Distance and Displacement Measurements by Laser Technique

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This special section is devoted to recent advances in distance measurement techniques. Following the Optical Distance Measurements and Applications (ODIMAP) Workshops we organized in Nantes, France, in 1997, and in Pavia, Italy, in 1999, attended by more than 120 delegates from all over the world, we believe that distance measurement is still a very fertile ground for new ideas and engineering approaches, with a solid history of achievements behind it and a bright perspective of new achievements ahead.

Indeed, the story of distance measurement and interferometric techniques is studded with big discoveries and surprising results. We may trace the first ones back to the Michelson interferometer ruling out the ether hypothesis, closely followed by the Sagnac and Fizeau interferometers supplying key results to check relativity.

After the invention of the laser, the laser interferometer has become the workhorse of tool-machine and mechanical metrology, while its two-beam counterpart, the laser-Doppler velocimeter as it is called, has filled the need for noncontact, precision anemometry. These two instruments have sold in the thousands of units per year for at least 30 years—a big success and a record in electro-optics instrumentation.

Almost contemporary, the measurement of angular velocity through a Sagnac interferometer has generated the ring-laser gyro (RLG) and the fiber-optic gyroscope (FOG)—the heart of the inertial navigation unit (INU) of any modern airliner.

Also, since lasers became available, the pulsed and sine-wave telemeters have flourished and provided an invaluable tool both in aerospace and civil topography. Readers may remember the first big science experiment LURE (Lunar Ranging Experiment) in 1969, when Apollo 11 astronauts brought several corner cubes onto the moon, and five large telescopes aimed a 1-J *Q*-switch pulse ruby laser on them, measuring the earth–moon distance with a 30-cm resolution. Nowadays, telemetry of satellites is a basic tool in geodesy of the earth, and last year the Mars Orbiting Laser Altimeter (MOLE) returned an amazing map of the red planet with 100-$\times$100-m pixel resolution.

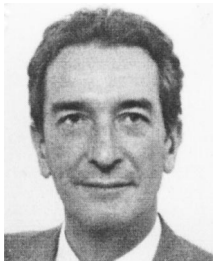
Meanwhile, work is in progress to complete multikilometer arm, 10^{-18}-m resolution interferometers intended to sense gravitational waves, with a capability of detecting gravitational collapse of stars megaparsec away.

These developments, and their fallout in industrial applications, are very promising of an exciting prospect for interferometry, range finding, and distance measurement techniques.

In this special section we have collected original papers on the different aspects of this field, and we hope this will provide a useful picture of the current state of the art as well as a stimulus for further advances.

Thierry Bosch received the PhD degree in electronics engineering from the National Institute of Applied Science of Toulouse, France, in 1992. In 1993, he joined as an assistant professor the School of Mines of Nantes, where he was in charge of the Instrumentation and Sensors Group. He is now professor at the Electronics Laboratory of the National Polytechnic Institute of Toulouse—ENSEEIHT. His research interests are related to laser industrial instrumentation development including interferometry, phase-shift and self-mixing-based range finding techniques, vibration and velocity measurements. He has cooperated in several programs of R&D with European companies active in the areas of sensor design, metrology, transportation or avionics. He has organized several national and international meetings either as a chairman or a Steering/Program Committee member. He has been guest co-editor for *Journal of Optics* (June 1998) on Inteferometry and chaired the International Conference ODIMAP in 1997. With Prof. Marc Lescure, he has edited the Milestone volume entitled *Selected Papers on Laser Distance Measure-*

ments published by SPIE in 1995. He is now the chairman of the IEEE Instrumentation & Measurement Technical Committee on Laser & Optical Systems and serves as an associate editor of the *IEEE Transactions on Instrumentation & Measurement*.



Silvano Donati has been a full professor of optoelectronics at University of Pavia, Department of Electronics, since 1980. Upon earning a degree in physics with honors from the University of Milano, he did research on photodetectors and laser instrumentation at CISE, Milano, from 1966 to 1975. In 1975 he joined the University of Pavia first as a full-time lecturer, with courses in electronics circuits, electronic materials and technologies, and electro-optic systems, before becoming a full professor of optoelectronics in 1980. Since then he has led the Optoelectronics Group. He has conducted research in electronics (noise in CCD, coupled oscillators), electro-optical instrumentation (laser interferometry, fiber gyros, fiber optics, current sensors), and more recently all-fiber components for communications (couplers, isolators, polarization components) and optoelectronic interconnections. He has cooperated in several programs of R&D with national companies active in the areas of communications, instrumentation, and avionics. He also made a successful spin-off on fiber couplers with an Italian company. Dr. Donati has authored or coauthored about 180 papers and holds ten patents. He is a member of SPIE, IEEE, AEI, APS, OSA, ISHM, and has served to organize several national and international meetings and schools in the steering and program committees, and as chairman of Fotonica (1997) and Elettroottica (1994). From 1986 to 1992, he was the director of the Italian Scientific Review in electronics, *Alta Frequenza—Rivista di Elettronica* of AEI (Italian Electronics Association), of which he has been a member emeritus since 1997. He and his group have been awarded six prizes (five from AEI and one from Phillip Morris). He was the chairman of the Optoelectronics Society of AEI from 1992 to 1996. In 1997 he founded and is presently the chair of the IEEE-LEOS Italian Chapter. He started the WFOPC (Fiber Optics Passive Components) International Conference in 1998 as the chairman, and chaired ODIMAP II, 1999, the 2nd International Conference on optical distance measurement techniques. Has been a guest editor for the *Journal of Optics* (June 1998) and of the *Journal of Selected Topics in Quantum Electronics* (September 1999). He is the author of *Photodetectors* (Prentice Hall, 2000).