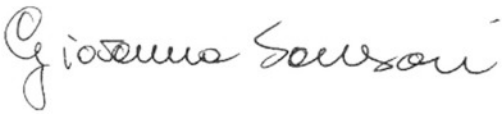
# Prof. Giovanna Sansoni
# Short CV
# 2019

*Prof. Giovanna Sansoni*



I received my **master degreee in Electronic Engineering-Systems and Signals** at the Polytecnic of Milan in 1984. **In January 1985** I started my experience of teaching and reaserach at the University of Brescia. **In March 1986** I became an Assistant Professor (**Researcher)**, in the field of Electronic Instrumentation and Measurements, at the Schoolo of Engineering of the University of Brescia. **In November 1998** I got the position of **Associate Professor** at the Department of Electronics for Industrial Automation, at the Engineering faculty of the University of Brescia. **From November 2009 to August 2017** I have been **Full Professor** of Electronic Instrumentation and Measurements at the Department of Information Engineering, University of Brescia. Since August 2017 I join the Department of Mechanical and Industrial Engineering of the University of Brescia.

# 1 Research activity

My research training started in 1985, at the Department of Industrial Automation (now Department of Information Engineering), of the University of Brescia. My activity has always been characterized by a transversal, multidisciplinary approach, which inherently comes from my scientific area: the development of measurement instrumentation and procedures. In the following, a brief survey of the activities is presented.

## 1.1 Current research activities:

1. **Machine Learning and Deep Neural Networks** for gesture recognition and safety applications in robotic cells and collaborative robotics;
2. Metrological characterization of Time of Flight (**TOF**) sensors;
3. Development of 3D measurement principles based on *Depth From Defocus* (DFD) e *Depth From Focus* (DFF) using **liquid lenses**;
4. Development of **autofocus algorithms** based on liquid lenses for compact low cost systems;
5. **Wear and fatigue monitoring** of wheel-rail specimens using vision systems integrated on bi-disk test benches.

## 1.2 Past research activities:

ATT.1: DEVELOPMENT AND METROLOGICAL CHARACTERIZATION OF ELECTRO-OPTICAL INSTRUMENTATION FOR APPLICATIONS TO NON-CONTACT, THREE-DIMENSIONAL MEASUREMENT

I have been working at the development and the metrological characterization of optical instrumentation for 3-D acquisition of surfaces since 1990:

1. Instrument based on a single bidimensional, non coherent light pattern, using phase coding;

2. Instrument based on the projection of a single light pattern, using two-frequency pattern and phase measurement;

3. Instrument based on multipattern projection PMP (Phase Shift Profilometry);

4. Portable instrument for the multiview acquisition of complex objects, using multipattern light projection and combined Gray-Code Phase Shift technique;

5. Instrument based on the photogrammetric and structured light approaches, for the three dimensional measurement of profiles.

ATT.2: REVERSE ENGINEERING AND RAPID PROTOTYPATION: APPLICATIONS TO MANUFACTURING, AUTOMOTIVE, CULTURAL HERITAGE AND BIOMEDICAL FIELDS

The experience gathered in the development of 3D instrumentation been exploited in reverse engineering applications, to obtain topological and mathematical models of complex, free-form surfaces, for rapid prototyping (RP) and CAD-CAM applications. This activity represents a relevant benchmark for (i) the evaluation of the measurement performance of the acquisition systems, (ii) the demonstration of the usability of the optical sensor as the sole measurement source of the entire process, (iii) the completion of relevant measurement campaigns "in situ".

The most important results of this research activity are documented in the following fileds:

1. cultural heritage domain

2. automotive domain

3. crime scene documentation

4. legal medicine

5. maxillo-facial prosthetics

ATT.3: DEVELOPMENT OF INSTRUMENTATION AND METHODS FOR INDUSTRIAL APPLICATIONS

This activity deals with development and characterization of electro-optical instrumentation for the industrial framework. The most important projects are listed below:

1. Development of systems and techniques for the measurement of waviness and roughness of machined surfaces.

2. Development of data acquisition systems for on-line control of shape and of temperature of trains.

3. Development and characterization of light-stripe sensors for contactless measurement of pipe eccentricity.

ATT.4: MECHANICS AND ROBOTICS

The research activities are listed below:

1. Development of vision for robotics. This activity started on request of an industrial commissioner (DENSO EUROPE B.V.). The aim was to develop suitable algorithms of vision for pick & place applications. Both 2D and 3D systems have been developed in view of their integration on the robot arm.

