CURRICULUM VITAE & PUBLICATIONS

Prof. Giosuè Caliano

Summary

- Master Degree in Electronic Engineering cum laude from the University of Salerno, with a thesis entitled *"Bidimensional Reading of the Barcode,"* supervised by Prof. M. Pappalardo (1993).
- From May 1993 to June 1995, employed under contract at the University of Salerno, conducting research and supplementary teaching activities.
- From July 1995 to October 1997, employed at F.O.S. Fibre Ottiche Sud (Pirelli Group) as an Industrial Automation and Control Engineer, responsible for the development of measurement machines.
- From October 1997 to June 2018, employed at Roma Tre University as responsible of the research laboratory ACULAB.
- Senior Member of IEEE since January 2013.
- From January 2012 to December 2019, held the teaching assignment for the course *"Sensors and Transducers"* in the Master's Degree in Electronic Engineering.
- From January 2017 to December 2019, held the teaching assignment for the course *"Electronics Laboratory"* in the Master's Degree in Electronic Engineering.
- Unanimously obtained the National Scientific Qualification as Full Professor on September 6, 2019, in Electronics in addition to prior qualifications as Associate Professor obtained in 2014 and 2019.
- Unanimously obtained the National Scientific Qualification as Associate Professor on October 25, 2023, in Electrical Engineering.
- On July 3, 2024, appointed Associate Professor of Electrical Engineering at the Department of Civil, Computer Science, and Aeronautical Technologies Engineering, Roma Tre University.

Scientific Publications and Industrial Patents

Author of 146 scientific publications and 13 industrial patents.

- 45 scientific publications in international journals (17 of which are IEEE Transactions);
- 10 book chapters published in English;
- 77 contributions presented at international conferences;
- 14 contributions published in national journals and conferences;
- 13 industrial patents (9 in the USA and Europe, 1 in China, 3 in Italy).

An analysis conducted using the "SCOPUS-SciVerse" tool attributes to Prof. Caliano's scientific production an h-index of 26, with a total citation count of 2220 (April, 2025).

Research Activities

The research activity is divided into two phases:

From 1993 to 1995, at the University of Salerno:

- Models and methodologies for bidimensional barcode decoding.
- Development of piezoelectric pressure sensors.
- Measurement techniques for the characteristic parameters of piezoelectric ceramics.
- Design and realization of a new ultrasonic transducer for use in medical rehabilitation therapy and medical diagnostics.

From 1997 to the present, at Roma Tre University:

- Microfabricated silicon-based ultrasonic transducers (CMUT) for medical ultrasound imaging.
- Piezoelectric ultrasonic transducers for medical-diagnostic applications.
- Optimization techniques for biomedical ultrasound imaging.

- Integrated circuits and digital systems for interfacing ultrasonic transducers with medical-diagnostic imaging systems.
- Piezoelectric ultrasonic actuators and motors for applications in ophthalmic ultrasound and endoscopy.
- Biometric applications of ultrasound.
- Acoustic-optical interactions.
- Development of digital interface boards.
- Development of digital interfaces for network-connected smart sensors.
- Non-destructive in situ analysis of cultural heritage using contact and non-contact sonic techniques, as well as for industrial, avionics, and civil materials.

List of Titles

A – Participation in and/or Coordination of International and National Research Projects Funded Through Competitive Peer-Reviewed Calls

1. Integrated CNR/IESS – DIE/Roma Tre University Project titled *"Development of capacitive transducers through silicon microfabrication for applications in ultrasound techniques,"* 1998.
2. *"Integrated Italy-Spain Actions"* project titled *"Modeling and optimization of Langevin-type piezoelectric structures for applications in actuators and high-power ultrasound generation,"* 1999.
3. Research project titled *"Design and realization of the upgraded SOMMA sonar system (Sonar Multifunction Multibeam for Antarctic applications),"* under the "Technology" sector of the National Antarctic Research Program (PNRA), 2001.
4. Operational Manager for ACULAB in the UMIC-EUREKA E!2145 project titled *"Ultrasound Probes Exploiting Microstructures for Medical Echography and Non-Destructive Testing Applications,"* in collaboration with CNR/IESS (Rome), ESAOTE BIOMEDICA S.p.A. (Genoa), THOMSON MICROSONICS (France), IMASONIC (France), and CNR/LMPO (France), 2000-2005.
5. Project titled *"Study, design, and realization of a high-frequency transducer for ophthalmic applications,"* OPTIKON 2000 S.p.A., Rome, 2001.
6. Operational Manager for Aculab in the PRIN-2002 project: *"Piezoelectric actuator system for wave generation in lubricated cylindrical bearings to control fluid film force,"* 2003-2004.
7. Integrated Italy-Spain IT1135 Project for MEMS bidimensional transducer studies, in collaboration with CSIC, 2003-2004.
8. Operational Manager for Aculab in the FP6 Project MUSTWIN (NMP-CT-2003-505630) for the development of MEMS-based ultrasound probes for medical diagnostics, with European partners (Imasonic, France; CNRS, France; CEA-LETI, France; INOSON GmbH, Germany; Telemed, Lithuania; Esaote, Italy; IR Microsystems, Switzerland; EPFL, Switzerland; Cranfield University, UK; Thales Research and Technology France, France), 2004-2007.
9. Operational Manager for Aculab in the FIRB 2001 project of the Ministry of University and Research, with Italian partners (University of Rome Tor Vergata, CNR) for MEMS air transducer studies for localization, *"Microtechnologies for immersive virtual telepresence,"* RBNE01PMZA-006, 2004-2005.
10. Operational Manager for Aculab in the PRIN 2007 project of MIUR titled *"Ultrasound probe on silicon for advanced diagnostic applications,"* prot. 2007KBK3C8, 2008-2009.
11. Scientific coordinator of the project *"Development and testing of a front-end electronics embedded in a CMUT probe,"* funded by the U.S.-based company MAXIM-IP, one of the top five companies in microelectronics, 2011.
12. Scientific coordinator of the project *"Development of a 192-elements linear CMUT probe,"* funded by General Electric (GE) Health Care through its French subsidiary Parallel Design SaS, 2012.
13. Operational Manager for Aculab in the PRIN 2010-11 project of MIUR titled *"Research platform based on CMUT probe technology for advancing medical ultrasonography through new image formation strategies and signal processing,"*, 2013-2015.
14. Scientific coordinator of the project *"Development of a low-frequency (30-100kHz) ultrasonic projector,"* funded by the Israeli company Microtech Medical Technology Ltd., 2013-2014.
15. Saphari Project (Eurostars E!6771): *"A prototype probe fabricated in CMUT-on-silicon technology,"* conducted as part of a European project in collaboration with Dune srl, 2014-2015.
16. Scientific coordinator of the Roma Tre Unit in the DENECOR project (*Devices for Neurocontrol and Neurorehabilitation*), FP7-ENIAC-JU (ID. SP1-JTI-ENIAC-2012-3), coordinated by Philips Medical System, with 22 European partners, a total budget of €20 million, 2013-2016.
17. Coordinator and scientific director of the project *"PICUS: Low-cost portable system for the diagnosis and monitoring of defects and detachments in artworks, supporting restorers and conservators,"* as part of the research program of the Lazio Region, in collaboration with CNR-INM and the University of Tuscia, 2021-2023.

B – Reviewer Activity for International Journals

1. Referee for the international journal *"Transaction on Ultrasonics, Ferroelectrics, and Frequency Control"* of IEEE since 1998.
2. Referee for the journal *"Sensors & Actuators Part A"* since 1999.
3. Referee for the journal *"Ultrasonics"* since 1998.
4. Referee for the journal *"Optical Letters"* since 2005.
5. Referee for the journal *"Journal of Micromechanics and Microengineering"* since 2005.
6. Referee for the journal *"Microelectronics Reliability"* since 2021.
7. Member of the Editorial Board (Associate Editor) of the journal *"Applied Sciences"* (Acoustics and Vibrations Section) since 2018.
8. Reviewer for research projects of the French National Research Agency (ANR France) since 2019.

C – Teaching Activity

1. In the academic years 1993/94 and 1994/95, conducted exercises for the courses *"Electronic Components"* and *"Applied Electronics"* at the Faculty of Engineering, University of Salerno, under Prof. M. Pappalardo.
2. In the academic year 1998/99, conducted exercises for the course *"Electronics II"* in the Electronic Engineering program, Roma Tre University.
3. In 2000, was assigned teaching responsibilities as part of the operational program *"Research, Technological Development, and Higher Education,"* Sub-program II Measure 3 *"Training for Industrial Research,"* for the course *"Structural Problems and Control Methods for the Preservation of Cultural and Environmental Heritage"*, held at the Institute of Information Processing - CNR - Pisa.
4. In the academic years 1998/99 and 1999/00, conducted exercises for the course *"Electronics I"* in the University Diploma in Electronic Engineering program.
5. In the academic years 1997/98 through 2005/06, 2010/11, and 2011/12, held seminars and exercises in the course *"Sensors and Detectors"* in the Electronic Engineering program, Roma Tre University.
6. In the academic years 1998/99 and 1999/00, held seminars and exercises for the course *"Electronic Instrumentation and Measurements"* in the Electronic Engineering program, Roma Tre University.
7. Served as a supervisor for graduate theses and as a doctoral thesis advisor.
8. From the academic year 2012/13 to 2019/20, was assigned teaching responsibilities by the Faculty of Engineering, Roma Tre University, for the course *"Sensors and Transducers"* in the Master's Degree program in Electronic Engineering.
9. From the academic year 2017/18 to 2019/20, was assigned teaching responsibilities by the Faculty of Engineering, Roma Tre University, for the course *"Electronics Laboratory"* in the Master's Degree program in Electronic Engineering.
10. Starting from the academic year 2024/25, holds the teaching assignment for the course *"Electrotechnics"* in the Bachelor's Degree program in Civil Engineering.

D – Participation in Foreign Research Institutions

1. CSIC Madrid (*Consejo Superior de Investigaciones Científicas*), Center for Applied Acoustics and Non-Destructive Evaluation, Spain (1999-2000 and 2003-2004).
2. Franche-Comté Electronique Mécanique Thermique et Optique (FEMTO-CNRS), Time-Frequency Department, Besançon, France (2001).

E – Awards and Recognitions

1. Founder of the *"International Workshop on Microfabricated Ultrasonic Transducers"* and member of its Scientific Committee since its inception.
2. Organized and served as *General Chair* for three editions of the *"International Workshop on Micromachined Ultrasonic Transducers"* (2001 in Rome, 2011 in Salerno, 2016 in Rome).
3. Served as *Local Chair* of the 52nd IEEE *International Ultrasonics Symposium* held in Rome in 2009.
4. Awarded the title of *Senior Member* of IEEE on January 1, 2013.
5. Received the *Best Makers 2020* award from the Lazio Region and the Chamber of Commerce of Rome for the development of the non-contact analysis system *PICUS CL* for artworks, presented at Maker Faire 2020.

