UNIVERSITÀ
POLITECNICA
DELLE MARCHE

Supervisor: Prof. Susanna Spinsante

Dept. of Information Engineering (DII)

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Research activities

Main research topics

The research is primarily focused on the intersection of Electronic Measurements and Sensors, IoT, and Healthcare Technology. The key research areas include:

1. Wearable Sensor Metrology

A significant portion of the work focuses on evaluating the "medical grade" potential of consumer wearables.

- Metrological Characterization: Assessing the accuracy and reliability of skin conductance, heart rate, ECG, and photoplethysmographic (PPG) sensors in wrist-worn and chest-strap devices.
- Data Fusion: Combining data from multiple wearable sources (accelerometers, EDA sensors, heart rate) to improve the classification of physical activity intensity and emotional stimuli.

2. Contactless & Remote Measurements

Recent research and publications emphasize measurements that do not require physical contact with the subject or object/phenomenon to sense.

- Radar Technologies: Using mmWave FMCW radar for vibration measurements (mostly applied to drones), indoor target tracking and localization.
- Spectroscopy: AI-assisted digital measurements using Raman spectroscopy for water quality monitoring (detecting inorganic pollutants).

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3. IoT & Smart Sensing for Environmental/Industrial Use

Beyond healthcare, measurement expertise is applied to «smart» systems.

•Smart Agriculture: Advanced beehive monitoring using sound, weight, and temperature sensors to assess colony health.

•Industrial Maintenance: IoT-based smart sensors for the predictive maintenance of medium-voltage (MV) switchgears.

4. Ambient Assisted Living (AAL) & Fall Detection

Research focuses on developing non-obtrusive systems to monitor the elderly and vulnerable populations.

•Technologies: RGB-D sensors (Microsoft Kinect), radar, and wearable sensors (smart insoles).

•Key Focus: Automated fall detection, gait analysis, and "lifelogging" while maintaining user privacy through depth-based (skeleton) data rather than traditional video.

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Activities – awarded projects

Proposer and scientific coordinator for the activities of the Università Politecnica delle Marche within the project titled vINCI (*Clinically-validated INtegrated Support for Assistive Care and Lifestyle Improvement: the Human Link*). The project was approved under the 2017 Call of the **European AAL Joint Programme**, with a total eligible cost of €159,095.00 for the Università Politecnica delle Marche. The project, coordinated by Prof. Ciprian Dobre (National Institute for Research and Development in Informatics - Romania), involved the participation of nine additional partners from Italy, Cyprus, Poland, and Slovenia.

Proposer and scientific coordinator for the Università Politecnica delle Marche in the project titled PAAL (Privacy-Aware and Acceptable Lifelogging services for older and frail people). The project was approved under the 2017 Joint Transnational Call for Proposals of the **European Joint Programming Initiative "More Years, Better Lives"** with a total project cost of €207,585.50 for the Università Politecnica delle Marche. The three-year project, coordinated by Prof. Francisco Florez-Revuelta of the University of Alicante (Spain), involved four other partners: Università Politecnica delle Marche, RWTH Aachen University (Germany), University of Toronto (Canada), and Stockholm University (Sweden).

Proposer and scientific coordinator for the Università Politecnica delle Marche – Department of Information Engineering (DII) in the project titled "Education 4.0: Living Labs for the Students of the Future (LLSF)." The project is funded under the **European Union's Erasmus+ Program**, KA220-HED - Cooperation partnerships in higher education (contract number: 2021-1-RO01-KA220-HED-000032176), and is coordinated by the Polytechnic University of Bucharest. The 36-month project commenced on February 1, 2022. Within the framework of the project, for which UnivPM received funding of €71,391.00.

