

# Silvano Donati

*Emeritus Professor  
IEEE Life Fellow, OSA Emeritus Fellow*



[Optoelectronics Section](#)  
[Faculty of Engineering](#)  
[University of Pavia](#)

President, [IEEE Italy Section](#) (2007-09)  
OSA Int'l Advisory Committee (2006-09)  
IEEE LEOS Board of Governors (2002-07)  
Chairman, [LEOS](#) Italian Chapter ('96-'01)  
Counselor, [IEEE](#) Student Branch

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documents please go to website

<http://www-3.unipv.it/donati>

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# ***RESUME'***

(click on [blue](#) titles or go to website for more details)

*Education:* Graduation (Laurea) in Physics, cum laude, University of Milano, 1966

*Spot on Scientific Production:*

Over [300](#) scientific publications

[Two books](#) by Prentice Hall, one w/ Chinese, India and e-book editions, one [book](#) in Italian, several [book chapters](#)

Editor and/or Chairman of 13 [Conference Proceedings](#)

Guest Editor of 8 [Special Issues](#) in International Journals

[H factor](#) 31, 4950 total citations and 3000 citations on seminal papers (selfmix and chaos)

*Spot on Service to the Scientific Community:*

President, IEEE Italy Section (2007-09)

Counselor, OSA Int'l Advisory Committee (2006-09)

Vice President, IEEE Italy Section (2005-07)

IEEE LEOS [Board of Governors](#) Elected Member (2005-2007)

[Vice President](#), IEEE LEOS Membership, Region 8 (2002-04)

[Editor](#), *Alta Frequenza-Rivista di Elettronica*, 1986-92

[Chairman and Founder](#), Italian IEEE LEOS (now PhoS) Chapter

Chairman, AEI Optoelectronics Society (1992-1996)

Member of IEC-CEI Standard Committee TC-76 and TC-86 (1988-1996)

A number of [services to the IEEE](#): Institute, Society, Region and Section

*Awards and Acknowledgements:*

- [Aaron Kressel Award](#), IEEE Photonics Society, 2015
- Distinguished Service Award, IEEE Photonics Society, 2011
- [Distinguished Lecturer Award](#), IEEE LEOS/Photonics Society, [2006/07 and 2007/08](#)
- Elevation to [Life Fellow](#) Member, [IEEE](#), 2010
- Elevation to [Fellow](#) Member, [IEEE](#), 2003
- Elevation to [Fellow](#) Member, Optical Society of America, 2003
- [seven Awards](#) from LEOS Society and IEEE Region 8 awarded for the activity of the LEOS Italian Chapter - Guglielmo [Marconi Prize](#), awarded by AEI 1999, in recognition of prominent scientific career
- Elevation to Senior Member, IEEE 1999.
- Elevation to [Socio Benemerito](#) (Meritorious Member), AEI 1998.
- [ElectroOptics Prize](#), awarded from the Optoelectronics Society of AEI, 1996, for the best research work in Optoelectronics.
- Ottavio Bonazzi Prize, awarded by AEI, in [1974](#) and in [1996](#), for the best experimental research in Electronics.
- Philip Morris Prize, awarded by Philip Morris 1995, for the prominent research work in electrical Engineering.
- [Telecommunication Gold Medal](#), awarded by Siemens Telecomunicazioni Italia, in 1991 and in 1993, for research in Communications.

- [Milano AEI Prize](#), awarded by Sezione di Milano of AEI, 1990, for the best research work in Electronics.
- A paper [29d] included in the SPIE Milestone in Optics Series; two papers excerpted in textbooks, Desurvire "Erbium Doped Optical Amplifiers" [48d] and Agrawal "Nonlinear Fiber Optics" [57d].

*Courses Taught:*

at University of Pavia, Faculty of Engineering:

[Optical Communications](#) (1994-2001),

ElectroOptical Systems (1975-80), first course on *Photonics* given in Italian University

[Optoelectronic Instrumentation](#) (1980 to present),

[Photodetectors](#) (1980 to present),

[Electronic Materials and Technologies](#) (1977-91),

[Electronic Circuits Design](#) (1971-1977)

at [National Taiwan University](#): [Optoelectronic Instrumentation](#) (2005)

at [Sun Yat Sen University, Kahosiung](#): [Optoelectronic Instrumentation](#) (2007 and [2008](#))

at [Cheng-Kung Nat. University, Tainan](#): [Optoelectronic Instrumentation](#) (2010)

at [Chung-Hsing Nat. University, Taivhung](#): Optoelectronic Devices (2012 and 2013),

and [Optoelectronic Instrumentation](#) (2013 and 2014)

at [Universidad Catolica del Peru](#): [Optoelectronic Instrumentation](#) (May [2007](#))

at [ISTIM, School of Engineering, Milano](#): Electronics (4 years)

*Mentoring:*

120+ Thesis of Master in Electronic Engineering supervised

21 Thesis of PhD in Electronic Engineering supervised

*Promoting the growth:*

*the Optoelectronics Group in Pavia:*

founded 1975, started with a single Researcher and a Master graduate –

today it features 4 Professors (2 Chair, 2 Associate) 1 staff Technician, and

additionally 5-7 post-Docs, 5-7 PhD student, 2-4 graduates (Group photo

[1995](#), [1998](#), [2001](#), [2005](#))

*Research Contracts:*

- several annual contracts awarded by CNR and MPI (years 1980-2004) totalling 1250 k€

- European contract Brite-Euram Selfmix (1997-1999) for development of SELMIX (190k€)

- European contract FET Occult on chaos cryptography, 2004-07 (240 k€)

- European contract FET Picasso on cryptography chip, 2008-2011 (320 k€)

- European contract FET IOLOS on ring laser bistable, 2007-2010 (185k€)

- European contract FET MEGAFRAME on SPAD array, 2009-2012 (225k€)

*Various:*

- served as a Panelist of the COBRA (Research Consortium) evaluation Board, Eindhoven (The Netherlands) 2006