F – Technology Transfer Results

1. Served as the scientific coordinator of the project *"Development of a Low-Frequency (30-100kHz) Ultrasonic Projector,"* a research project funded by Microtech Medical, Tel Aviv, Israel (2013-2014).
2. Served as the scientific coordinator of the project *"A 192-elements Linear CMUT Probe,"* a research project funded by General Electric Health Care - Parallel Design SaS, France (2012).
3. Served as the scientific coordinator of the project *"Development and Testing of a Front-End Electronics Embedded in a CMUT Probe Previously Developed by Aculab Laboratory,"* a research project funded by MAXIM Semiconductor IP, USA (2011).
4. In January 2009, co-founded and was among the applicants for an academic spin-off of Roma Tre University (*Aculab Ultrasounds Srl*), receiving approval from both Roma Tre University and National Ministry of University.
5. Collaborated with numerous companies on the development, application, and commercialization of the 13 patents created.

G – Collaborations with Research Institutions and Universities

- CNR - Istituto di Acustica "Corbino", Rome: *"Innovative ultrasound therapy transducers project,"* 1994.
- CSIC Instituto de Acústica, Madrid: Collaboration within two integrated Italy-Spain projects, 1999 and 2003-2004.
- CNR-IESS (now IFN), Rome: Collaboration from 1998 to 2007 on various research projects (mentioned in the projects section) involving MEMS/CMUT device technology research groups.
- ENEA (Casaccia), Rome: Collaboration within the National Antarctic Research Program (PNRA), 2001-2002.
- University of Salerno, Department of Mechanical Engineering: Collaboration within the PRIN 2002 project.
- CNRS-LMPO, Besançon (France): Collaboration within the EUREKA *"UMIC"* and FP6 *"MUSTWIN"* projects, 2000-2007.
- University of Rome "Tor Vergata", Department of Electronics: Collaboration within the FIRB 2001 project.
- CEA-LETI, Grenoble (France): Collaboration within the FP6 *"MUSTWIN"* project, 2004-2007.
- EPFL, Lausanne (Switzerland): Collaboration within the FP6 *"MUSTWIN"* project, 2004-2007.
- Cranfield University, UK: Collaboration within the FP6 *"MUSTWIN"* project, 2004-2007.
- Mediterranean University of Reggio Calabria, DIMET: Collaboration within the PRIN 2007 project, 2008-2009.
- University of Basilicata, DIFA: Collaboration within the PRIN 2007 project, 2008-2009.
- University of Salerno, DIIMA: Collaboration within the PRIN 2007 project, 2007-2009.
- Fondazione Bruno Kessler (FBK), Trento: Collaboration in various bilateral research projects for developing MEMS/CMUT transducer technology (since 2007).
- CNR-IMM, Rome: Collaboration in bilateral research projects on silicon removal techniques (since 2009).
- University of Florence, Department of Electronics and Telecommunications: Collaboration in ultrasound probe research applied to Doppler analysis, leading to the PRIN 2011 project.
- University of Pavia, Department of Electronics: Collaboration in modeling integrated front-end systems for MEMS/CMUT probes.
- CNR-INM (Marine Engineering), Rome: Collaboration in bilateral research projects developing non-destructive analysis techniques for artistic and cultural heritage.

H – Service Activities at Roma Tre University

- Employed at Roma Tre University on October 13, 1997 as responsible for the Acoustoelectronics Laboratory (ACULAB).
- Participated in numerous departmental committees, including those for hiring contract staff and conducting elections and competitions.
- Appointed as Associate Professor at Roma Tre University on November 1, 2024.
- On December 11, 2024, appointed as the Quality Assurance Manager (RAQ) for teaching.

Detailed Curriculum Vitae

Giosuè Caliano graduated with honors in Electronic Engineering from the University of Salerno in May 1993, with a thesis titled *"Bidimensional Reading of the Barcode,"* supervised by Prof. M. Pappalardo [NC3], which was later patented [PT10].

He began his research career as a contractor at the Department of Information and Electrical Engineering of the Faculty of Engineering at the University of Salerno. His work focused on models and methodologies for bidimensional barcode decoding, the development of piezoelectric pressure sensors [IJ1], and measurement techniques for the characteristic parameters of piezoelectric ceramics [IC1].

Starting in November 1993, he collaborated in teaching activities under the guidance of Prof. Massimo Pappalardo's Electronics group.

In 1994, he was awarded a scholarship from *Biorem S.r.l., Elettromedicali* to conduct research on the study and development of transducers for ultrasound therapy. In this context, he designed and developed a new ultrasonic transducer for use in medical rehabilitation therapy [IJ2].

From 1995 to 1997, his academic activities were interrupted as he joined F.O.S. Fibre Ottiche Sud (Pirelli Group, now Prysmian Inc.), where he served as an Industrial Automation and Control Engineer, overseeing the development of measurement machines.

Research Activities *(The bibliography references the attached list of publications)*

The research activity focuses on the development and modeling of ultrasound sensors and transducers, utilizing both traditional piezoelectric ceramics technology and planar silicon technology, along with their applications.

Silicon Microfabricated Ultrasound Transducers (MEMS CMUT) for Medical Ultrasound

Dr. Caliano has been involved in research on this new family of MEMS electronic devices since 1998, being one of the first globally to explore this area. This has represented his primary research focus between 1998 and 2018.

In recent years, the capacitive technique has been revisited for generating and receiving ultrasonic waves as an alternative to the piezoelectric method [IC12]. Essentially, one plate of a parallel-plate capacitor (capacitor microphone) can be used as a transducer. While the principle has been known for nearly a century, recent advancements in silicon microelectronics technology have enabled the creation of micro-capacitors small enough to operate at frequencies suitable for ultrasonic applications [IJ3, IC3, NJ1]. Capacitive transducers can be microfabricated on silicon wafers and function as an array of "capacitor microphones," where the movable plate typically consists of a thin silicon nitride membrane (a few microns thick), positioned fractions of a micron above the fixed electrode, usually the silicon substrate itself [IJ8, IJ10, IJ11, IC4, IC6, IC8, NC4, NC5, NC6]. The greater structural control provided by this new microelectronic technology improves performance in terms of sensitivity, bandwidth, dynamic range, and higher achievable operating frequencies. Moreover, the compatibility of this technology with the fabrication of electronic devices (e.g., BiCMOS) allows for the combination of transducing elements with drive and acquisition electronics, either integrated on the same wafer or through hybridization techniques. Dr. Caliano has worked on developing the analytical model of capacitive transducers [IJ5] and the PSpice model [IJ8]. He designed and developed a novel fabrication technology for CMUT devices, protected by an industrial patent [PT1, IC28]. This innovation formed the basis of a university spin-off initiative.

The developed technology has generated significant interest in the scientific and industrial communities due to its unique features. Notably, all known MEMS-CMUT fabrication processes, referred to as "sacrificial release," involve micro-holes on the transducer surface. These holes are required to evacuate the cavities beneath the membranes and, in the case of two-dimensional arrays, to electrically connect the upper pads to the lower ones, enabling external circuit connections. However, the presence of these evacuation holes negatively impacts membrane uniformity and the sealing of the underlying cavities. Additionally, the holes significantly affect the fill factor, especially in high-frequency transducers, limiting the ability to achieve very wide bandwidths and high sensitivity. A new fabrication concept was proposed by Dr. Caliano, known as the *"Reverse Technology (RT)"*. The capacitive cell is not fabricated, as in the standard process, by growing successive layers on a silicon wafer (as in classical microelectronics), but instead by reversing the sequence of layers. The device is built starting from an LPCVD silicon nitride layer deposited on a silicon wafer using a standard process. Finally, once the CMUT structure is realized, the bulk silicon wafer supporting the device is completely removed, and an acoustically active support substrate is added on the opposite side, allowing the device to vibrate freely. By working on the back of the device, it is not necessary to create holes in the vibrating silicon nitride structural layer to evacuate the cavities. The device is fabricated using a commercial silicon wafer, and the process temperatures do not exceed 350°C, enabling the use of a wide range of materials. The connection pads are already available on the back of the die, ready for soldering using flip-chip bonding techniques. Generally, CMUT devices fabricated with the conventional technique require the use of a large number of lithographic masks (>15). The technique developed by Dr. Caliano reduces the number of masks to seven. Another innovation of the RT process concerns the acoustic support, which also serves as a mechanical support. Due to the high acoustic impedance of silicon, the use of a silicon-based ultrasonic transducer introduces several challenging problems; all technologies reported in the literature use a relatively thick silicon mass (>350 microns) as support for the active device. In the RT process, there are only 4 microns of silicon nitride beneath the active device, and the support material (composed of epoxy resins loaded with various powders) has been studied and characterized to not only provide mechanical support to the device but fundamentally to act as an absorber of the acoustic energy emitted backward by the device itself [PT1, IJ23, IJ27, B4, IC35, IC36, IC37, IC39, IC44]. The modeling work has led to significant advancements, both in determining the electromechanical coupling coefficient and in the experimental mapping of the vibrations of individual membranes. Important considerations regarding front-end electronics for these types of transducers have also been developed. The technological process was supported by the technological laboratories of the CNR (Institute of Solid State Electronics, now IFN) in Rome, the IMM (Institute of Microelectronics and Microsystems) of the CNR, and the Fondazione Bruno Kessler in Trento (formerly ITC-IRST, Trentino Institute of Culture), as well as a foundry at Lionix-BV, a spin-off of the University of Twente (Netherlands), for mass production.

From the outset, the entire activity was funded by both the CNR and the industry (ESAOTE S.p.A.) and, starting in 2000, received funding from the European Union through the EUREKA program (*UMIC Project E!2145*), the FP6 program (*MUSTWIN Project*), and the FP7 program (*DENECOR Project*), with a total budget of several million euros aimed at designing and producing ultrasound probes based on the new devices. Dr. Caliano (operational manager for Roma Tre) played a key role in coordinating activities between international and Italian partners as a Work Packages leader. The UMIC project activities led to the development of both single-element transducers and sub-arrays (six-element and 4x2-element arrays), culminating in the creation of the first 64-element ultrasound probe. In 2003, using this device, Dr. Caliano was the first researcher in the world to connect it to a commercial ultrasound machine and obtain the first in vivo images of internal organs.