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Mentorship activities:

1) Tutor of 12 MSc theses (Electronic Engineering, Biomedical Engineering)
2) Tutor of 30 BSc theses (Electronic Engineering and Digital Technologies, Biomedical Engineering)
3) Member of the Doctoral School in Information Engineering Committee at UnivPM since 2013
4) Supervisor of PhD students at Università Politecnica delle Marche:
    1) Mahdiyar Sarayloo (2013-2016)
    2) Angelica Poli (2019-2022)
5) Co-supervisor of PhD students at Università Politecnica delle Marche:
    1) Laura Montanini (2013-2016)
    2) Nefeli Dourou (2025-2027)
6) External evaluator of PhD theses / member of the final PhD examination committee for the following Academic Institutions: University of Alicante (Spain), Ulster University, University of Camerino (Italy), University of Siena (Italy), University of Udine (Italy), University of Bologna (Italy), University of Beira Interior (Portugal)

Other roles

- Member appointed of the Educational Visibility & Outreach Committee (until 12/31/28) within the Education Board Standing Committees of the IEEE Signal Processing Society
- Member of the IEEE Transport Electrification Council AdCom in the role of Representative of the IEEE Instrumentation and Measurement Society (I&M), nominated by I&M Chair, Prof. Shervin Shirmohammadi
- Chair of the Technical Committee “RGB-D sensors”, IEEE Sensors Italy Chapter

- Founding member and former president of two UnivPM spin off companies: ArieLAB Srl (operating in the field of ICT technologies development for Active Assisted Living) and DowSee Srl (operating in the field of ICT and AI technologies development for innovating services and manufacturing)

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Publications

- ORCID: https://orcid.org/0000-0002-7323-4030
- Scopus Author ID: 6506113067:
  H. index 29; no. citations 3 779; no. documents 301 (11/03/2026)

Most relevant 10 publications:

Publication Title	*Year*
A human activity recognition system using skeleton data from RGBD sensors	2016
A Depth-Based Fall Detection System Using a Kinect® Sensor	2014
Radar and RGB-depth sensors for fall detection: A review	2017
A smart sensor-based measurement system for advanced bee-hive monitoring	2020
Wrist-worn and chest-strap wearable devices: Systematic review on accuracy and metrological characteristics	2020
UAV propeller rotational speed measurement through FMCW radars	2023
Wireless ECG and cardiac monitoring systems: State of the art, available commercial devices and useful electronic components	2021
Photoplethysmographic (PPG) sensors, potential and limitations: Is it time for regulation? A comprehensive review	2023
Driver drowsiness detection: A machine learning approach on skin conductance	2023
Displacement evaluation by mmWave FMCW radars: Method and performance metrics	2024

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Staff, equipment and laboratory

The research staff of the Electrical and Electronic Measurements & Sensors LAB (ME2S LAB) currently includes an Assistant Professor and an Associate Professor. A member of the Department technical staff also supports the activities of the LAB, when needed.

Among the instruments and facilities available within the LAB, it is possible to mention:

- Rohde & Schwarz MXO4-BNDL Oscilloscope 1.5 GHz, 4 channels, MXO4-K36: Frequency response analyzer, MXO4-B6: Arbitrary waveform generator, 100 MHz, 2 analog channels
- PXI National Instruments – Vector signal transceiver PXIe 5841 9 KHz-6 GHz 1 GHz BW
- ROHDE&SCHWARZ LCX200 LCR meter
- Dewesoft Krypton DAQ + PCB piezoelectric accelerometers and tachometer
- Workbench instruments (HP34401A, 8.5 digit HP 3458A multimeters, frequency meter HP 53131, power supplies, acquisition boards)
- 10 Liquid Instruments Moku:GO M2 FPGA-based digital multi-instruments
- 5 RedPitaya STEM-125 boards + 3 LCR impedance analysers
- Tester (Fluke, FNIRSI)
- 4 Empatica EmbracePlus wearable multi-sensor devices
- ProComp Infiniti DAQ for biosignals with several sensors (EDA, BVP, ST, ECG…)
- Several embedded boards and sensors/actuators
- Radar Continental ARS 548 RDI 4D; Radar 24 GHz uRAD; Radar 77 GHz TI AWR1843; Radar TI TIDEP 01012
- RGB-D INTEL REAL SENSE D455 camera, Orbbec Astra Mini RGB-D sensor
- 3D BAMBU LAB H2S LASER FULL COMBO 10W printer

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