2. Combined use of optical and contact probes in CMMs. This activity was aimed at integrating the measurement information from a 3D Vision sensor and a Coordinate Measuring Machine (CMM) for the reverse engineering of free-form surfaces. The objective was to reconstruct the CAD model of complex shapes with high accuracy and at the same time rapidly, and minimising the operator time.

ATT.5: 2D VISION FOR MEDICINE

This activity has been developed in collaboration with clinicians, for the development of:

1. A 2D vision software tool for the analysis and the follow-up of macula edema by using optical coherence tomography;
2. A 2D vision software tool for the non-invasive analysis of small arteries and retinal arterioles by means of scanning laser Doppler flowmetry.

### 1.3 The Research Projects

**Since 1987** I have been developing research activity at the Laboratory of Optoelectronics (OPTOLAB: www.optolab-bs.it), of the University of Brescia. In **2001** I became Responsible of the research and of the teaching activities of the Laboratory: in that role, I have had the responsibility of a considerable number of **research projects (see table 1)**.

### 1.4 Industrial experience

Since the beginning of my career, I have been working **for** and **in cooperation with** industrial companies, in the frame of applied research projects I was involved into, either as a coordinator or as a participant. In addition, I took part in the foundation of a number of start-ups, opened by my Ph.D. students.

In Table 2, the projects of applied research and development carried out for industrial companies are listed.

### 1.5 Technology transfer and Start-ups

My attitude as research coordinator has always been focused on disseminating and making the research results as productive as possible, having in mind two major objectives:

1. To fill the gap between university research and productive industrial requirements of applied research;
2. To make the results delivered by research programmes productive.

Since the 90's, I have been working so that my Ph.D students could make business out of their research achievements. As a result, a number of small, high-tech start-ups were born. Details on their activities can be found at:

OpenTechnologies Srl (**www.opentechnologies.it**);

Q-Tech srl (**www.q-tech.it**);

Nirox srl (**www.nirox.it**)

Semtec srl (now Antares Vision srl) (**www.antaresvision.it**).

*Table 1: list of the research projects*

| Project Name | Year | Description | Partnership | Coordinator/ Participant |
|---|---|---|---|---|
| LASERALLUMINIO | 2012-2015 | Development of On-line image acquisition for the monitoring of Aluminum laser welding | Italian Companies<br>INDUSTRIA 2015 | Participant |
| Micro-manipulation and Assembly | 2009-2011 | Development of vision procedures for pick and place operations in robot cells | Italian Universities<br>PRIN 2009 | Participant |
| Crime scene analysis | 2005-2007 | Development of 3D vision procedures for crime scene and post-mortem analysis | Italian Universities<br>PRIN 2005 | Participant |
| Low-Cost 3D Imaging Automatic System | 2003-2005 | Development of low-cost 3D optical camera for data acquisition and surface modelling | Italian Universities<br>PRIN 2003 | Unit responsible |
| Development of novel reverse engineering optical 3D procedures | 2000-2002 | Integration of Optical 3D and Mechanical non-contact measurement procedures for the reverse engineering of free-form surfaces | Italian Universities PRIN 2000 | Project Coordinator |
| Optoelectronics Technologies project | 1988-1990 | Development of innovative technologies in optoelectronics | Italian universities and industries | Participant |
| Multi-sensor Electro-optical Equipment for Automated Manufacturing Systems | 1990-1993 | Development of 3D sensors based on fringe projection and interferometry | UE Academic partners<br>European Project | Participant |

*Table 2: list of the industrial projects*

| Contract title | year | Description | Partner | Participant/Coordinator |
|---|---|---|---|---|
| *On-line control of defects in spindles* | 2012 | Development of a 3D system for the detection of working defects in spindles | Tenaris-Dalmine Spa, Bergamo, Italy | Coordinator |
| *Integration of vision on a smart robot demonstrator* | 2009-2010 | Development of a vision-robot integrated work cell for smart serving operation | DENSO EUROPE, Germany | Coordinator |
| Feasibility study for the measurement of eccentricity in tubes | 2007-2008 | Development of an instrument for the optical 3D measurement of tubes | Trafilerie Gnutti Chiari, Italy | Coordinator |
| System for the acquisition and the embedded control of shape and temperature of trains | 2006-2006 | Multi-sensor equipment for the on-line acquisition of shape, temperature and images of travelling trains | Q-Tech srl, Italy | Coordinator |
| Feasibility study of a vision system for the on-line quality control of felts | 2000 | Development of a scattering-based technique and of image processing for the detection of defects in fabrics | Mario Crosta srl, Milan, Italy | Coordinator |
| Feasibility of a system for the measurement of roundness in mill cylinders | 2000 | Design, development and characterization of a 3D laser slit for the measurement of geometric parameters in mill cylinders | Pomini spa, Castellanza, Italy | Coordinator |
| Development of an instrument for the quality control of buttons | 1999 | Design, development and characterization of a laser blade system for the measurement of the 3D profile of buttons | Bonetti spa, Brescia, Italy | Coordinator |
| On-line measurement of roughness and waviness of milled surfaces | 1997-1998 | Design, development and characterization of a novel system for the detection of scratches, and of micro defects in milled surfaces | Pomini Spa, Castellanza, Italy | Participant |
| Optical 3D system for CMM | 1996 | Study of a fringe projection based system to be integrated in a Coordinate Measuring Machine | POLI Officine Meccaniche, Italy | Coordinator |
| Image processing for dam control | 1995 | Image processing algorithms for the on-line control of the deformation of dams | ISMES, Bergamo, Italy | Participant |