In the subsequent European MUSTWIN project (with a budget of approximately €2.5 million), the first 192-channel ultrasound probe was developed, marking the project's complete success. This also included the refinement of the previously mentioned *"Reverse Technology (RT)"*, which resulted in a patent covering the device construction technology. This patent was extended beyond Europe to include the United States, China, and Japan. With the collaboration of ESAOTE, the 192-element CMUT probe developed during this period was successfully implemented on commercial ultrasound machines, achieving excellent results in diagnostic imaging. This probe served as the foundation for the spin-off project previously presented to Ministry of University and Roma Tre University. In subsequent years, the 192-element probe was optimized and engineered. With the collaboration of Maxim Semiconductors Inc., a custom 8-channel front-end electronics system on a single chip was developed, designed by Dr. Caliano and his collaborators. This chip, cataloged by Maxim as MAX4805A, was specifically designed to be used in conjunction with the CMUT probe, simplifying the complex front-end electronics previously used by a factor of at least five. The MAX4805A integrated circuit features: high channel density (8 channels per package, 5mm x 5mm, 32-pin TQFN); low power dissipation (8mW/channel); bandwidth of 44MHz; low voltage noise of 2.2nV/√Hz; low current noise of 1.7pA/√Hz. The American company also funded the research with a contract for which Dr. Caliano was the scientific coordinator. The same probe, based on the *"Reverse Technology"*, also attracted significant interest from General Electric Healthcare, which invested a substantial amount in a contract with Roma Tre University (for which Dr. Caliano was the scientific coordinator) to continue the probe's characterization and research in the field.

Technological research in recent years has led to the design of a 256-channel probe (within the PRIN 2011 project), based on the *Reverse Technology*, and afterwords, a matrix probe (128+128 channels) within the European DENECOR project (2016), in close collaboration with STMicroelectronics and the University of Florence. The main application of this probe is in the cardiovascular field, particularly for the analysis of carotid arteries. This probe is highly complex as it integrates, on two bonded silicon dies, both the matrix ultrasound probe and the complete control and transmission/reception electronics. The ASIC was produced at STMicroelectronics, while the matrix probe was designed by Dr. Caliano and his collaborators and manufactured at FBK Trento. The bonding process between the dies, implementing the new 3D-interconnect copper technology, was carried out at the Fraunhofer Institute IZM in Berlin, the only institution in Europe equipped with this technology.

Dr. Caliano, in 2009, as part of activities ancillary to research in the field of silicon acoustic transducers, designed and developed a measurement machine for acoustic transducers operating up to 30 MHz. This machine employed a parallel processor architecture capable of generating high-voltage sinusoidal burst signals (up to +/- 100 V) and was fully interfaced with other laboratory equipment, achieving performance levels not attainable with commercially available devices.

Piezoelectric Ultrasound Transducers for Medical-Diagnostic and Consumer Applications

In this field, the research focused on modeling structures, fabrication, optimization techniques, and applications. In modeling work, a matrix model for piezoelectric disks and rings was proposed. This model considers the interaction with the surrounding medium to compute the corresponding transfer functions [IJ1, IC1, NC1, NC2]. It enables the calculation of the spatial distribution of radial displacements. Optimization techniques for piezoelectric ceramic-based ultrasound transducers led to a new approach in designing power transducers for therapeutic applications [IJ2] and imaging diagnostics [IC2, IC5, IC9]. A power transducer with an unrestricted bandwidth was designed and successfully implemented in ultrasound therapy machines using a newly conceived criterion (research funded by BIOREM S.p.A.).

Research explored new criteria for determining distortions introduced by inter-element coupling in ultrasound probes and for optimizing the coupling layer between the probe and the propagation medium. Both projects were funded by ESAOTE, a European leader in medical ultrasound equipment.

Dr. Caliano proposed the first pressure sensor based on a ceramic-metal bimorph, capable of measuring pressures greater or less than atmospheric pressure with direct frequency reading. The sensor, with minimal cost, can be designed to measure widely varying pressure ranges [IJ1].

An industrial application of ultrasound was presented in [IJ15, IC41]. The problem addressed was the *"lubrication"* of continuous molten steel streams in molds. The basic idea was to excite the natural vibration modes of the continuous steel stream in the molds using a distributed number of high-power ultrasound sources placed strategically.

First, the vibrational characteristics of a rectangular mold were characterized both through modeling and experimentally using a laser vibrometer. Subsequently, a set of up to four Langevin-type high-power piezoelectric transducers, specifically designed and manufactured, were positioned to maximize the achievable displacement.

Afterwards, Dr. Caliano initiated a new activity on piezoelectric-metal bimorphs to develop trackpads for mobile phones [IJ33, IC43] and innovative humidity sensors, in collaboration with the University of Salerno.

Optimization Techniques for Biomedical Ultrasound Imaging

Dr. Caliano, in close collaboration with the University of Pavia, focused on optimization techniques for B-mode ultrasound imaging. Most ultrasound medical imaging systems currently on the market use the standard *Delay and Sum (DAS)* technique to form B-mode images. However, the resolution and contrast achievable with this technique are limited by the aperture size and operating frequency.

Various beamformers have been presented in the literature to overcome these limitations, primarily based on adaptive algorithms, which deliver superior performance at the cost of increased computational complexity.

In this line of research, an alternative linear beamforming algorithm known as *Delay, Multiply, and Sum (DMAS)* was proposed. Originally conceived for microwave systems in breast cancer detection, the DMAS beamformer was modified and tested both in simulation and experimentally. The results demonstrated that the DMAS beamformer outperformed the standard DAS technique, particularly showing significantly higher contrast resolution, resulting in a wide dynamic range and improved B-mode image quality [IJ34, IJ40, IC55, IC60, IC63, IC65]. This work has been widely cited in the literature.

Integrated Digital Electronic Circuits and Systems for Interfacing Ultrasound Transducers with Medical-Diagnostic Imaging Systems

A research line on integrated electronic topologies for the front-end sections of ultrasound systems was initiated in collaboration with STMicroelectronics and the University of Pavia. Starting from a basic simulator implementing the topology of a μ-beamformer and an optimized receiver [IJ32], a complex integrated Tx-Rx front-end for CMUT transducers was developed, utilizing high-voltage BCD-SOI technology [IC52, IJ41, IC54, IC57].

The chosen topology (capacitive feedback) offers a significant improvement in SNR compared to the commonly adopted trans-resistance topology. The integrated system was designed to operate in the 1-15 MHz range and includes an Rx amplifier with low power consumption, a high-voltage Tx/Rx switch, and a 100V driver in Tx mode. Compared to previously reported front-end systems, the implemented transceiver shows an extensive dynamic range and noise performance that is state-of-the-art in the field. The Rx amplifier's power dissipation is only 1 mW, enabling the integration of hundreds of channels (256) on a single chip. Additionally, the noise normalized for power dissipation is more than twice as good as previously reported CMUT amplifiers.

Piezoelectric Ultrasonic Actuators and Motors for Applications in Ophthalmic and Endoscopic Ultrasound

Dr. Caliano, in collaboration with other researchers, focused on developing the “acoustic fiber” for power applications, proposing a flexible motor suitable for actuating ultrasound transducers for endoscopic ultrasound (the motor has a diameter of 3 mm and a length of 500 mm) [IJ4, IJ23, IC10].

Subsequently, a mechanical scanning system for ophthalmic ultrasound was designed and developed, based on a small piezoelectric ultrasonic motor. The prototype achieved a scanning speed of 15 sectors per second, exhibiting remarkable characteristics such as minimal weight and quiet operation. Numerous in-vivo tests were conducted, producing ultrasound images of the cornea and internal eye organs. This activity was carried out as part of a research project funded by MIUR and the company Optikon 2000, a leader in ophthalmic equipment in Italy [IJ20, IC24].

Biometric Applications of Ultrasound

Dr. Caliano, in collaboration with other researchers, applied the CMUT transducers developed at ACULAB to the field of ultrasound biometrics, a promising area of research that is still less explored compared to the primary field of medical ultrasound imaging.

Ultrasound systems for biometric applications have proven to be a valid alternative to current optical scanners. The use of ultrasonic waves offers intrinsic advantages over other methods. Ultrasonic waves are insensitive to surface contaminants (oil, grease, dust, etc.) and can provide information not only about the surface of the skin but also about the underlying volume of the investigated region. Additionally, ultrasonic waves can determine whether the subject under examination is alive (via Doppler investigation of vessels), a capability that conventional optical biometric systems lack.

The results obtained [IJ27, IJ31, IC36, IC38, IC40, IC47, IC51] are encouraging. Specifically, an FEM model of the CMUT device was developed to design a 192-element high-frequency array (12.5 MHz center frequency). The probe was fabricated using the previously described *Reverse Technology*. Measurements were compared with model predictions, showing excellent agreement. Experimentally, ultrasonic fingerprint images and palm print scans were produced for biometric purposes.

Acousto-Optic Interactions

Dr. Caliano developed a machine for measuring and visualizing acoustic beams based on acousto-optic interaction, also known as the *Schlieren method*. The machine is innovative as it employs holographic techniques, significantly reducing the equipment size (less than one meter in length) while enabling the visualization of very long beams (up to 30 cm) at high acoustic frequencies (up to 40 MHz). It uses lenses with diameters of 2-4 cm and focal lengths of approximately 20 cm, utilizing a computer-based segmented beam image reconstruction technique.

Additionally, the machine can perform axial tomography of the beam section at any distance from the active device [IJ30, IC30].

Non-Destructive In Situ Analysis of Ancient Frescoes Using Sonic Techniques

Dr. Caliano developed a technique for in situ measurement of the conservation state of ancient frescoes and, more generally, the architectural covering layers of artworks [IJ43, IJ44, IJ45, IC72, IC73, IC74, PT12]. The technique, based on sonic analysis (frequency and time-domain) of the impact of a calibrated striker on the surface, enables the creation of a two-dimensional map of underlying defects. This approach led to the development of a portable and low-cost machine (called PICUS) that also allows for long-term monitoring of defect evolution. This capability aids restorers in designing appropriate intervention and, if necessary, recovery plans.

A recently developed technique achieves the same output without using a calibrated striker, instead employing a focused parametric acoustic beam, allowing for non-contact analysis of artworks, which significantly benefits the field. This advancement also resulted in the design and production of a portable, low-cost machine based on commercially available microcontroller boards (Arduino). Both techniques can also be applied in civil engineering for the analysis and diagnosis of complex structures such as bridges and tunnels, as well as in industrial settings for non-destructive analysis of composite and non-composite materials and specialized materials used in avionics and the space industry. This work earned Dr. Caliano the *"Best Maker 2020"* award from the Lazio Region, established by the Chamber of Commerce of Rome and Lazio Innova, as mentioned elsewhere. In April 2021, the Lazio Region awarded €150,000 in funding for the two-year research project *"PICUS"* under the *"Progetti di Gruppi di Ricerca"* call, for which Dr. Caliano serves as coordinator and scientific director, in collaboration with the University of Tuscia and CNR-INM.