- served as a Referee on RAE (Research Assessment Exercise) of University of Oulu (Finland), 2013

- served as a judge on Associate Professor Promotion, University of Tampere, (Finland), 2013 and 2014

- served as a IEEE Fellow Judge (2011-13)

- served as a Nominator to successful IEEE Fellow (5) and OSA Fellow (4)

**The Optoelectronics Group, at University of Pavia, 2001**



**Silvano Donati**  
Head (full professor)

**Valerio Annovazzi Lodi**  
(full professor)

**Sabina Merlo**  
(associate professor)

**Guido Giuliani**  
(staff researcher)



**Michele Norgia**  
(post-Doc res.)

**Gianmarco Rossi**  
(PhD graduate)

**Davide D'Alessandro**  
(PhD graduate)

**Marco Passerini**  
(PhD student)

**Andrea Fanzio**  
(staff technician)

*the Pavia Optoelectronics Group, 2005/6*



**Silvano Donati**  
Head, full professor

**Valerio Annovazzi Lodi**  
(full professor)

**Sabina Merlo**  
(associate professor)

**Guido Giuliani**  
(staff researcher)

**Michele Norgia**  
(Post-Doc researcher)



**Marco Passerini**  
(Post-Doc researcher)

**Davide d'Alessandro**  
(PhD graduate)

**Riccardo Miglierina**  
(PhD student)

**Yuanguang Yu**  
(visiting researcher)

**Andrea Fanzio**  
(technician)



# The Pavia's Optoelectronics Group, 2012-13

## Staff Components



Valerio Annovazzi Lodi  
Full Professor, Head



Silvano Donati  
Full Professor



Sabina Merlo  
Associate Professor



Guido Giuliani  
Associate Professor



Giuseppe Martini  
Assistant Professor



Mauro Benedetti  
post Doc



Enrico Randone  
post Doc



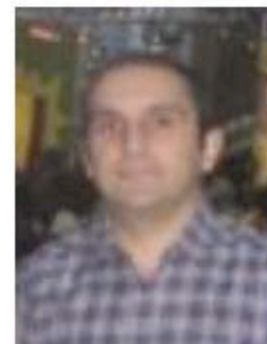
Giuseppe Aromataris  
post Doc



Andrea Fanzio  
technician



Valeria Vercesi  
PhD student



Mohamad Taghi Fathi  
PhD student

## Other components and Students:

Maria J. Latorre Vidal (PhD student), Marco Zanola (PhD student),  
Marco Soldo (PhD student), Gloria Silva (PhD student), Francesca  
Carpignano (PhD student)

## *Main Scientific Achievements - Silvano Donati*

### **Invention of the Self-Mixing Interferometry**

Professor Donati first devised the scheme of self-mixing interferometry in 1977 (paper [17d]) with the demonstration of the fringe-counting interferometer based on a He-Ne laser source. A seminal paper [37d] followed in 1995 with the adaptation of the self-mixing scheme to the laser diode. To do that, he devised a new scheme capable of circumventing the sign (or direction) ambiguity of the interferometer, using just a single (amplitude) channel. Paper [37d] reporting theory and experiment has become in the years a must reading for all those starting in the field and has collected 360+ citations. Other 4-5 papers refining the subject followed in years 1997-2000 [47d, 60d, 63d, 66d], collecting additional 950 citations.

Nowadays, self-mixing scheme is recognized as a viable scientific tool in a variety of applications, ranging from detection of remote echoes [2a] to measurement of displacement, velocity, vibrations, and several physical quantities (return loss, optical insulation, coupling factor, attenuation, line-width, alpha factor, etc.). About applications to consumer goods, Philips (NL) has used a self-mixing device as the scroll-down sensor of cellular phones and playstations. Our Lab at University of Pavia has developed and sold several preproduction units of: a *Selmix Vibrometer* and a *Displacement Interferometer* operating on a normal diffusing surface by means of BST (Bright Speckle Tracking) technique [63d], that is, without the need of a corner cube retroreflector. The works of prof. Donati on self-mixing have been referenced by over 2500 papers.

### **Invention of Optical CSK (chaotic-shift-keying)**

Another application of coupled oscillators actively pursued by Professor Donati has been the optical chaos generated by mutual and cross coupling. He started with the study of weak-coupling modulation [22d] and then extended the theory to the treatment of strong mutual coupling and self-coupling [36d]. The first discovery [36d] was that a state of final synchronization follows the chaos regime, the second and most important was the conception of CSK (chaotic-shift-keying) scheme first proposed in 1997 [49d] and nowadays widely used in chaotic-coded communication systems. Last, paper [55d] provided new insight on the regimes of injection and locking, another work widely referenced. In total, the seminal papers on the chaotic regime and applications have totalled 900+ citations.

Two EC FET programs (Occul, Picasso) have been triggered by this research, pooling seven partners from I, F, D, E, UK, GR. The cooperation resulted recently in a Letter to “Nature“ reporting the first experimental results.

Worth to mention, “Coupling Phenomena and applications to Selfmix and Chaos” has been the subject of a Distinguished Lecturer award by the IEEE LEOS Society to prof. Donati, for the year 2007/08 and 2008/09, when he visited 22 LEOS Chapters around the globe.

### **New Theory of Optical Amplifier Noise**

This theory shines new light on the origin of noise in optical amplifiers. A totally new approach was introduced in [48d], demonstrating that the noise at the output of any optical amplifier is just the *amplified vacuum fluctuation*, originating from the pumping input port (left open to the vacuum). The new model has been used to predict cascaded noise of optically regenerated fiber trunks [57d].