## 2 Education

Since 1990 I have been teaching the students of the Engineering Faculty of Brescia. Here the courses are listed:

- Instrumentation and Measurement
- Electronic Instrumentation
- Elaboration of signal and of measurement information
- Electronic Computers
- Optical Measurements
- Vision systems for industry
- 2D vision systems

- 3D Vision systems

# 3 Post Doc students

1. Research project: "**SMART BREAK – Smart Bialetti: smart vision for beverages and food detection**"; 01-09-2014-31.08.2015.
2. Research project: "**Image processing for on-line control of laser welding**": From 01.01.2015 to 31.12.2015.
3. Research project: **Study and development of vision systems based on liquid lenses for health and wealth applications**. Periodo: 01.01.2016-31.12.2016.
4. Research project: **PROGETTO E REALIZZAZIONE DI SISTEMA DI VISIONE PER LA MISURA DELLA FRECCIA IN FUNI SOTTOPOSTE A CARICO IN LINEE VITA**. From: 01.01.2016 to 31.12.2016.
5. Research project: **Depth from defocus metrology**. From 01.01.2017 to 31.12.2017.

## 3.1 Ph.D Tutoring

1. Member of the Ph.D Committee of Information Engineering;
2. Tutorship of two Ph.D Students working on deep learning for gesture recognition and posture detection in Health application

# 4 List of publications

## 4.1 International journals

1. *Pasinetti, S., Hassan, M. M., Eberhartdt, J., Lancini, M., Docchio, F., Sansoni, G., Performance analysis of the PMD Camboard Picoflexx Time-Of-Flight camera for markerless motion capture applications (**2019**) IEEE Transactions on Instrumentation and Measurement, **in press**.*
2. *Lancini, M., Pasinetti, S., Montini, V., Sansoni, G. Monitoring upper limbs during exoskeleton-assisted gait outdoors (**2019**) Biosystems and Biorobotics, 22, pp. 127-131.*
3. *Bodini, I., Petrogalli, C., Faccoli, M., Lancini, M., Pasinetti, S., Sansoni, G., Docchio, F., Mazzù, A. Evaluation of wear in rolling contact tests by means of 2D image analysis (**2018**) Wear, 400-401, pp. 156-168.*
4. *Mazzù, A., Gambari, F.M., Bodini, I., Pasinetti, S., Sansoni, G. An engineering investigation on the Bronze Age crossbar wheel of Mercurago, (**2017**) Journal of Archaeological Science: Reports, 15, pp. 138-149.*
5. *Pasinetti, S., Bodini, I., Lancini, M., Docchio, F., Sansoni, G., Automatic selection of focal lengths in a Depth-From-Defocus measurement system based on liquid lenses, (**2017**) Optics and Lasers in Engineering, 96, pp. 68-74.*