The future scenarios on which Dr. Caliano is working involve the integration of Artificial Intelligence (AI) in the analysis and recognition of measured data. The developed PICUS tool features a WiFi interface that connects to a network infrastructure, enabling the transmission of measurement data to the cloud, where it is processed by specifically developed neural networks. The results of these processes are directly available in the cloud, allowing operators to access them via a smartphone and share the measurements with other colleagues who can monitor them remotely in real time, even from another part of the world. Dr. Caliano, together with his collaborators, has developed a neural network that, using Deep Learning techniques, can accurately classify adhesion defects with high precision through a supervised approach tailored by the AI designed for this purpose. The AI-based method offers numerous advantages over the traditional auscultation approach commonly used by professionals in the field of conservation and restoration. The conventional method is often sensitive to boundary conditions and can involve significant physical effort. Although operated by humans, the AI-based method is less prone to bias and external conditions. It relies on objective criteria, enhancing the repeatability of condition assessments. By leveraging AI algorithms, the method can quickly and accurately identify defects and areas requiring intervention, streamlining and optimizing the overall process.

Development of Digital Interfaces for Network-Connected Smart Sensors

Dr. Caliano worked also on developing hardware-software interfaces for network-connected smart sensor systems, including cooperative and distributed operation. This research began in late 2020 and resulted in an article in the national press [NJ3], showcasing an application example managed via a smartphone app with data exchange through the cloud.

Professional Activity

From 1995 to 1997, employed at F.O.S. Fibre Ottiche Sud (Pirelli Group) as an Industrial Automation and Control Engineer, responsible for the development of measurement machines.
In this context, he conceived, designed, and implemented a machine for measuring the geometric characteristics of pre-processed glass (MGC) used in the field of optical fibers; this equipment specializes in the geometric measurement of glass bars ("cane") constituting the future "core" of optical fibers. Currently, nine examples of this machine are operational on production lines at the Prysmian-FOS plant in Battipaglia (SA).
He characterized and developed a machine for measuring the dimensions and defects of optical fibers, based on an interferometric laser beam meter (IDM).
He developed a theoretical-experimental method for calibrating high-power RF generators (>30 kW) for electromagnetic induction furnaces used in the production of optical fibers. These machines, based on a triode power oscillator, tuned at the grid and plate, require precise calibration to withstand the power surges needed during the various fiber drawing cycles.
He is a designer of electronic measuring instruments, with particular specialization in digital electronics, microcontrollers, microprocessor systems, and networking.
He is a designer of industrial electrical systems and lighting systems in the field of public works.

Bibliography

International journal

[IJ1] G. Caliano, N. Lamberti, A. Iula, M. Pappalardo: "A Piezoelectric Bimorph Static Pressure Sensor"; Sensors and Actuators, A. Physical vol. 46, No. 1-3, pp. 176-178, 1995.

[IJ2] N. Lamberti, G. Caliano, A. Iula, M. Pappalardo: "A New Approach for the Design of Ultrasono-Therapy Transducers"; IEEE Trans. on Ultrasonics, Ferroelectrics and Frequency Control, Vol. 44, No. 1, Jan. 1997, pp. 77-84

[IJ3] G. Caliano, V. Foglietti, E. Cianci, M. Pappalardo: "A Silicon Microfabricated Ultrasonic Transducer: 1 MHz Trasmission in Air and in Water"; Microelectronic Engineering 53 (2000), pp. 573-576, Elsevier Science

[IJ4] R. Carotenuto, A. Iula, G. Caliano, N. Lamberti: "Flexible piezoelectric motor based on an acoustic fiber"; Applied Physics Letters - September 2000 – Vol. 77, Issue 12, pp. 1905-1907

[IJ5] A. Caronti, A. Iula, G. Caliano, M. Pappalardo: "An accurate model for capacitive micromachined ultrasonic transducers"; IEEE Trans. on Ultrasonics, Ferroelectrics and Frequency Control, vol.49 (2) 2002, pp. 159-168

[IJ6] A. Caronti, H. Majjad, S. Ballandras, G. Caliano, R. Carotenuto, A. Iula, V. Foglietti and M. Pappalardo: "Vibration Maps of Capacitive Micromachined Ultrasonic Transducers by Laser Interferometry"; IEEE Trans. On Ultrasonics, Ferroelectrics and Frequency Control, vol. 49 (3) 2002, pp. 289-292

[IJ7] D. Memmi, V. Foglietti, E. Cianci, G. Caliano, M. Pappalardo: "Fabrication of capacitive micromechanical ultrasonic transducers by low temperature process"; Sensors and Actuators A: Physical, Volume: 99, Issue: 1-2, April 30, 2002, pp. 85-91

[IJ8] G. Caliano, A. Caronti, M. Baruzzi, A. Rubini, A. Iula, R. Carotenuto, M. Pappalardo: "PSpice modeling of capacitive microfabricated ultrasonic transducers"; Ultrasonics, Vol. 40, Issue 1-8, pp. 449-455, Elsevier Science

[IJ9] E. Cianci, V. Foglietti, D. Memmi, G. Caliano, A. Caronti, M. Pappalardo: "Fabrication of capacitive ultrasonic transducers by a low-temperature and fully surface-micromachined process", Precision Engineering, Volume: 26, Issue: 4, October, 2002, pp. 347-354

[IJ10] E. Cianci, V. Foglietti, G. Caliano, M. Pappalardo: "Micromachined capacitive ultrasonic transducers fabricated using silicon on insulator wafers", Microelectronic Engineering, Volume: 61-62, July, 2002, pp. 1025-1029

[IJ11] N. Lamberti, A. Iula, R. Carotenuto, G. Caliano, M . Pappalardo: "The electromechanical coupling factor for longitudinal and transverse propagation modes"; Revista de Acustica, Vol. XXXIII, num. 3-4 (2002) ISSN: 0210-3680

[IJ12] R. Carotenuto, G. Caliano, A. Caronti, and M. Pappalardo, "Resolution enhancement of experimental echographic images using luminance extrapolation", IEEE Trans. on Ultrasonics, Ferroelectrics and Frequency Control, vol. 51 (3) 2004, pp. 364-367

[IJ13] E. Cianci, L. Visigalli, V. Foglietti, G. Caliano, M. Pappalardo, ""Improvements towards a reliable fabrication process for cMUT", Microelectronic Engineering 67-68 (2003) pp. 602-608

[IJ14] A. Caronti, R. Carotenuto, G. Caliano, M. Pappalardo, "The effects of membrane metallization in capacitive microfabricated ultrasonic transducers," J. Acoust. Soc. Am. 115 (2) Feb. 2004, pp.651-657

[IJ15] A. Iula, G. Caliano, A. Caronti, M. Pappalardo: ""A Power Transducer System for the Ultrasonic Lubrication of the Continuos Stell Casting"; IEEE Trans. on Ultrasonics, Ferroelectrics and Frequency Control, vol. 50 (11), 2003, pp. 1501-1508

[IJ16] E. Cianci, A. Minotti, V. Foglietti, G. Caliano, M. Pappalardo: ""One-dimensional capacitative micromachined ultrasonic transducer arrays for echographic probes", Microelectronic Engineering 73-74 (2004) pp. 502-507

[IJ17] R. Carotenuto, G. Caliano, A. Iula, M. Pappalardo, "Langevin Flexural Piezoelectric Motor Based on Stator Precessional Motion" Sensor & Actuators, vol. 113, no. 2, pp. 189-197, 2004.

[IJ18] G. Caliano, R. Carotenuto, E. Cianci, V. Foglietti, A. Caronti, A. Iula, M. Pappalardo: "Design, fabrication and characterization of a capacitive micromachined ultrasonic probe for medical imaging", IEEE Trans. On Ultrasonic, Ferroelectrics and Frequency Control, vol. 52 (12), pag. 2259-2269, 2005

[IJ19] G. Caliano, A. Savoia, A. Caronti, V. Foglietti, E. Cianci, and M. Pappalardo, "Capacitive micromachined ultrasonic transducer with an open-cells structure" Sensors&Actuators A: Physical, Volume 121, Issue 2, 30 June 2005, Pages 382-387

[IJ20] R. Carotenuto, G. Caliano, A. Caronti, A. Savoia, and M. Pappalardo: "Fast Scanning Probe for Ophthalmic Echography Using an Ultrasound Motor" IEEE Trans. On Ultrasonic, Ferroelectrics and Frequency Control, vol. 52 (11), pag. 2039-2046, 2005

[IJ21] A. Caronti, A. Savoia, G. Caliano, and M. Pappalardo: "Acoustic Coupling in Capacitive Microfabricated Ultrasonic Transducers: Modeling and Experiments" IEEE Trans. On Ultrasonic, Ferroelectrics and Frequency Control, vol. 52 (12), pag. 2220-2234, 2005

[IJ22] A. Caronti, G. Caliano, R. Carotenuto, A. Savoia, M. Pappalardo, E. Cianci and V. Foglietti: "Capacitive micromachined ultrasonic transducer (CMUT) arrays for medical imaging" Microelectronics Journal, Vol. 37, Issue 8, August, 2006, pp. 770-777

[IJ23] R. Carotenuto, G. Caliano, A. Caronti, A. Savoia, M. Pappalardo: "Flexible acoustic fiber ultrasound motor modeling using impedance and transmission matrices" IEEE Trans. On Ultrasonic, Ferroelectrics and Frequency Control, Vol. 53 (7), pag: 1381-1386, 2006

[IJ24] A. Coppa, E. Cianci, V. Foglietti, G. Caliano, M. Pappalardo: "Building CMUTs for imaging applications from top to bottom" Microelectronic Engineering 84 (2007) 1312–1315

[IJ25] Caliano G; Savoia A; Caronti A; Longo C; Gatta P; Pappalardo M: "Echographic Images Improvements with a CMUT Probe" Revista de Acustica, ISSN: 0210-3680, vol. 38, num. 3-4, (2007) Art. Num: PACS: 43.38.Gy

[IJ26] V. Bavaro, G. Caliano, M. Pappalardo: "Element shape design of 2-D CMUT arrays for reducing grating lobes" IEEE Trans. On Ultrasonic, Ferroelectrics and Frequency Control, Vol. 55 (2), pag. 308-318, 2008

[IJ27] A. Iula, A. Savoia, G. Caliano, "Capacitive Microfabricated Ultrasonic Transducers for Biometric Applications"; Microelectronic Engineering, Vol. 88, Issue 8, 2011, pp. 2278-2280