The main theory, including analytical development and figures are reprinted in Agrawal’s book “Applications of Nonlinear Fiber Optics”, and excerpted in detail by Desurvire’s book “Optical Amplifiers – 2nd edition”

### **Major Contributions to ElectroOptical Instrumentation**

These contributions range widely, from telemeters [10d, 11e] and LLLTV and vision through turbid media [4d, 5d, 12d, 13d] to optical gyroscopes [32e, 50d, 56d, 67d, 2c] to magneto-optical sensors [26d, 27d, 35d, 14e, 36e], as well as conventional and self-mixing interferometers, also in presence of speckle pattern [20d]. They are summarized by the book “*Electro Optical Instrumentation*”, published by Prentice Hall in 2004 and later translated in Chinese by Shanghai University Press (2006), made of an India edition (2006) and also available as e-book (2008).

### **Major Contributions to Photodetector Noise Theory**

The main achievements are: the theory of photomultiplier gain and noise, established in 1970 [1-3d, 1c] and still today unsurpassed, the theory of the avalanche photodiode [3d], the analysis and experiments about the measurements of correlation [9d] and of squeezed-state radiation [33d, 20b]. Most recently, the new model of

the noise in photodetection [2a] has been developed, which is accurate at the level of the second quantization of the electromagnetic field. All the original results have been incorporated in the book "*Photodetectors*", published with Prentice Hall in 1999.

### **Major Contributions to All-Fiber Components and Sensors**

In this field, the Author has given innovative contributions to: magneto-optical components (isolators and circulators) [25d, 13b, 41d, 39d] piezo-actuators on silica [54d], fiber-tip components [51d, 42d] and last but not least, fiberoptic couplers [36d, 31d, 73e].

The exceptionally good performances achieved with fused couplers (notably a 0.01 dB loss versus the 0.5 commonly offered by vendors as the best) has prompted a spin-off pursued by a young graduate of our University, who was able to set-up a 24-people spin-off Company (TELES, Milano) producing a US\$7 M year sales in the period 1995-2002.

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## ***BOOKS***

[1] S. Donati: "[Fotorivelatori](#)", A volume of IV+408 pages, size 16x24, bound, AEI Milano, October 1997. ISBN 88-87237-00-X. II Edition, October 1998.

[2] S. Donati: "[Photodetectors - Devices, Circuits and Applications](#)" *Prentice Hall*, Upper Saddle River, NJ, USA, October 1999. A volume of XIV+440 pages, bound, size 16x24. ISBN 0-13020337-8.

From the review of C.Vinegoni and J.D.Gautier, *Optics and Photonics News*, Sept.2000, pp.43-44: "it's rare to find a book on the multifaceted topics of photodetection. The author ... has met the challenge. . . . a textbook for students taking a photodetection course, it will also be useful to any researcher or PhD student in photonics. In the reviewers opinion, Ch.5 is the best . . . it deals with semiconductor photodiodes, APDs, phototransistors and photoconductors, and includes several circuitry schemes very useful from the practical point of view to anyone working with this kind of device. Two very interesting sections are devoted to non-demolitive detection and squeezed-state detection. The overall impression is that of a well-produced book with good figures...the only shortcoming is the absence of any exercise for students . In conclusion, this is a very valuable book both for the newcomer to the field and to researchers. Both graduate and undergraduate students will certainly find it useful and stimulating".

From the review of a peer scientist reporting to the Publisher: I think this is a very good book. Dr Donati has done an excellent job in assembling material from a wide range of detector and imaging applications . . . From the perspective of the technical reader, Dr. Donati is a very effective communicator.. . His description of detection limits in Ch.3 is the best that I have seen. I also think that the section on squeezed states is excellent. In the areas that I am most familiar with, the material that is presented is very accurate. The level of presentation is consistent thorough. I am impressed that Dr. Donati has been able to maintain a level that a novice in the field can follow easily while also making it interesting for seasoned experts. Dr. Donati has provided many excellent charts and a lot of valuable reference data. In my opinion this book has two primary strengths: breadth and excellent treatments of fundamental properties. I know of no other book that is even close to this book in the number of topics covered and the amount of detail presented.

[2a] S. Donati: "[Photodetectors: Solved Problems](#)" *Prentice Hall*, Upper Saddle River, NJ, USA, October 1999.

[2b] S. Donati: "[Photodetectors: Viewgraphs](#)" *Prentice Hall*, Upper Saddle River, NJ, USA, October 1999.

[2c] [Errata Corrige](#)

[3] S. Donati: "[Electro-Optical Instrumentation - Sensing and Measuring with Lasers](#)" a volume of XVIII+425 pages, bound, 2004, Prentice Hall, USA, ISBN 013 0161610-



9 see web: <<http://vig.prenhall.com/catalog/academic/product/0,1144,0130616109,00.html>>

[3a] S. Donati: "[Electro-Optical Instrumentation: Solved Problems](#)"

[3b] S. Donati: "[Electro-Optical Instrumentation: Viewgraphs](#)"

[3c] [Errata Corrige](#)

*Note: downloading "Solved Problems" [3a] is allowed for class or educational use, provided the Author and the Publisher are acknowledged. To download "Viewgraphs" [3b] ask a password to: [silvano.donati@unipv.it](mailto:silvano.donati@unipv.it) Note: Viewgraphs are released as a support to lessons only, to Professors and Instructors adopting the textbook. In your mail please specify title of the course, year of curriculum, number of students expected to attend, and their qualification (Bachelor, Master, or PhD. Add the url of the course.*

[3a-bis] S. Donati: “电仪传测”, [Guang Dien Yi Che](#)”, Chinese translation by [Z. Hong](#) and [W.Y.Xiao](#) of the book: “Electrooptical Instrumentation”. [Xi'an Jiaotong University Press, Xian](#), China, 2006, 328 pages. ISBN7-5605-2096-0. Price: RMB 38

[3a-ter] S. Donati: “[Electrooptical Instrumentation](#)” Prentice Hall Professional. Mobipocket e-book. Published date : 16 Sept. 2008, Size: 13579 KB. ISBN : 0132441624 Price : \$84.00, see

<<http://www.mobipocket.com/en/eBooks/eBookDetails.asp?BookID=112220>>

[3a-quat] S. Donati: “[Electrooptical Instrumentation](#)” Prentice Hall and Dorling Kindersley (india) Pvt Ltd, 2009, ISBN 8129709627. Price RS 295, see

