

Prof. Giovanna Sansoni
Short CV
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I received my **master degree 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. In August 2017 I joined the Department of Mechanical and Industrial Engineering of the University of Brescia.

I am **IEEE** member, member of the Italian Society of Optics (**SIOF**), and of the Italian Association of Electrical and Electronics Measurements (**GMEE**).

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 the scientific area I belong to: 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 files:

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.antaressvision.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 INDUSTRIA 2015	Participant
Micro-manipulation and Assembly	2009-2011	Development of vision procedures for pick and place operations in robot cells	Italian Universities PRIN 2009	Participant
Crime scene analysis	2005-2007	Development of 3D vision procedures for crime scene and post-mortem analysis	Italian Universities 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 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 European Project	Participant

Table 2: list of the industrial projects

Contract title	year	Description	Partner	Participant/C ordinator
<i>On-line control of defects in spindles</i>	2012	Development of a 3D system for the detection of working defects in spindles	Tenaris-Dalmine Spa, Bergamo, Italy	Coordinator
<i>Integration of vision on a smart robot demonstrator</i>	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