[IJ28] N. Lamberti, A. Savoia, G. Caliano, A. Iula, "A High Frequency cMUT probe for Ultrasound Imaging of Fingerprints"; Sensors&Actuators A 172-2, December 2011; pp. 561-569

[IJ29] A.S. Savoia, G. Caliano, M. Pappalardo, "A CMUT Probe for Medical Ultrasonography: from Microfabrication to System Integration"; IEEE Trans. On Ultrasonic, Ferroelectrics and Frequency Control, Vol. 59, No. 6, June 2012, pp. 1127-1138

[IJ30] G. Caliano, A.S. Savoia, A. Iula, "An Automatic Compact Schlieren Imaging System for Ultrasound Transducers Testing"; IEEE Trans. On Ultrasonic, Ferroelectrics and Frequency Control, Vol. 59, No. 9, September 2012, pp. 2102-2110

[IJ31] A. Iula, A. S. Savoia, G. Caliano, "An ultrasound technique for 3D palmprint extraction"; Sensors&Actuators A 212, June 2014; pp. 18-24

[IJ32] G. Matrone, A.S. Savoia, M. Terenzi, G. Caliano, F. Quaglia, G. Magenes, "A Volumetric CMUT-Based Ultrasound Imaging System Simulator with Integrated Reception and μ-Beamforming Electronics Models"; IEEE Trans. On Ultrasonic, Ferroelectrics and Frequency Control, Vol. 61, No. 5, May 2014, pp. 792-804

[IJ33] N. Lamberti, G. Caliano, A. S. Savoia, "ACUPAD: a Track-pad Device Based on a Piezoelectric Bimorph"; Sensors and Actuators A: Physical, Volume 222, 1 February 2015, Pages 130-139, ISSN 0924-4247, http://dx.doi.org/10.1016/j.sna.2014.10.031.

[IJ34] G. Matrone, A.S. Savoia, G. Caliano, G. Magenes, "The Delay Multiply and Sum Beamforming Algorithm in Ultrasound B-Mode Medical Imaging"; IEEE TRANSACTIONS ON MEDICAL IMAGING, Volume: 34 Issue: 4 Pages: 940-949, DOI: 10.1109/TMI.2014.2371235 Published: APR 2015

[IJ35] A. Bagolini, A. S. Savoia, A.Picciotto, M. Boscardin, P. Bellutti, N. Lamberti, and G. Caliano, "PECVD Low Stress Silicon Nitride Analysis and Optimization for the Fabrication of CMUT Devices" J. Micromech. Microeng. 25 (2015) 015012 (12pp), doi:10.1088/0960-1317/25/1/015012
[IJ36] A. S. Savoia, M. La Mura, B. Mauti, N. Lamberti, G. Caliano, "Reverberation Reduction in Capacitive Micromachined Ultrasonic Transducers (CMUTs) by Front-face Reflectivity Minimization", Physics Procedia, Vol. 70, 2015, Pages 941-944.
[IJ37] A.S. Savoia, B. L. Mauti, G. Caliano, "A low frequency broadband flextensional ultrasonic transducer array", IEEE Trans. On Ultrasonic, Ferroelectrics and Frequency Control, Vol. 63, No. 1, January 2016, Pages 128-138
[IJ38] M. La Mura, N. Lamberti, B. L. Mauti, G. Caliano, A. S. Savoia, "Acoustic Reflectivity Minimization in Capacitive Micromachined Ultrasonic Transducers (CMUTs)", Ultrasonics, Volume 73, January 2017, Pages 130–139
[IJ39] G. Caliano, G. Matrone, A.S. Savoia, "Biasing of Capacitive Micromachined Ultrasonic Transducers", IEEE Trans. On Ultrasonic, Ferroelectrics and Frequency Control, Vol. 64 , No. 2, February 2017, Pages 402-413, doi: 10.1109/TUFFC.2016.2623221
[IJ40] G. Matrone, A. S. Savoia, G. Caliano, G. Magenes, "Depth-of-field enhancement in Filtered-Delay Multiply and Sum beamformed images using Synthetic Aperture Focusing", Ultrasonics, Vol. 75, March 2017, Pages 216-225, doi: 10.1016/j.ultras.2016.11.022
[IJ41] M. Sautto, A.S. Savoia, F. Quaglia, G. Caliano, A. Mazzanti, "A Comparative Analysis of CMUT Receiving Architectures for Design Optimization of Integrated Transceiver Front-Ends", IEEE Trans. On Ultrasonic, Ferroelectrics and Frequency Control, Vol. 64 , No. 5, May 2017, Pages 826-838, DOI: 10.1109/TUFFC.2017.2668769
[IJ42] M. Vallet, F. Varray, J. Boutet, J. Dinten, G. Caliano, A. S. Savoia, D. Vray, "Quantitative comparison of PZT and CMUT probes for photoacoustic imaging: Experimental validation", Photoacoustics, Vol. 8, December 2017, Pages 48-58, DOI: 10.1016/j.pacs.2017.09.001
[IJ43] F. Mariani, A. S. Savoia, G. Caliano, "An innovative method for in situ monitoring of the detachments in architectural coverings of ancient structures", Journal of Cultural Heritage, vol. 42, pp. 139-146, March- April 2020, DOI: 10.1016/j.culher.2019.07.013
[IJ44] G. Caliano, F. Mariani, P. Calicchia, "PICUS: A Pocket-Sized System for Simple and Fast Non-Destructive Evaluation of the Detachments in Ancient Artifacts", Applied Sciences, vol. 11, num. 8, April 2021, DOI: 10.3390/app11083382
[IJ45] M. Lo Giudice, F. Mariani, G. Caliano, A. Salvini, "Deep learning for the detection and classification of adhesion defects in antique plaster layers", Journal of Cultural Heritage, vol. 69, pp. 78-85, September-October 2024, DOI:10.1016/j.culher.2024.07.012

Chapters

[B1] Iula, N Lamberti, G. Caliano, M. Pappalardo: "A New Three-Dimensional Model for Circular Piezoelectric Transducers" Acoustical Imaging, vol XXI, ed. J.P. Jones, Plenum Press, New York, pp. 139-144. ISBN: 978-0-306-45009-9, 1995
[B2] N. Lamberti, F. Montero de Espinosa, G. Caliano, R. Carotenuto: "A New Technique for the Design of Acoustic Matching Layers for Piezocomposite Transducers"; in Theoretical and Computational Acoustics 2001, Ed. by Er-Chang Shang, Qihu Li & T F Gao, World Scientific USA, ISBN: 978-981-277-736-2, 2002
[B3] M. Pappalardo, G. Caliano, V. Foglietti, A. Caronti, E. Cianci: "A new approach to ultrasound generation: the capacitive micromachined transducers" in New Acoustics – selected topics, Eds. C. Ranz-Guerra, J.A. Gallego-Juarez, pp.87-103, ISBN: 84-00-08111-0, Madrid, Spain, 2002
[B4] E. Cianci, V. Foglietti, A. Minotti, A. Caronti, G. Caliano, and M. Pappalardo, "Fabrication techniques in micromachined capacitive ultrasonic transducers and their applications," in C. T. Leondes (Ed.), MEMS / NEMS Handbook, Vol. 2, Springer, pp. 19-48, ISBN: 978-0-387-24520-1, 2006.
[B5] M. Pappalardo, G. Caliano, A. Savoia, and A. Caronti, "Micromachined ultrasonic transducers," in Piezoelectric and Acoustic Materials for Transducer Applications, Eds. A. Safari, E. K. Akdogan, pp. 453-478, ISBN: 978-0-387-76538-9, 2009.
[B6] A.S. Savoia and G. Caliano, "MEMS-based transducers (CMUT) for medical ultrasound imaging" in Frontiers of Medical Imaging, edited by C.H. Chen, publisher: World Scientific Publishing, Singapore; pp. 445-464, ISBN: 978-9-814-61109-1, 2014
[B7] Caliano G, Savoia A S, "Advancements on Silicon Ultrasound Probes (CMUT) for Medical Imaging Applications". In: (a cura di De Gloria A), Applications in Electronics Pervading Industry, Environment and Society. LECTURE NOTES IN ELECTRICAL ENGINEERING, Volume 351, 2016, Pages 51-57
[B8] A.S. Savoia, G. Caliano, "MEMS-Based Transducers (CMUT) and Integrated Electronics for Medical Ultrasound Imaging", in: Andò B., Baldini F., Di Natale C., Marrazza G., Siciliano P. (eds) Sensors. CNS 2016. Lecture Notes in Electrical Engineering, vol 431. Springer, Cham. DOI: 10.1007/978-3-319-55077-0_53; ISBN: 978-3-319-55077-0
[B9] A. S. Savoia, B. Mauti, G. Caliano, "Integration of Two-Dimensional MEMS Ultrasonic Transducer Arrays with Front-End Electronics for Medical Ultrasound Imaging." Lecture Notes in Electrical Engineering vol. 629, pp.177-182. ISBN:978-3-030-37557-7. DOI:10.1007/978-3-030-37558-4_26
[B10] F. Mariani, G. Caliano, F. Di Stasio, P. Pogliani "Evaluation of Detachment Between Layers of Ancient Plaster Renderings: Comparison Between the Traditional Technique and a New and Innovative Automated Procedure Called PICUS" in the book (cap. 14) "Current Approaches, Solutions and Practices in Conservation of Cultural Heritage"; Editor(s) Name(s): Gulder Emre, Ayberk Yilmaz, Paola Pogliani, Gulce Ogruc Ildiz, Rui Fausto; Published by Istanbul University Press. DOI: 10.26650/B/AA9PS34.2024.006

International conferences

[IC1] Iula, N. Lamberti, G. Caliano, M. Pappalardo: "A Matrix Model of the Thin Piezoceramic Ring"; 1994 IEEE International Ultrasonics Symposium Proc., vol 2, pp. 921-924.
[IC2] N. Lamberti, P. Gori, A. Iula, G. Caliano, R. Carotenuto, M. Pappalardo: "Radiation Pattern Distorsion caused by Interelement Coupling in Linear Array"; atti del 1999 IEEE International Ultrasonics Symposium; Lake Tahoe (USA), Ottobre 1999, pp. 1071
[IC3] G. Caliano, F. Galanello, V. Foglietti, E. Cianci, A. Caronti, A. Iula: "Development of silicon ultrasonic transducer using micromachining"; Proc. of SPIE 2000, 4176, 244 (2000), Symposium on Micromachining and Microfabrication, Santa Clara (USA)
[IC4] G. Caliano, V. Foglietti, F. Galanello, A. Caronti, N. Lamberti, R. Carotenuto, M. Pappalardo: "Micromachined ultrasonics transducers using silicon nitride membrane fabricated in PECVD technology"; 2000 IEEE International Ultrasonics Symposium; Puerto Rico (USA), Ottobre 2000, pp 963