<<http://www.flipkart.com/electro-optical-instrumentation-sensing-measuri/8129709627-ru23f09d2f>>

## **RESEARCH**

### *activity briefing and [summary](#)*

- 2010-16 Contributions and applications of Self-Mixing to Biophotonics and Mechanical Engineering (A.Kressel Award from IEEE PhoS)
- 2006-09 [Microoptics concentrators](#) for the recovery of the fill-factor in detectors
- 2002-05 Development of Self-mixing interferometers: [sub-nm vibrometers](#) and diffuse-target [displacement measurements](#) with bright speckle tracking, two preproduction instruments developed; [multipoint vibrometer](#) developed
- 1998-01 Novel gyroscopes for automotive and robotics: the integrated RLG in GaAIAs and the optical [readout MEMS](#) gyroscope
- 1995-01 Coupling in semiconductor laser: study of synchronizaton and chaos. [Proposal](#) of new schemes of [chaotic cryptography](#)
- 1996-97 New theory of photodetection and optical [amplifier noise](#) based on a 2nd-quantization beam splitter model
- 1994-96 Promoting the start-up of a spin-off company producing high-performance [fused couplers](#) ([Teles](#), Milano)
- 1994-99 Development of a semiconductor-laser [injection interferometer](#) and [vibrometer](#) based on the moderate feedback-level
- 1992-93 Development of all-fiber [optical isolator](#) for second window (to SIRT1, MI)
- 1991-92 Development of an all-fiber magnetic field sensor with birefringence-matched multiturn coil (CNR MADESS)

- 1990-92 Development of a 2 Gb/s optical interconnect (released to Siemens)
- 1990-91 Programme for the satellite attitude control with FOGs, for the Italian Space Agency (Roma)
- 1988-89 Development of a thick-film [inclinometer](#) (released to Magneti Marelli)
- 1986-88 Development of optical isolators (released to Face Standard, Roma)
- 1985-91 Development and fabrication of an optoelectronic, diffuse radiation, infrared [link for bidirectional](#) interconnection (released to Mario Negri, Milano)
- 1985-87 Development of [lapped fiberoptic couplers](#) (released to Italtel)
- 1984-85 Development of a [prototype FOG, open loop, 1°/h](#), released to ELSAG (Genova) for production
- 1982-85 Design leader for the CNR-IKI (Moscow) [star sensor](#) programme in the gamma-ray telescope mission
- 1982-84 One of the first [all-fiber current sensor](#) (0.5 A noise, 1000 A range)
- 1982-90 High resolution UV-VIS spectrophotometers developed for C. Erba Strumentazione (MI), high resolution (m-dB) spectrophotometer for [attenuation measurements in optical fibers](#)
- 1982-83 All fiber polarizing components by bend and twist
- 1980-81 [Early fiberoptic gyro](#) (10°/h) with 2-mode He-Ne, 100-m 1<sup>st</sup> window fiber
- 1975-76 First He-Ne injection laser interferometer (nm resolution and 20 m range)
- 1975-76 Theory of the CCD MTF and noise for imaging applications
- 1973-75 First speckle pattern strain interferometer on image size 50x50 cm 1972-73 New theory of the avalanche photodiode frequency response and noise 1969-71 First two-frequency Q-switched laser telemeter (100 km range)
- 1968-72 Gated vision through fog and haze: theoretical study and realization of a 10W (average) GaAs illuminator (50 ns pulses) and a 4-stage gated-image intensifier
- 1966-71 New theory of the photomultiplier noise analyzed by time-dependent branching processes
- other topics covered in the [Optoelectronics Group web](#)

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## ***COMPLETE LIST of PUBLICATIONS***

(listed in descending chronological order - \$ means winning a prize)  
To read publications classified in 8 thematical group, go to page 30ff

### **a: Books**

- [3a-quater] S. Donati: "[Electrooptical Instrumentation](#)" Prentice Hall and Dorling Kindersley (India) Pvt Ltd, 2009, ISBN 8129709627. Price RS 295, see <http://www.flipkart.com/electro-optical-instrumentation-sensing-measuri/8129709627-ru23f09d2f>
- [3a-ter] S. Donati: "[Electrooptical Instrumentation](#)" Prentice Hall Professional. Mobipocket e-book. Published date : 16 Sept. 2008, Size: 13579 KB. ISBN : 0132441624 Price : \$84.00, see <http://www.mobipocket.com/en/eBooks/eBookDetails.asp?BookID=112220>
- [3a-bis] S. Donati: "[Guang Dien Yi Che](#)", Chinese translation by Z. Hong and W.Y.Xiao of the book: "[Electrooptical Instrumentation](#)". Xi'an Jiaotong University Press, Xian, China, 2006, 328 pages. ISBN7-5605-2096-0. Price: RMB 38

- [3a] S. Donati: "[Electro-Optical Instrumentation - Sensing and Measuring with Lasers](#)" a volume of XVIII+425 pages, bound, 2004, Prentice Hall, USA, ISBN 013 0161610-9 see web: <http://vig.prenhall.com/catalog/academic/product/0,1144,0130616109,00.html>
- [2a] S. Donati: "[Photodetectors - Devices, Circuits and Applications](#)" *Prentice Hall*, Upper Saddle River, NJ, USA, October 1999. A volume of XIV+440 pages, bound, size 16x24. ISBN 0-13020337-8. [http://vig.pearsoned.com/store/product/0,,store-562\\_banner-0\\_isbn-0130203378,00.html](http://vig.pearsoned.com/store/product/0,,store-562_banner-0_isbn-0130203378,00.html)  
<http://www.amazon.com/exec/obidos/ASIN/0130203378/qid%3D950528363/104-7015419-9327914>
- [1a] S. Donati: "[Fotorivelatori](#)", A volume of IV+408 pages, size 16x24, bound, edited by AEI Milano, October 1997. ISBN 88-87237-00-X. II Edition, October 1999.

