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Axel Donges · Reinhard Noll

Laser Measurement Technology

Fundamentals and Applications

Springer

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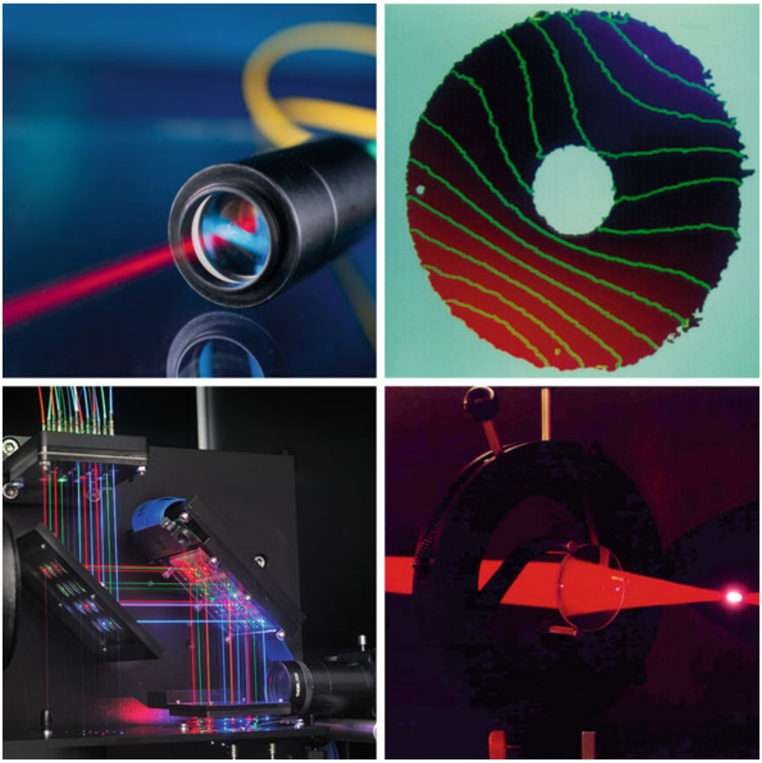

Top left measuring head of a sensor based on optical coherence tomography. *Top right* speckle interferogram showing the out-of-plane deformation field of a measuring object. *Bottom left* multi-wavelength excitation of fluoresceing particles in a microfluidic chip. *Bottom right* focusing of a nanosecond laser pulse inducing a plasma in the atmosphere at irradiances $> 10^7$ W/cm^2

Preface

In the past decade, a rapid development of laser measurement technology took place. Powerful laser measuring methods are available for a variety of measuring and inspection tasks. Their applicability and benefit were demonstrated successfully for offline and inline measurements of physical and chemical quantities. The underlying dominant characteristics of laser measuring methods are simply the fact, that lasers measure without contact and with the velocity of light.

A clear trend originating in the early 1990s of the passed century becomes more and more obvious. The measuring equipment is no longer a delicate instrumentation to be operated in laboratory or measuring rooms only, but it is transferred into production facilities being installed close or even inside a production line. By this, laser measuring methods enable inline acquisition of measurands allowing for a fast insight into the process or product and thus represent the key component for closed loop concepts where the measuring information gained directly in the production line is used for prompt feedback actions to upstream or downstream process stages. In this sense, laser measurement technology creates a novel era of process transparency opening new potentials for process optimization and quality control in industry. This far-reaching potential was not accessible so far.

Scientists and engineers in research, development, and production should therefore study laser measurement technology to understand the physical principles, the set-up of laser measurement equipment and to get an overview of its application potentials.

In this book, the fundamentals of laser measurement technology are described in Chaps. 1–5, laser measuring methods and their applications are subject of Chaps. 6–14. Target audience are physicists and engineers in the job as well as students of applied physics and engineering sciences at universities. The fundamentals, methods, and applications are described to such an extent that the reader is able to track and assess future developments of laser measurement technology. The required previous knowledge is limited to the fundamentals of physics as those teached in the first semesters at universities.

The authors came in touch with laser technology in the early 1980s of the last century as doctoral candidates at the Institute for Applied Physics at the Technische Hochschule Darmstadt. Fascinated by the potentials of laser radiation they took different professional careers. A.D. moved to the educational sector and became a Professor and now dean for physics and optics at the nta Hochschule

Isny. R.N. started at the newly founded Fraunhofer Institute for Laser Technology (ILT) in Aachen and is now head of the competence area laser measurement technology and EUV sources. He has transferred various laser measurement techniques to industrial use and stimulated the foundation of new companies to develop and market new laser measurement devices. Since 2012 he is an Assistant Professor at the RWTH Aachen university. For this book, the authors bring in their comprehensive experience in teaching, research, development, and application in the field of laser measurement technology.

The authors want to express their special thanks to their wives for their patience and encouragement to enable this book project.

Isny, Aachen

Axel Donges
Reinhard Noll

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