[IC5] N. Lamberti, G. Caliano, P. Gori, A. Iula, R. Carotenuto, M. Pappalardo: “Radiation Pattern Distortion Caused by the Interelement Coupling via the Backing and the Matching Layers in Linear Array Transducers”; 2000 IEEE International Ultrasonics Symposium; Puerto Rico (USA), Ottobre 2000, pp. 1173
[IC6] V. Foglietti, G. Caliano, E. Cianci, F. Galanello, M. Pappalardo: “Fabrication of micromechanical capacitive ultrasonic transducers by surface micromachining”; Proc. of MICRO.tec 2000, VDE World Micro-technologies Congress 1, p. 79, Sept. 2000, Hannover (Germany)
[IC7] A. Caronti, G. Caliano, A. Iula, and M. Pappalardo: “Electrical impedance mismatch in capacitive micromachined ultrasonic transducers”; 2000 IEEE International Ultrasonics Symposium; Puerto Rico (USA), Ottobre 2000.
[IC8] V. Foglietti, E. Cianci, D. Memmi, G. Caliano, M. Pappalardo: "Fabrication of capacitive ultrasonic transducers by a low-temperature and fully surface-micromachined process", Proc. 2th International Conf. of Euspen 2001, 1, pag 46
[IC9] N. Lamberti, A. Caronti, G. Caliano, A.Iula, R.Carotenuto, M. Pappalardo: “An energetic definition of the electromechanical coupling coefficient for CMUTs”; 2001 IEEE International Ultrasonic Symposium; Atlanta (USA), Ottobre 2001, pp. 895
[IC10] R. Carotenuto, A. Iula, G. Caliano, N. Lamberti, M. Pappalardo: “An Acoustic Fiber based Piezoelectric Motor; 2001 IEEE International Ultrasonic Symposium; Atlanta (USA), Ottobre 2001, pp. 501
[IC11] M. Pappalardo, A. Caronti, G. Caliano, R. Carotenuto, V. Foglietti: “A new alternative to piezoelectric transducer for NDE and medical applications: the capacitive ultrasonic micromachined transducer (cMUT)”; invited paper in 8th ECNDT (European Conference on NDT), Barcellona, Spain, June 2002
[IC12] E. Cianci, L. Visigalli, V. Foglietti, G. Caliano, M. Pappalardo: “Improvements towards a reliable fabrication process for cMUT”; MNE 2002, Micro- and Nanoengineering International Conference, Lugano (Switzerland), September 2002
[IC13] G. Caliano, R. Carotenuto, A. Caronti, M. Pappalardo, V. Foglietti, E. Cianci, L. Visigalli, I. Persi: “cMUT Echographic Probes: Design and Fabrication Process”; 2002 IEEE International Ultrasonic Symposium; Munich (Germany), October 2002, pp. 1067
[IC14] A. Caronti, R. Carotenuto, G. Caliano, M. Pappalardo, E. Cianci: “A Finite Element Study of Cross Coupling in 1-D Capacitive Micromachined Ultrasonic Transducer Arrays”; 2002 IEEE International Ultrasonic Symposium; Munich (Germany), October 2002, pp. 1059
[IC15] A. Caronti, L. D’Ambrosio, L. Visigalli, G. Caliano, and M. Pappalardo, “Finite element models for cross coupling analysis in capacitive micromachined ultrasonic transducers,” presented at 2nd International Workshop on Micromachined Ultrasonic Transducers, Besançon (France), June 27-28, 2002.
[IC16] L. Visigalli, V. Foglietti, E. Cianci, A. Caronti, G. Caliano, and M. Pappalardo, “The technology of capacitive micromachined ultrasonic transducers with low parasitic capacitance,” presented at 2nd International Workshop on Micromachined Ultrasonic Transducers, Besançon (France), June 27-28, 2002.
[IC17] A. Caronti, D. Fiasca, G. Caliano, and M. Pappalardo, “An experimental study of cross-coupling and acoustic interactions in 1-D capacitive micromachined ultrasonic transducer arrays,” 2003 U.S. Navy Workshop on Acoustic Transduction Materials and Devices, State College, Pennsylvania, May 06-08, 2003.
[IC18] A. Caronti, R. Carotenuto, G. Caliano, and M. Pappalardo, “The electromechanical coupling factor and transformation factor of capacitive micromachined ultrasonic transducers,” invited in 3rd International Workshop on Micromachined Ultrasonic Transducers, Lausanne (Switzerland), June 26-27, 2003.
[IC19] A. Caronti, D. Fiasca, G. Caliano, E. Cianci, and M. Pappalardo, “Experimental study of acoustic coupling in capacitive micromachined ultrasonic transducer arrays by optical interferometry,” 2003 IEEE Ultrasonics Symposium, Honolulu (Hawaii), Oct. 5-8, 2003, pp. 1960
[IC20] M. Pappalardo, G. Caliano, A. Caronti, F. D'Alessio, C. Cucco, E. Cianci, V. Foglietti, ”Capacitive Ultrasonic Transducers with a New Vibrating Structure” presented at 2003 IEEE Ultrasonics Symposium, Honolulu (Hawaii), Oct. 5-8, 2003, pp. 1955
[IC21] G. Caliano, R. Carotenuto, E. Cianci, V. Foglietti, A. Caronti, and M. Pappalardo, “Echographic Images Generated by a Capacitive Micromachined Ultrasonic Probe” 2004 U.S. Navy Workshop on Acoustic Transduction Materials and Devices, State College, Pennsylvania, May 10-13, 2004.
[IC22] G. Caliano, R. Carotenuto, E. Cianci, V. Foglietti, A. Caronti, and M. Pappalardo, “A cMUT Linear Array Used as Echographic Probe: Fabrication, Characterization, and Images” presented at 2004 IEEE Ultrasonics Symposium, Montreal (Canada), Aug. 24-27, 2004, pp. 395
[IC23] A. Caronti, G. Caliano, A. Savoia, R. carotenuto, M. Pappalardo, "A Low-Noise, Wideband Electronic System for Pulse-Echo Ultrasound Imaging with CMUT Arrays" presented at 2004 IEEE Ultrasonics Symposium, Montreal (Canada), Aug. 24-27, 2004, pp. 2219
[IC24] R.Carotenuto, G.Caliano, A. Caronti, A. Savoia, M. Pappalardo, "Very Fast Scanning Probe for Ophthalmic Echography Using an Ultrasound Motor" presented at 2004 IEEE Ultrasonics Symposium, Montreal (Canada), Aug. 24-27, 2004, pp. 2039-2046
[IC25] A. Caronti, A. Savoia, G. Caliano, R. Carotenuto, C. Longo, P. Gatta, and M. Pappalardo, "FEM modeling of CMUT arrays for medical imaging and experimental validation" invited lecture in 7th Annual Ultrasonic Transducer Conference Marina Del Rey, CA, USA - March 16-18, 2005.
[IC26] A. Savoia, A. Caronti, G. Caliano, M. Pappalardo, "Echographic images obtained with an open-cell capacitive micromachined ultrasonic transducer (mamMUT)" 2005 U.S. Navy Workshop on Acoustic Transduction Materials and Devices, State College, Pennsylvania, May 10-12, 2005.
[IC27] N. Lamberti, G. Caliano, A. Iula, and M. Pappalardo, “A Method for the Measurement of the k Factor in Lossy Piezoelectric Materials: FEM and Experimental Results” 2005 IEEE Ultrasonics Symposium, Rotterdam (Holland), Sep. 19-21, 2005, pp. 357
[IC28] G. Caliano, A. Caronti, A. Savoia, C. Longo, E. Cianci, V. Foglietti, and M. Pappalardo “Capacitive Micromachined Ultrasonic Transducer (cMUT) Made by a Novel “Reverse” Fabrication Process” 2005 IEEE Ultrasonics Symposium, Rotterdam (Holland), Sep. 19-21, 2005, pp. 479
[IC29] A. Savoia, G. Caliano, R. Carotenuto, C. Longo, P. Gatta, A. Caronti, E. Cianci, V. Foglietti, and M. Pappalardo “Enhanced Echographic Images Obtained Improving the Structural Membrane Layer of the cMUT Probe” 2005 IEEE Ultrasonics Symposium, Rotterdam (Holland), Sep. 19-21, 2005, pp. 1960
[IC30] J. Le Floc’h, P. Gatta, G. Caliano, R. Carotenuto, and M. Pappalardo “Calibrated Tomographic Schlieren System for Characterization of Medical Probes” 2005 IEEE Ultrasonics Symposium, Rotterdam (Holland), Sep. 19-21, 2005, pp. 661
[IC31] A. Savoia, G. Caliano, A. Caronti, R. Carotenuto, P. Gatta, C. Longo, and M. Pappalardo “Multilayer cMUT Structure for Improved Sensitivity and Bandwidth” 2006 IEEE Ultrasonics Symposium, Vancouver (Canada), Oct. 3-6, 2006, pp. 1939
[IC32] A. Caronti, C. Longo, A. Savoia, P. Gatta, G. Caliano, and M. Pappalardo “Analysis of Acoustic Interation Effects and Crosstalk in cMUT Linear Arrays for Medical Imaging” 2006 IEEE Ultrasonics Symposium, Vancouver (Canada), Oct. 3-6, 2006, pp. 582
[IC33] A. Savoia, V. Bavaro, G. Caliano, A. Caronti, R. Carotenuto, P. Gatta, C. Longo and M. Pappalardo “Crisscross 2D cMUT Array: Beamforming Strategy and Synthetic 3D Imaging Results” 2007 IEEE Ultrasonics Symposium, New York (USA), Oct. 28-31, 2007, pp. 1514
[IC34] A. Caronti, A. Coppa, A. Savoia, C. Longo, P. Gatta, B. Mauti, A. Corbo, B. Calabrese, G. Bollino, A. Paz, G. Caliano, and M. Pappalardo, “Curvilinear capacitive micromachined ultrasonic transducer (CMUT) array fabricated using a reverse process,” 2008 IEEE Ultrasonics Symposium, Pechino (Cina), 2008, pp. 2092
[IC35] A. Caronti, G. Caliano, P. Gatta, C. Longo, A. Savoia, and M. Pappalardo, “A finite element tool for the analysis and the design of capacitive micromachined ultrasonic transducer (cMUT) arrays for medical imaging,” Acoustics2008, Paris (France), invited talk; published on J. Acoust. Soc. Am., 123, 5, pp. 3375, 2008
[IC36] A. Iula, M. De Santis, G. Caliano, M. Pappalardo, “Experimental evaluation of the moving linear array technique applied to livescan biometrics”, 2009 IEEE Ultrasonics Symposium, Roma (Italy), 2009