## **b: Journal Special Issues (Guest Editor) and Conference Proc. (Editor and Chair)**

- [21b] H.-C.Chang and S.Donati (Editors): "[Proceedings of WFOPC '07](#)", *Fifth International Workshop on Fiber Optics Passive Components*, Taiwan 5-7 Dec.2007 (53 papers). A volume of XII+236 pages, IEEE LEOS Taiwan Chapter, 2007.
- [20b] M.Itzler, S.Donati, M.S.Unlu, K.Kato: "[Photodetector and Imaging](#)", Special Issue of the Journal Selected Topics in Quantum Electronics, vol.10 (July/Aug.2004), Introduction: pp.665; 21 papers, pages 668-840.
- [19b] S.Donati: (editor): [Atti di Elettroottica 2004](#), 8° Convegno nazionale sulla Strum. e Metodi di Misura Elettroottici, Pavia, 15-17 giugno 2004, un volume di XII+305 pagine, EAI Milano 2004.
- [18b] S. Donati, T.Bosch (Editors): '[Optical Distance Measurements](#)', Special Issue of Journal of Optics A, vol.4, (Nov. 2002), pp.S232-S413.
- [17b] S. Donati, C.Mirasso (Editors): '[Optical Chaotic Cryptography](#)', Feature Issue of: IEEE Journal of Quantum Electronics, vol. QE-38 (Sept 2002), pp.1138-1184.
- [16b] S. Donati (Editor): "[Proceedings of ODIMAP III](#)", 3rd Conference On Distance Measurements and Applications, Pavia, 20-22 Sept.2001 (65 papers). A volume of XI+445 pages, size 17x24, published by IEEE-LEOS, 2001.
- [15b] T. Bosch, S.Donati (Guest Editors): '[Distance and Displacement Measurements by Laser Techniques](#)', Special Issue of Optical Engineering, vol.40, (2001), pp.1-99.
- [14b] S. Donati, T. Tambosso (Editors): '[Proceedings of WFOPC 2000 - 2nd Workshop on Fibers and Passive Optical Components](#)', LEOS, 2000. A volume of XII+288 pages, size 16x24, Pavia.
- [13b] S. Donati, K. Okamoto, T. Tambosso (Guest Editors): "[Fiberoptics Passive Components](#)" (31 papers). Special Issue of: IEEE *Journal of Selected Topics in Quantum Electronics*, vol. STQE-5 (Sept-Oct.1999), pp.128-228.
- [12b] S. Donati (Editor): "[Proceedings of ODIMAP II](#)", Second Conference On Distance Measurements and Applications, Pavia, 20-22 May 1999 (61 papers). A volume of XI+410 pages, size 17x24, published by IEEE-LEOS, May 1999.
- [11b] S. Donati (Editor): "[Proceedings of WFOPC '98](#)", First International Workshop on Fiber Optics Passive Components, Pavia 18-19 Sept. 1998 (48 papers). A volume of VIII+176 pages, published by IEEE-LEOS, ISBN 8887-237-07-7, Sept.1998.
- [10b] T. Bosch, R. Dandliker, S. Donati, G. Hausler, M. Lescure, R. Myllyla (Guest Editors): "[Optoelectronic Distance/Displacement Measurements and Applications](#)" (26 papers), Special Issue of *Journal of Optics*, vol. 29 no.3, (June 1998), pp.105-252.
- [9b] S. Donati, F. Lombardi (Editors): "[Proceedings Fotonica'97](#)", Roma 1997. A volume of X+509 pages (99 papers), bound, size 21x30 (AEI, Milano) (in Italian).
- [8b] S. Donati, A. Gilardini (Editors): "[Infrared Techniques](#)". A volume of III+166 pages (16 papers), bound, size 16x23, AEI, Milano 1997 (in Italian).
- [7b] S. Donati, A. Zuccala (Editors): "[Optical Amplifiers II](#)". A volume of IV+165 pages (18 papers), bound, size 16x23, AEI, Milano 1996 (in Italian)
- [6b] F. Docchio, S. Donati (Editors): "[The Laser Interferometer in Industrial Applications](#)". A volume of 213 pages (24 papers), bound, AEI, Milano 1995 (in Italian).

- [5b] S. Donati: (Editor): "[Proceedings Elettrootica'94](#)", Pavia, 1994. A volume of 492 pages (94 papers), bound, (AEI, Milano) (in Italian).
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1A- Chaos-based communications at high bit rates using commercial fibre-optic links Argyris, D Syvridis, L Larger, V Annovazzi-Lodi, P Colet ... - Nature, 2005 -  
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with the papers above, the ElectroOptics Group reaches **H=43 and i100 =23**

## **CONFERENCES**

*S. Donati has been Chairman of:*

LEOS [WFOPC 2007](#) – Workshop on [Fiber and Passive Components](#) ([Taipei](#), Dec. 5-7 2007)  
LEOS [ODIMAP III](#) – 3rd Workshop on Optoelectr. Dist. Meas. &Applic. (Pavia, Sept.20-22, 2001)  
LEOS [WFOPC 2000](#) – Workshop on Fiber and Passive Components (Pavia, June 8-9 2000)  
LEOS [ODIMAP II](#) - 2nd Workshop on Optoelectr. Dist. Meas. &Applic. (Pavia, May 20-22 1999)  
LEOS [WFOPC '98](#) - Workshop on Fiber Optics Passive Components (Pavia, Sept.18-19 1998)  
AEI [Elettroottica 2004](#) – 8th National Meeting in Electrooptics (Pavia, June 15-17, 2004)  
AEI [Fotonica '97](#) – 5th National Meeting in Photonics Communic. (Roma, May 20-23 1997)  
AEI [Elettroottica '94](#) - 3rd National Meeting in Electrooptics (Pavia, May 25-27 1994)  
AEI "Laser Safety" - School on laser applications and their safe use (Milano, May 6-9 1991)  
ISHM "Hybrid Circuits Technology"- School in Microelectronics (Pavia, 28 Sept.-2 Oct.1987)