6. *S. Pasinetti, I. Bodini, M. Lancini, F. Docchio, G. Sansoni, "A depth from defocus measurement system using a liquid lens objective for extended depth range", IEEE Transactions on Instrumentation and Measurement, (**2017**) in press.*
7. *I. Bodini, G. Sansoni, M. Lancini, S. Pasinetti, F. Docchio, "A novel optical apparatus for the study of rolling contact wear/fatigue based on high-speed camera and multiple-source laser illumination", Rev. Scient. Instr., 87, (8), (**2016**) 083701.*
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9. *G. Sansoni, P. Bellandi, F. Leoni, F. Docchio, "Optoranger: a 3D pattern matching method for bin picking applications", Opt. Laser Eng., 54 (**2014**) pp. 222-231.*
10. *P. Bellandi, F. Docchio, G. Sansoni, "Roboscan: a combined 2D and 3D vision system for improved speed and flexibility in pick-and-place operation", Int J Adv Manuf Technol, 69 (5-8) (**2013**) pp. 1873-1866.*
11. *G. Sansoni, P. Bellandi, F. Docchio, "3D system for the measurement of tube eccentricity: an improved rugged, easy to calibrate layout", Meas. Sci. Technol., 24 035901 (**2013**) doi: 10.1088/0957-0233/24/035901*
12. *G. Sansoni, F. Docchio, "Biomedical 2D and 3D imaging: state of art and future perspectives", J. Gabriel et al. (Eds): BIOSTEC 2012, CCIS 357, pp. 3-19, Springer-Verlag Berlin Heidelberg **2013**.*
13. *D. Rizzoni, C. Costagliola, A. Sebastiani, P. Danzi, G.A. Tiberio, S.M. Giulini, F. Docchio, G. Sansoni, A. Sarkar, E. Agabiti Rosei. "Relationship between media-to-lumen ratio of subcutaneous small arteries and wall-to-lumen ratio of retinal arterioles evaluated noninvasively by scanning laser Doppler flowmetry". J. Hyertension 30:1169-1175, **2012**.*
14. *L. Fumagalli, P. Tomassini, M. Zanatta, G. Libretti, M. Trebeschi, G. Sansoni, F. Docchio, "Multifunction Portals for Train Monitoring: Recent advances and innovative optoelectronic instrumentation", in: Reliability and Safety in Railway, ISBN 978-953-51-0451-3, **2012**, pp. 317-332.*
15. *P. Bellandi, G. Sansoni, A. Vertuan, "Development and characterization of a multi-camera 2D-vision system for enhanced performance of a drink serving robotic cell", Robot Comput Integr Manuf, 28 (1) (**2012)** pp. 35-49.*
16. *G. Sansoni, F. Docchio, "From optical acquisition to rapid prototyping: applications to medicine and to cultural heritage", in: Rapid Prototyping/ Book 2, ISBN 979-953-307-048-2, **2011**, pp. 153-178.*
17. *G. Sansoni, P. Bellandi, F. Docchio, "Design and development of a 3D system for the measurement of tube eccentricity", Meas. Sci. Technol. 22 075302, doi: 10.1088/0957-0233/22/7/075302, **2011.***
18. *G. Sansoni, C. Cattaneo, M. Trebeschi, D. Gibelli, P. Poppa, D. Porta, M. Maldarella, M. Picozzi, "Scene of crime analysis by a 3D optical digitizer: a useful perspective for forensic science", Am J Forensic Med Pathol, 32(3), (**2011)** pp. 280-286.*
19. *G. Sansoni, M. Trebeschi, F. Docchio, "State-of-The-Art and Applications of 3D Imaging Sensors in Industry, Cultural Heritage, Medicine, and Criminal Investigation", Sensors, **2009**, Vol.9, N.1, pp. 568-601.*
20. *G. Sansoni, C. Cattaneo, M. Trebeschi, D. Gibelli, D. Porta, M. Picozzi, "Feasibility of contactless 3D optical measurement for the analysis of bone and soft tissues lesions: new technologies and perspectives in forensic sciences", J Forensic Sci, 54 (3) (2009) pp. 540-545.*
21. *G. Sansoni, G. Cavagnini, F. Docchio, G. Gastaldi, "Virtual and physical prototyping by means of a 3D optical digitizer: application to facial prosthetic reconstruction", Virtual and Physical Prototyping, Vol. 4, pp. 217-226, **2009**.*