[IC37] G. Caliano, A. Savoia, C. Longo, A. Caronti, S. Rothmann, A. Iula, M. Pappalardo, "cMUT Sensor for Applications as a Wide-band Acoustic Receiver in the MHz Range", 2010 IEEE Ultrasonics Symposium, San Diego (USA), 2010, ISBN 978-1-4577-0380-5, pagg. 1869-1872

[IC38] A. Iula, A. Savoia, C. Longo, A. Caronti, G. Caliano, M. Pappalardo, "3D Ultrasonic Imaging of the human hand for biometric purposes", 2010 IEEE Ultrasonics Symposium, San Diego (USA), 2010, ISBN 978-1-4577-0380-5, pagg. 37-40

[IC39] A. Savoia, G. Caliano, A. Iula, C. Longo, A. Caronti, R. Carotenuto, M. Pappalardo, "Design and fabrication of a cMUT probe for ultrasound imaging of fingerprints," 2010 IEEE International Ultrasonics Symposium, San Diego, CA, 2010, pp. 1877-1880. doi: 10.1109/ULTSYM.2010.5935836

[IC40] A. Iula, A. Savoia, G. Caliano, M. Pappalardo, "Capacitive Microfabricated Ultrasonic Transducers for Biometric Applications", MNE 2010 – 36th International Conference on Micro&Nano Engineering, Genoa (Italy), 19-22 September 2010

[IC41] A. Iula, N. Lamberti, A. Savoia, G. Caliano " Fluid film force control in lubricated journal bearings by means of a travelling wave generated with a piezoelectric actuators' system", ICU 2011 International Congress on Ultrasonics, Gdansk (Poland), 5-8 September 2011, AIP Conf. Proc. 1433, 697 (2012); doi: 10.1063/1.3703278

[IC42] A. Savoia, G. Caliano, B. Mauti, M. Pappalardo, "Performance Optimization of a High Frequency CMUT Probe for Medical Imaging", 2011 IEEE Ultrasonics Symposium, Orlando (USA), 2011; ISBN 978-1-4577-1251-7, pp. 600-603

[IC43] G. Caliano, N. Lamberti, A. Savoia, A. Iula, "A Track-pad Device Based on a Piezoelectric Bimorph", 2011 IEEE Ultrasonics Symposium, Orlando (USA), 2011; ISBN 978-1-4577-1251-7, pp. 1676-1679

[IC44] A. Savoia, G. Caliano, M. Pappalardo: "Ultrasound Probes Fabricated on Silicon for Medical Imaging"; Nanotechitaly 2011 International Conference, 23-25 November, Venice, Italy; p. 349-350

[IC45] P. Bellutti, M. Boscardin, A. Bagolini, A.S. Savoia, G. Caliano: "Capacitive Ultrasonic Transducers for medical applications: technological optimization at FBK"; Nanotechitaly 2011 International Conference, 23-25 November, Venice, Italy; pp.305-306

[IC46] G. Matrone, G. Magenes, A. Savoia, G. Caliano, M. Terenzi, D. Ronchi, F. Quaglia: "An Ultrasound System Simulation Tool for Advanced Front-End Electronics Design" In: Proceedings of 2012 IEEE International Ultrasonics Symposium. p. 627-639, Piscataway (NJ):IEEE, ISBN: 978-1-4673-4561-3, Dresden (Germany), 7-10 October 2012, doi: 10.1109/ULTSYM.2012.0156

[IC47] A. Iula, A. Savoia, G. Caliano: "3D Ultrasound palm vein pattern for biometric recognition" In: Proceedings of 2012 IEEE International Ultrasonics Symposium. p. 1-4, Piscataway (NJ):IEEE, ISBN: 978-1-4673-4561-3, Dresden (Germany), 7-10 October 2012, doi: 10.1109/ULTSYM.2012.0611.

[IC48] A. S. Savoia, G. Caliano, G. Matrone, G. Magenes, N. Lamberti,: "Phase shift micro-beamforming of CMUT arrays using the spring-softening effect" IEEE International Ultrasonics Symposium. p. 1424-1427, ISBN: 978-1-4673-5686-2, Prague (Czech Republic), 21-25 July 2013; doi: 10.1109/ULTSYM.2013.0361

[IC49] R. Carotenuto, G. Caliano, N. Lamberti, A. S. Savoia, A. Iula: "A vibrating stylus as two-dimensional PC input device" IEEE International Ultrasonics Symposium. p. 461-464, ISBN: 978-1-4673-5686-2, Prague (Czech Republic), 21-25 July 2013; doi: 10.1109/ULTSYM.2013.0119

[IC50] R. Carotenuto, G. Caliano, A. S. Savoia: "3D Locating system for Augmented Reality glasses using coded ultrasound" IEEE International Ultrasonics Symposium. p. 441-444, ISBN: 978-1-4673-5686-2, Prague (Czech Republic), 21-25 July 2013; doi: 10.1109/ULTSYM.2013.0114

[IC51] A. Iula, G. E. Hine, A. Ramalli, F. Guidi, E. Boni, A. S. Savoia, G. Caliano: "An enhanced Ultrasound technique for 3D Palmprint Recognition" IEEE International Ultrasonics Symposium. p. 978-981, ISBN: 978-1-4673-5686-2, Prague (Czech Republic), 21-25 July 2013; doi: 10.1109/ULTSYM.2013.0251

[IC52] Sautto, M. ; Leone, D. ; Savoia, A. ; Ghisu, D. ; Quaglia, F. ; Caliano, G. ; Mazzanti, A. "A CMUT transceiver front-end with 100-V TX driver and 1-mW low-noise capacitive feedback RX amplifier in BCD-SOI technology"; European Solid State Circuits Conference (ESSCIRC), ESSCIRC 2014 - 40th; DOI: 10.1109/ESSCIRC.2014.6942108; Venice (Italy), 2014

[IC53] A. S. Savoia, G. Caliano, B. Mauti, N. Lamberti: "A Low Frequency Broadband Flexural Mode Ultrasonic Transducer for Immersion Applications", 2014 IEEE INTERNATIONAL ULTRASONICS SYMPOSIUM (IUS), Pages: 2591-2594, DOI: 10.1109/ULTSYM.2014.0647

[IC54] A.S. Savoia, G. Caliano, M. Sautto, A. Mazzanti, D. Leoni, D. Ghisu, F. Quaglia: "An Ultra-Low-Power Fully Integrated Ultrasound Imaging CMUT Transceiver Featuring a High-Voltage Unipolar Pulser and a Low-Noise Charge Amplifier", 2014 IEEE INTERNATIONAL ULTRASONICS SYMPOSIUM (IUS), Pages: 2568-2571, DOI: 10.1109/ULTSYM.2014.0641

[IC55] A.S. Savoia, G. Matrone, A. Ramalli, E. Boni, G. Caliano, G. Magenes, P. Tortoli: "Improved Lateral Resolution and Contrast in Ultrasound Imaging Using a Sidelobe Masking Technique", 2014 IEEE INTERNATIONAL ULTRASONICS SYMPOSIUM (IUS),Pages: 1682-1685, DOI: 10.1109/ULTSYM.2014.0417

[IC56] N. Lamberti, G. Caliano, A. S. Savoia: "An Active Acoustic Back Cover Based on Piezoelectric Elements", 2014 IEEE INTERNATIONAL ULTRASONICS SYMPOSIUM (IUS), Pages: 2458-2461, DOI: 10.1109/ULTSYM.2014.0613

[IC57] A.S. Savoia, G. Scaglione, G. Caliano, A. Mazzanti, M. Sautto, F. Quaglia: "Second-Harmonic Reduction in CMUTs Using Unipolar Pulsers", 2015 IEEE INTERNATIONAL ULTRASONICS SYMPOSIUM (IUS), Pages:1-4, DOI: 10.1109/ULTSYM.2015.0230

[IC58] N. Lamberti, M. La Mura, G. Caliano, A.S. Savoia: "Design and Performance of an Active Acoustic Back Cover Based on Piezoelectric Elements", 2015 IEEE INTERNATIONAL ULTRASONICS SYMPOSIUM (IUS), Pages:1-4, DOI: 10.1109/ULTSYM.2015.0248

[IC59] N. Lamberti, M. La Mura, V. Apuzzo, P. D'Uva, A. Casella, G. Caliano, A.S. Savoia: "A Resonant Sensor for Liquid Density Measurement Based on a Piezoelectric Bimorph", 2015 IEEE INTERNATIONAL ULTRASONICS SYMPOSIUM (IUS), Pages:1-4, DOI: 10.1109/ULTSYM.2015.0536

[IC60] G. Matrone, A. S. Savoia, G. Caliano and G. Magenes, "Ultrasound Synthetic Aperture Focusing with the Delay Multiply and sum beamforming algorithm," 2015 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), Milan, 2015, pp. 137-140. doi: 10.1109/EMBC.2015.7318319

[IC61] A. Ramalli, P. Tortoli, A.S. Savoia, G. Caliano, "Improved Array Beam Steering by Compensation of Inter-element Cross-talk", 2015 IEEE INTERNATIONAL ULTRASONICS SYMPOSIUM (IUS), Pages:1-4, (DOI: 10.1109/ULTSYM.2015.0175)

[IC62] N. Lamberti, M. La Mura, V. Apuzzo, A. Casella, P. D'Uva, G. Caliano, A.S. Savoia: "A Resonant Sensor for Liquid Density Measurement Based on a Piezoelectric Bimorph", Advances in Sensors and Interfaces (IWASI), 2015 6th IEEE International Workshop on, Year: 2015, Pages: 293 - 296, DOI: 10.1109/IWASI.2015.7184935

[IC63] G. Matrone, A. S. Savoia, G. Caliano and G. Magenes, "Ultrasound Synthetic Aperture Focusing with the Delay Multiply and sum beamforming algorithm," 2015 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), Milan, 2015, pp. 137-140. doi: 10.1109/EMBC.2015.7318319

[IC64] A. S. Savoia, E. Boni, A. Ramalli, G. Matrone, P. Tortoli, G. Caliano: "Nonlinear ultrasound imaging experiments using a CMUT probe", 2016 IEEE INTERNATIONAL ULTRASONICS SYMPOSIUM (IUS), Pages:1-4, DOI: 10.1109/ULTSYM.2016.7728699

[IC65] G. Matrone; A. S. Savoia; G. Caliano; G. Magenes: "Ultrasound plane-wave imaging with delay multiply and sum beamforming and coherent compounding", 2016 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), Pages: 3223 - 3226, DOI: 10.1109/EMBC.2016.7591415