*Member of the Technical Program Committee of:*

LEOS WFOPC 2005 - [Workshop on Fiber and Passive Components](#) (Palermo June 22-24, 2005)  
LEOS WFOPC 2002 - [Workshop on Fiber and Passive Components](#) (Glasgow June 6-9, 2002)  
SPIE Optoelectronics 2000-05: Physics and Simulation of Optoelect. Devices VIII through XIII  
OFS 10th Optical Fiber Sensor Conference (Glasgow, 11-13 Oct. 1994)  
OFS 9th Optical Fiber Sensor Conference (Florence, 4-6 May 1993)  
ISHM 9th Europ. Hybrid Microelectronics Conf. (Bournemouth, 2-4 May, 1991)  
ISHM 8th Europ. Hybrid Microelectronics Conf. (Stresa, 7-9 May, 1990)  
ISHM 7th Europ. Hybrid Microelectronics Conf.(Hamburg, 24-26 May, 1989)

*1-day Workshops organized and chaired:*

Infrared Techniques (Pavia, 30 Sept. 1997)  
Optical Amplifiers II (Pavia, 26 Sept. 1996)  
Laser Interferometers (Pavia, 25 Sept. 1995)  
Optical Amplifiers (Pavia, 29 June 1992)

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## **COURSES TAUGHT**

Prof. Donati has taught a total number of **75 courses** of 6 or 9-credits.

He has initiated from scratch ALL the five courses listed below, then has passed them after a number of years to younger colleagues now Associate or Full professors. He has written notebooks for all the courses, and in the case of Photodetectors and Electrooptical Instrumentation these notebooks have then become a book.

### **Syllabus of courses**

**Optical Communications** (2nd semester, 1st year of Master in Engineering)

Optical fibers: multi and single-mode, structures and types, propagation and parameters, windows, spectral attenuation, dispersion (multimode, guide, material, polarization). Standard, dispersion-shifted, flattened, and NZD fibers. HiBi and spun fibers. Optical fiber components: couplers, polarizers/retarders, isolators, circulators, filters, AWGs, Bragg gratings. All-fiber vs.  $\mu$ -optics and integrated optics technologies, lithium niobate, silica on silicon. Sources and detectors for TLC: LED/lasers, pin/APD's. FP and DFB lasers. Pigtailling of lasers. Design and performances of front-ends for photodetectors. Design of point-to-point communication links.

The electrical repeater (RX/TX). Design of PON for MAN/LANs. Optical amplifiers. EDFA: doped fibers, pump-diode lasers, small-signal gain, saturation, and noise analysis. SOAs. Cascading amplifiers and fibers (all-optical regeneration). DWDM techniques. Solitons. Measurements on fibers and optoelectronic components. Textbooks: "Photodetectors" by S. Donati, Prentice-Hall 1999; lecture notebooks: "Optical Fibers" by S. Donati, CUEP 1997 Testi dei problemi d'esame: [Opto I dom/esame](#) *Student group photos*

### **Optoelectronic Instrumentation** (1st semester, 2nd year of Master in Engineering)

Overview. Alignment systems, laser level, pointing and tracking. Diameter sensors by diffraction. Granulometry. Telemetry with pulse laser sources and modulated CW sources for topography and geodesy. Analysis of noise and timing accuracy. Laser interferometry for mechanical metrology. Profilometry. Injection Interferometry. Vibrometry. Testing of large structures. Doppler velocimetry. Speckle pattern interferometry (ESPI). Optical fiber sensors: intensity, polarization and interferometric. Strain, temperature, electrical (V/I) and chemical OFS. The Zeeman gyroscope for avionics and the optical fiber gyroscope (FOG). Applications to navigation systems and attitude control. Textbooks: "Electro-Optical Instrumentation" by S. Donati, Prentice Hall 2004 [Errata Corrigé](#) Testi dei problemi d'esame: [Opto II dom/esame](#)

### **Photodetectors** (1st semester, 1st year of Master in Engineering)

Detectors. The photodetection processes. Direct and coherent detection. Spectral sensitivity, threshold of photoemission. Regimes of thermal- and quantum-limited photodetection. Figures of merit of detectors. Photocathodes. Photomultipliers: types, biasing, gain and dark current, the SER response, noise in energy and light-pulse measurements, accuracy of timing, counting mode. Semiconductor photodiodes: parameters and design. Junction engineering. Low-noise design of front-end amplifiers for photodiodes. The APD's: materials, ionization ratio, multiplication gain, bandwidth and noise analysis. Other semiconductor photodetectors: photoresistors, infrared detectors for MIR, FIR and EIR. Responsivity and detectivity. Thermal detectors with application to thermovision. Image devices: vidicon, intensified vidicons, CCD's. Charge transfer and readout organizations; noise Image intensifiers, X-ray converters, streak cameras. Advanced topics: injection detection, squeezed state, parametric and QND detection, optically preamplified detection. Textbooks: "Photodetectors" by S. Donati, Prentice-Hall 1999. [Solved Problems](#) to download [Viewgraphs](#) to download (ask Password to [author](#) first) *Note: Viewgraphs are intended for Professors holding a University course* Testi dei problemi d'esame: [Opto II dom/esame](#)

### **Electronic Materials and Technologies** (2nd semester, 3th year of Bachelor in Engineering)

Passive components: resistances, capacitors and inductances/transformers, performance and comparison between different types available. Trends: THD versus SMD devices. Piezoelectric materials, theory of piezoelectricity. Quartz resonators. Electro- and magneto-strictive devices and transducers. SAW devices and applications as filters. Printed circuit boards. Production of laminates. Double face PCBs with metallized holes, multilayers, volumetric PCBs. Interconnection techniques: soldering, wave-soldering, reflow soldering; photoresists. Cold interconnections. Physics of the contact, resistance vs force and critical temperature. Hybrid thick-film and thin-film circuits. Patterning and photolithography. IC technologies, custom and ASICs. Reliability (theory), failure rate, fits. Parallel and series reliability. Estimate of reliability from standards data (MIL217C). Packaging of devices. Polymers and ceramic materials in electronics.