22. *G. Sansoni, M. Trebeschi, F. Docchio, "Fast 3D profilometer based upon the projection of a single fringe pattern and absolute calibration", Meas. Sci. Technol., Vol. 17, pp. 1757-1766,* ***2006****.*
23. *G. Sansoni and E. Redaelli, "A 3D vision system based on one-shot projection and phase demodulation for fast profilometry", Meas. Sci. Technol., N. 16, 1109-1118,* ***2005****.*
24. *G. Sansoni, F. Docchio, "3-D optical Measurements in the Field of Cultural heritage: The Case of the Vittoria Alata of Brescia", IEEE Trans. Instr. Meas., Vol. 54, No. 1, 359-368,* ***2005****.*
25. *G. Sansoni, F. Docchio, "In-field performance of an optical digitizer for the reverse engineering of free-form surfaces", Int J Adv Man Tech, Vol. 26, pp. 1353-1361,* ***2005****.*
26. *G. Sansoni, F. Docchio, "Three-dimensional optical measurements and reverse engineering for automotive applications", Robotics and Computer-Integrated manufacturing, Vol. 20, pp. 359-367,* ***2004****.*
27. *G. Sansoni, A. Patrioli and F. Docchio, "OPL-3D: a novel, portable optical digitiser for fast acquisition of free-form surfaces," Rev. Scient. Instr., Vol. 74, N. 4, 2593-2603,* ***2003****.*
28. *V. Carbone, M. Carocci, E. Savio, G. Sansoni, L. De Chiffre, "Combination of a vision system and a Coordinate Measuring Machine for the Reverse Engineering of Freeform Surfaces", Int. J. Adv. Manuf. Tech., No. 17, 263-271,* ***2001****.*
29. *P. Tomassini, L. Rovati, G. Sansoni, F. Docchio, "Novel optical sensor for the measurement of surface texture", Rev. Scient. Instr., Vol. 72, No. 4, 2207-2213,* ***2001****.*
30. *G. Sansoni, R. Rodella, M. Carocci, V. Carbone, "Machine vision: optical digitization of free-form, complex surfaces using the projection of structured light", Optics and Photonics News, Vol. 11, No. 2, pp. 23-29,* ***2000****.*
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32. *G. Sansoni, M. Carocci, R. Rodella, "Three-dimensional vision based on a combination of gray-code and phase-shift light projection: analysis and compensation of the systematic errors", Appl. Opt., Vol. 38, No.31, 6565-6573, 1 November* ***1999****.*
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37. *F. Docchio, G. Sansoni, D. Marioli, and A. Taroni, "An Experimental apparatus for the characterization of thick-film optical waveguides", in: Applications of Photonic Technology, G. A. Lampropoulos et al. (eds), Plenum Press, 519-525, New York-London,* ***1995****.*
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47. *U. Minoni, G. Sansoni, "Relationships between real-time and fault tolerance: a case study of a redundant loop data acquisition network", Microprocessing and Microprogramming, 28, 229-232, **1989**.*
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49. *U. Minoni, G. Sansoni, N. Scarabottolo, "A fault tolerant microcomputer ring for data acquisition in industrial environments", IEEE Trans. Instrum. Meas., Vol. 38, No. 1, 32-36, **1989**.*

## 4.2 International Proceedings

50. *Mazzu, A., Gambari, F.M., Uberti, S., Bodini, I., Pasinetti, S., Sansoni, G. An engineering study of a Bronze Age war chariot (**2018**) IOP Conference Series: Materials Science and Engineering, 364 (1), art. no. 012016.*
51. *Nuzzi, C., Pasinetti, S., Lancini, M., Docchio, F., Sansoni, G. Deep Learning Based Machine Vision: First Steps Towards a Hand Gesture Recognition Set Up for Collaborative Robots (**2018**) 2018 Workshop on Metrology for Industry 4.0 and IoT, MetroInd 4.0 and IoT 2018 - Proceedings, art. no. 8439044, pp. 28-33.*
52. *Pasinetti, S., Nuzzi, C., Lancini, M., Sansoni, G., Docchio, F., Fornaser, A. Development and Characterization of a Safety System for Robotic Cells Based on Multiple Time of Flight (TOF) Cameras and Point Cloud Analysis (**2018**) 2018 Workshop on Metrology for Industry 4.0 and IoT, MetroInd 4.0 and IoT 2018 - Proceedings, art. no. 8439037, pp. 34-39.*

53. *Pasinetti, S., Sansoni, G., Docchio, F. In-Line Monitoring of Laser Welding Using a Smart Vision System (**2018**) 2018 Workshop on Metrology for Industry 4.0 and IoT, MetroInd 4.0 and IoT 2018 - Proceedings, art. no. 8428332, pp. 134-139.*
54. *Pasinetti, S., Hassam, M. M., Bodini, I., Lancini, M., Docchio, F., Sansoni, G., Marker-Less Motion Capture System using Time-of-Flight Cameras: Comparison of the PMD CamBoard Picoflexx and the MS Kinect v2 Cameras (**2017**) XXV National congress of the Italian association of laser velocimetry and non-invasive diagnostic (AIVELA2017), Proceedings.*
55. *Pasinetti, S., Bodini, I., Lancini, M., Docchio, F., Sansoni, G., Experimental characterization of an autofocus algorithm based on liquid lens objective for in-focus imaging in the macro range, (**2017**) Proceedings - 2017 7th International Workshop on Advances in Sensors and Interfaces, IWASI 2017, art. no. 7974249, pp. 195-200.*
56. *Bodini, I., Petrogalli, C., Mazzù, A., Faccoli, M., Lancini, M., Pasinetti, S., Sansoni, G., Docchio, F., On-line 2D monitoring of rolling contact fatigue/wear phenomena in dry tests, (**2017**) Journal of Physics: Conference Series, 882 (1), art. no. 012012.*
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