[IC66] A.S. Savoia, B. Mauti, G. Caliano: "Accurate Evaluation of the Electro-Mechanical and Parasitic Parameters of CMUTs through Electrical Impedance Characterization". 2017 IEEE INTERNATIONAL ULTRASONICS SYMPOSIUM (IUS), Pages:1-4, DOI:

[IC67] A.S. Savoia, B. Mauti, G. Caliano, L. Maiolo, A. Pecora, A. Minotti, G. Fortunato, A. Bagolini, P. Bellutti: “Optimization of the Efficiency and Reliability of Reverse-Fabricated CMUT Arrays”. 2017 IEEE INTERNATIONAL ULTRASONICS SYMPOSIUM (IUS), Pages:1-4, DOI:

[IC68] A.S. Savoia, B. Mauti, G. Caliano, R. Bardelli, F. Toia, F. Quaglia: “A 3D Packaging Technology for Acoustically Optimized Integration of 2D CMUT Arrays and Front End Circuits”. 2017 IEEE INTERNATIONAL ULTRASONICS SYMPOSIUM (IUS), Pages:1-4, DOI:

[IC69] A.S. Savoia, B. Mauti, L. Fanni, G. Caliano, E. Boni, M. Scaringella, P. Tortoli: “A 120+120-Element Crisscross CMUT Probe with Real-Time Switchable Electronic and Fresnel Focusing Capabilities”. 2018 IEEE International Ultrasonics Symposium (IUS), Kobe, 2018, pp. 1-4.doi: 10.1109/ULTSYM.2018.8580084

[IC70] A.S. Savoia, B. Mauti, L. Fanni, A. Bagolini, E. Boni, A. Ramalli, F. Guanziroli, S. Passi, G. Matrone, R. Bardelli, P. Bellutti, F. Quaglia, G. Caliano, A. Mazzanti, P. Tortoli: “A 256-Element Spiral CMUT Array with Integrated Analog Front End and Transmit Beamforming Circuits”. 2018 IEEE International Ultrasonics Symposium (IUS), Kobe, 2018, pp. 206-212. doi: 10.1109/ULTSYM.2018.8579867

[IC71] M. La Mura, N. A. Lamberti, G. Caliano, A.S. Savoia: “An ultrasonic flextensional array for acoustic emission techniques on concrete structures”. 2018 IEEE International Ultrasonics Symposium (IUS), Kobe, 2018, pp. 1-4. doi: 10.1109/ULTSYM.2018.8580178

[IC72] G. Caliano: “A contact-less method for monitoring the detachments in the architectural coverings of ancient structures by using Ultraino”, 2020 IEEE International Ultrasonics Symposium (IUS), Las Vegas, NV, USA, 2020, pp. 1-4, doi: 10.1109/IUS46767.2020.9251712

[IC73] G. Caliano: “Non-Destructive Diagnosis of Detachments in the Covers of Ancient Structures”, PIEZO2021: Piezoelectrics for End Users XI, Feb 21-24, 2021, University of Sassari, Italy, INVITED. ISBN 978-88-89884-40-9

[IC74] G. Caliano: “A Fast and Low-Cost “Mouse” for Analyzing the Bonding State of Wall Coverings”, 2021 IEEE International Ultrasonics Symposium (IUS), Xi’an, China, 12-16 Sep. 2021, pp. 1-3, DOI: 10.1109/IUS52206.2021.9593302

[IC75] G. Caliano, F. Mariani, F. Vitali, P. Pogliani “The “PICUS” system in the detection of defects on panel paintings and wooden boards”, 2022 IEEE International Ultrasonics Symposium (IUS), Venice, Italy, 10-13 Oct. 2022, pp. 1-4, DOI: 10.1109/IUS54386.2022.9958892

[IC76] F. Mariani, G. Caliano, S. De Angeli, P. Pogliani “Acoustic characteristics and defects of adhesion of ancient construction materials using the PICUS system”, 2023 IMEKO TC-4 International Conference on Metrology for Archaeology and Cultural Heritage Rome, Italy, October 19-21, 2023, ISBN 978-92-990090-6-2

[IC77] G. Caliano, F. Mariani, A. Salvini “A portable and autonomous system for the diagnosis of the structural health of cultural heritage (PICUS)”, 2023 IMEKO TC-4 International Conference on Metrology for Archaeology and Cultural Heritage Rome, Italy, October 19-21, 2023, ISBN 978-92-990090-6-2

National journal

[NJ1] G. Caliano: “I trasduttori ad ultrasuoni sfruttano i progressi della microfabbricazione su silicio”; Elettronica Oggi, n. 290, maggio 2000

[NJ2] M. Pappalardo, G. Caliano, “Ecografia 3D in tempo reale”; annuario CASPUR 2009, pagg. 113-119

[NJ3] G. Caliano: “Smart-Sensor connesso a Blynk”; ElettronicaIn, n. 252, pagg. 31-43, marzo 2021

[NJ4] G. Caliano: “La conversione A/D veloce per Fishino32”; ElettronicaIn, n. 258, pagg. 77-90, ottobre 2021

National conferences

[NC1] G. Caliano, N. Lamberti, A. Iula, M. Pappalardo: "Un Metodo per la Misura del Fattore di Accoppiamento Elettromeccanico dei Materiali Piezoelettrici". atti del XXII° Convegno AIA; Lecce, aprile 1994, pag. 21-26.

[NC2] Iula, N Lamberti, G. Caliano, M. Pappalardo: "Un Modello Matematico di Ceramiche Piezoelettriche Circolari", atti del XXII° Convegno AIA; Lecce, aprile 1994, pag. 51-56.

[NC3] G. Caliano, N. Lamberti, A. Iula, M. Pappalardo: "Una Nuova Metodologia per l’Individuazione e la Decodifica del Codice a Barre in una Scena Bidimensionale"; atti del 3° Convegno Nazionale ‘Strumentazione e metodi di misura elettroottici’; Pavia, Maggio 1994, pag. 403-407.

[NC4] F. Galanello, G. Caliano, M. Pappalardo, E. Cianci, V. Foglietti, A. Notargiacomo: “Fabrication and characterization of micromechanical ultrasonic transducers”; SILICON WORKSHOP Genova, 2-4 Febbraio 2000, INFM.

[NC5] F. Galanello, G. Caliano, M. Pappalardo, E. Cianci, V. Foglietti, A. Notargiacomo: “Fabrication and characterization of micromechanical ultrasonic transducers”; Proc. 5th Conf. of Sensor and Microsystems AISEM 2000, p. 376, World Scientific ed. (2000).

[NC6] V. Foglietti, D. Memmi, E. Cianci, G. Caliano, M. Pappalardo: “Capacitive Ultrasonic Transducers Fabricated by a Low Temperature Surface-Micromachined Process”; to be published on Proc. 6th Conf. of Sensor and Microsystems AISEM 2001, World Scientific ed.

[NC7] G. Caliano, A.S. Savoia, M. Pappalardo: “Pioneering activities of Roma Tre Aculab-group in the field of silicon micromachined sensors (cMUT) for application in high frequency ultrasound for medical imaging”; 43° Riunione Annuale del Gruppo Elettronica, GE2011, Trani 6-8 luglio 2011, ISBN 978-88-95612-85-0, pagg. 53-54

[NC8] G. Matrone, A.S. Savoia, G. Caliano and G. Magenes, “High-quality ultrasound B-mode imaging using the DMAS beamformer,” in Proc. GNB2014, June 25th-27th 2014, Pavia, Italy

[NC9] F. Mariani, A.S. Savoia, G. Caliano: “An Innovative Method for in Situ Monitoring of the Detachments in Architectural Coverings of Ancient Structures”. XX AISEM 2019, Napoli 11-13 Febbraio 2019;

[NC10] A. S. Savoia, B. Mauti, G. Caliano: “Integration of two dimensional Mems ultrasonic tarnsducer arrays with front-end electronics for medical ultrasound imaging”. XX AISEM 2019, Napoli 11-13 Febbraio 2019;

Patents

[PT1] **SURFACE MICROMECHANICAL PROCESS FOR MANUFACTURING MICROMACHINED CAPACITIVE ULTRA-ACOUSTIC TRANSDUCERS AND RELEVANT MICROMACHINED CAPACITIVE ULTRA-ACOUSTIC TRANSDUCER**
Publication number: US2008212407 (A1)
Publication date: 2008-09-04
[PT2] **BIDIMENSIONAL ULTRASONIC ARRAY FOR VOLUMETRIC IMAGING**
Publication number: US2010137718 (A1)
Publication date: 2010-06-03
[PT3] **MICROMACHINED CAPACITIVE ULTRASONIC TRANSDUCER (CMUT) WITH TWO-DIMENSIONAL (2-D) ARRAY ELEMENTS**
Publication number: ITRM20070572 (A1)
Publication date: 2009-04-30
[PT4] **MULTI-LEVEL CAPACITIVE ULTRASONIC TRANSDUCER**
Publication number: US2007258332 (A1)
Publication date: 2007-11-08

[PT5] **Microfabricated capacitive ultrasonic transducer for high frequency applications**
Publication number: US2007059858 (A1)
Publication date: 2007-03-15
[PT6] **Interdigitated geometry transducer for optimizing the irradiated acoustic beam**
Publication number: US2006007045 (A1)
Publication date: 2006-01-12
[PT7] **Microfabricated capacitive ultrasonic transducer and related surface micromechanical process of fabrication**
Publication number: US2005018536 (A1)
Publication date: 2005-01-27
[PT8] **Surface micromachining process for manufacturing electro-acoustic transducers, particularly ultrasonic transducers, obtained transducers and intermediate products**
Publication number: US2004180466 (A1)
Publication date: 2004-09-16
[PT9] **PROCESS FOR THE MANUFACTURING OF ELECTRO-ACOUSTIC TRANSDUCERS, PARTICULARLY ULTRASOUND TRANSDUCERS, AND INTERMEDIATE PRODUCT**
Publication number: ITSV20010014 (A1)
Publication date: 2002-11-08
[PT10] **System for two-dimensional reading and decoding of bar codes**
Publication number: IT1272986 (B)
Publication date: 1997-07-01
[PT11]**Multi-Cell Transducer**
Publication number: US2016/0013394 A1
Publication date: 14 Jan. 2016
[PT12] **METHOD AND DEVICE FOR IN SITU DIAGNOSIS OF DETACHMENTS IN ARCHITECTURAL STRUCTURE COATINGS**
Publication number: 102018000009696 (Italian patent)
Publication date: 23 Oct. 2018
[PT13] **AXIAL-PRECESSIONAL VIBRATION ELEMENT FOR ULTRASONIC HANDPIECES**
Publication number: 102021000014489 (Italian patent)
Publication date: 04 June 2021