Textbooks: lecture notes on "Electronics Materials and Technology" by S. Donati and G. Torelli

## Electronic Circuits Design (2nd semester, 2nd year of Bachelor in Engineering)

Laboratory instruments and their use: oscilloscope multimeter, waveform generator. RC and CR response. Op-Amp characterization measurements. Elementary circuits with Op-Amps: summer, follower, differentiator/integrator, clamping, clipping precision rectifier, log-converter. Logic gates (TTL, CMOS, ECL) and their use. Bistable multi and counters. Oscillators. Quartz oscillators with BJT and gates. Multivibrators, mono and multi, with transistors schemes and logic gates. A/D and D/A converters. High-frequency amplifiers. Using SPICE. One selected circuit designed by students, built and tested.

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Note: Professor Donati can deliver at your University the courses noted above as a Visiting Professor, in a format that can range from MSc to PhD classes, and with a number of lessons from 15 hours (short course) to 60 hours (full course). Also partial coverage of topics described above is possible.

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### Silvano Donati: Scientific production of last 5 years (2011-15)

- [98d] S.Donati, D.Rossi, M.Norgia: "[Single Channel Self-Mixing Interferometer Measures Simultaneously Displacement and Tilt and Yaw Angles of a Reflective Target](#)", *IEEE Journal Quantum El.*, vol. QE-51, 2015, DOI 1400108. IF=1.9
- [97d] M.Norgia, A.Pesatori, S.Donati: "[Compact Laser Diode Instrument for Flow Measurement](#)" *IEEE Trans. Instrum. Meas.*, vol.64 (2016) DOI: 10.1109/TIM.2016.2526759 IF=1.4
- [96d] S.Donati, T.Tambosso: "[Single-photon detectors: from traditional PMT to solid-state SPAD-based technology](#)", *IEEE Journ. Select. Topics Quantum El.*, vol.20, 2014 DOI:JSTQE.2014.2350836 IF=3.8
- [95d] S.Donati, T.Tambosso, R.-H.Horng: "[Curvature of Substrates is Measured by means of a Self-Mixing Scheme](#)" *IEEE Photonics Techn. Lett.*, vol.24, 2014, DOI 10.1109/LPT.2014.2349958. IF=3.5
- [94d] K.-H. Lo, S.-K. Hwang, S. Donati: "[Optical Feedback Stabilization of Photonic MW Generation using P1 Nonlinear Dynamics of Semiconductor Lasers](#)" *Optics Express*, vol. 22, 2014, pp.18648–61. IF=2.4
- [93d] S.Donati, G.Martini: "[Systematic and random errors in Self-Mixing measurements: effect of the developing speckle statistics](#)" *Applied Optics* vol.53, 2014, pp.4873-4880. IF=1.9
- [92d] S.Donati, G.Martini, T.Tambosso: "[Speckle Pattern Errors in Self-Mixing Interferometry](#)", *IEEE Journal Quantum El.* vol.19, 2013, pp.798-806. IF=1.9
- [91] S.Donati, V.Annovazzi W.Zhao: [光学密码术最新进展 - Advances in Optical Cryptography of Transmitted Data](#) (invited paper) *Chinese Optics*, vol.7, 2014, pp.89-97. IF=NA
- [90d] S. Donati, M.Norgia: "[Self-mixing Interferometry for Biomedical Signals Sensing](#)" (invited paper), *IEEE Journal Select. Topics Quantum El.* vol.20, 2014, DOI 10.1109/JSTQE.2013.2270279 IF=3.8
- [89d] S. Donati, R.-H.Horng: "[The Diagram of Feedback Regimes Revisited](#)", (invited paper), *IEEE Journ. Select. Topics Quantum El.* vol.19, 2013, DOI 10.1109/JSTQE. 2012.2234445 IF=3.8
- [88d] S. Donati, S.-K. Hwang: "[Chaos and High-Level Dynamics in Coupled Lasers and their Applications](#)", *Progress in Quantum Electronics* (2012), vol.36, March–May 2012, pp. 293–341. IF=9.5
- [87d] S.Donati, M.Fathi: "[Transition from Short-to-Long Cavity and from Self-Mixing to Chaos in a Delayed Optical Feedback Laser](#)", *IEEE Journal Quantum El.* vol.48, 2012 pp.1352-1359. IF=1.9
- [86d] S.Donati, Wang Zhao, Y.Yu: [用于光电仪器和相关测量的自混合干涉技](#) (Self-Mixing Interferometry for Measurements), *Chinese Optics*, vol.5, 2012, pp.93-123. IF=NA
- [85d] S. Donati: "[Developing Self-Mixing Interferometry for Instrumentation and Measurements](#)" *Laser Photonics Review*, vol.6 (2012), pp. 393–417 (DOI) 10.1002/ lpor.201100002. IF=9.4
- [84d] M.Fathi, S.Donati: "[Simultaneous Measurement of Thickness and Refractive Index by a Single-Channel Self-Mix Interferometer](#)" *Proc. IET part J, Optoelectronics* vol.6 (2012) pp.7–12. IF=1.1
- [83d] S.Donati: "[Responsivity and Noise of Self-Mixing Photodetection Schemes](#)", *IEEE Journal Quantum Electr.*, vol.47, 2011, pp-1428-1433. IF=1.9
- [82d] G.-F. Dalla Betta, S. Donati, Q. D. Hossain, G. Martini, L. Pancheri, D. Stoppa, G.Verzellesi: "[Design and Characterization of Current Assisted Photonic Demodulators in 0.18- \$\mu\$ m CMOS Technology](#)", *IEEE Trans. Electron Devices* 58, (2011), pp.1702-1709. IF=2.2

[81d] S. Donati, G. Martini, E. Randone: "[Improving Photodetector Performance by Micro-optics Concentrators](#)", *IEEE J. Lightwave Technologies*, vol.29, 2011, pp.661-665. IF=2.8

Total IF of 18 published papers in 5 years: IF= 52.2

Average number of Authors per paper: 3.0 Number of papers on corresponding Author: 13.

