as important for the first issue and Topical Editors were recruited to solicit and edit articles related to these areas, ranging from adaptive optics to x-ray optics.

This encyclopedia provides dual products: digital encyclopedia via the Internet and a print encyclopedia. The online version is a living document that grows with quarterly updates, and timely content is continually added to make the work dynamic. Suggestions for new content will be welcomed; they should be directed to me at the e-mail address listed below. The printed version will be updated through new editors.

I want to thank three groups of people for my participation in this worthy project. First are the people who had a hand in making me an optical engineer: Carl Halford, Glenn Boreman, the late John Nestler, Luc Biberman, Eddie Burroughs, Ray Deep, Gerry Holst, Rich Vollmerhausen, Tim Edwards, Jim Ratches, Dean Scribner, and Jon Leachtenauer. These people have my admiration, respect, and loyalty. They are truly the cream of the crop in the area of optical engineering, and I am very grateful for the opportunities that I have had to learn from them.

Second, I would like to thank the people who worked hard to initiate the project and make the encyclopedia a success. Thanks goes to Marcel Dekker, Inc., for getting the project off the ground. I appreciate the confidence of Glenn Boreman, Barry Johnson, and Russell Dekker in my ability to accomplish this mammoth project. This encyclopedia would not have been possible without their efforts. Although I did not share my appreciation with her enough, Ellen Lichtenstein (Encyclopedia Editor) was helpful and caring throughout the project. The work of Alison Cohen was also appreciated more than she knows. The work of all the Topical Editors and authors is very much appreciated. Our Topical Editors have been superb mentors in identifying encyclopedia content; their participation improved the resulting product significantly. Many of the entries are amazing in that they provide the fundamental concepts, give technical applications, and are a joy to read.

Third and most important, I would like to thank my family for the time and support to accomplish this project. My beautiful and inspirational wife, Rita, a famous OB/GYN doctor at Johns Hopkins, supports everything that I pursue. My eldest son, Ryan, and the Drigglets (Megan, Madison, and Buddy) gave me a chaos-management experience that served me well in managing encyclopedia tasks. Their lives are far more interesting than my own and I have been blessed to be a part of them. My closest brother, Keith Krapels, is not of blood, but of the experience of sharing a majority of our lives together. It is because of these people that I do not mind growing older since the process means spending time with them.

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