### Papers in Technical Conference Proceedings

- [154e] V. Annovazzi, G. Aromataris, M. Benedetti, S. Donati: "[Secure Transmission Network using Chaotic Lasers](#)" 3rd Intl IEEE Conference COMPENG, Barcelona 16-17 June 2014, paper Mo5.
- [153e] S. Donati, V. Annovazzi: "[The Incipit of Complexity in Self-Coupled Lasers](#)" 3rd Intl IEEE Conference COMPENG, Barcelona 16-17 June 2014, paper Mo4.
- [153e] T. Tambosso, S. Donati, R.-H. Horng: "[In-Situ Measurement of Wafer Camber by a Laser-Feedback Detector](#)" *IEEE Photonics Conf.* 2014,
- [152e] T. Tambosso, S. Donati: "[3-D Contouring by Self-Mix Interferometer in the Speckle-Pattern Regime](#)" *IEEE Photonics Conf.* 2014,
- [151e] S. Donati, V. Annovazzi: "[Recent Advances in Optical Cryptography of Transmitted Data](#)" (invited paper), 6th Intl Conf. on Adv. Optoelectronics and Lasers (CAOL 2013), Sudak, (Ukr) 9-13 Sept. 2013.
- [150e] G. Martini, E. Randone, S. Donati: "[Self-Mixing Laser Diode Vibrometer for Low-Frequency Applications](#)", Proc. ALT-2013.
- [149e] S. Donati, M. Norgia: "[A Lensless Self-Mixing Blood Flow Sensor](#)", 2nd Intl. Conf. on Biophotonics, Taipei, July 17-19, 2013, paper Th2-5, pp.65-67.
- [148e] S. Donati, M. Norgia: "[Self-mixing Interferometry for Biomedical Signals Sensing](#)" (Invited Paper), 2nd Intl. Conf. on Biophotonics, Taipei, July 17-19, 2013, paper FR2-1, pp.89-91.
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- [146e] S. Donati: "From Order to Chaos and Back with Optical Cryptography", (Prominent Speech), COMPENG 2012, Aachen, June 11-13, 2012.
- [145e] S. Donati: (Invited Paper): "[Chaos Cryptography for Secure Optical Communications](#)" Proc. 20th WOCC, Tainan 19-21 April 2012, paper O1-1, pp.48-49.
- [144e] S. Donati: (Invited Paper): "[Self-Mixing Interferometry: A Universal Yardstick to Measure Almost Everything](#)", Proc. Workshop on laser Dynamics and Applications, Nat. Chiao Tong University, Tainan 14 Mar. 2012, p.1-2.
- [143e] S. Donati: (Invited Paper): "[Self-Mixing Interferometry: Recent Advances](#)", (invited) Proc. IPC Conf., Tainan 7-10, Dec. 2011.
- [142e] S. Donati, G. Martini: "[Application of Delayed Optical Feedback to the Simultaneous Measurement of Index of Refraction and Thickness of Optical Slabs](#)" Proc. IPC Conference, Tainan 7-10 Dec. 2011.
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- [140e] S. Donati, G. Martini: "[Self-Mixing Interferometry as the Ideal Tool for Optical Measurements](#)" (Invited) Proc. LFNM'2011, 11th Intl. Conf on laser & Fiber Optical Networks Modeling, Kharkov, DSept.4-8, 2011, paper MoIP2.
- [139e] S. Donati, G. Martini: "[Self-Mixing Interferometry: A Universal Yardstick to for Optical Measurements](#)" (invited) Proceeding 10<sup>th</sup> WIO 2011 – Worksh. on Inform. Optics, Benicassim (Spain), June 26-29, 2011, paper zMo4
- [138e] S. Donati: "[Self-Mixing Interferometry, A Universal Yardstick to Measure Almost Everything](#)", (invited) *Proc. OSA/SPIE OPTO Meet. Young Researchers 2011*, Nikolaus Copernicus University, Torun (PL) May 9-12, 2011, paper M1.
- [137e] G.-F. Dalla Betta, S. Donati, Q.D. Hossain, G. Martini, L. Pancheri, D. Stoppa, G. Verzellesi: "[TOF-Range Image Sensor in 0.18 mm CMOS technology based on Current Assisted Photonic Demodulators](#)", *Proc. CLEO/QELS 2011*, Baltimore, May 1-6, 2011, paper CMG6.

### Patents

[9g] S. Donati, R.-H. Horng "Measuring device and optical measuring method" filed at Taiwan Patent Office, Dec.23, 2013.

**Courses delivered in last 36 months:** 6 at University of Pavia (Optoelectronic Instrumentation 3, Photonic Devices 3), 1 at NCKU (Optoelectronic Instrumentation) 4 at NCHU (Optoelectronic Instrumentation 2, Photodetectors 2), = **11 total** courses for **66** credits (as per Bologna protocol)

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Silvano Donati: Papers and Patents co-authored with Taiwanese/Chinese  
Colleagues

### Papers in International ISI Journals



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## ***LIST of PUBLICATIONS by CATEGORY*** of the Optoelectronics Group

To better illustrate the activity developed by the Optoelectronics

Group, publications of the general list (pp.9-24) are regrouped below into eight main themes of research:

- 1 - INTERFEROMETRY
- 2 - OPTICAL CHAOS
- 3 - OPTICAL AMPLIFIERS
- 4 - SEMICONDUCTOR LASERS
- 5 - NOISE in DEVICES and SYSTEMS
- 6 - OPTICAL and FIBEROPTIC SENSORS
- 7- PASSIVE and FIBEROPTIC COMPONENTS
- 8- BIOPHOTONICS

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\_\_\_\_\_titles in blue are downloadable from Author's website\_\_\_\_\_

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## 7 - OPTICAL and FIBEROPTIC SENSORS

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