

Wearables and Beyond for Physiological Monitoring: Printed, Flexible and Smart Sensors for Real-World Applications*

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Wearable technologies are rapidly transforming the way physiological parameters can be monitored across healthcare, sports, occupational safety, and wellness domains. However, conventional wearable systems still face important limitations related to mechanical rigidity, poor long-term comfort, motion artefacts, limited personalization, and reduced robustness in uncontrolled environments.

This invited talk will present an overview of recent advances in physiological monitoring through next-generation wearable sensing systems, with particular emphasis on additive manufacturing, printed electronics, soft materials, and multimodal sensor design. Different fabrication and design strategies will be discussed as powerful tools for the rapid prototyping and scalable development of conformable sensing platforms.

Selected case studies will illustrate the application of these technologies for monitoring respiratory activity, cardiovascular dynamics, body motion, posture, and human performance. Particular attention will be devoted to the measurement challenges associated with wearable sensing in daily life, including sensor-to-body coupling, calibration, repeatability, environmental influences, and motion-induced artifacts. The importance of metrological characterization and validation against gold-standard reference systems will be emphasized as a fundamental step toward reliable physiological monitoring.

Finally, the talk will discuss future perspectives toward intelligent and unobtrusive sensing ecosystems, where printed and flexible devices, embedded analytics, and artificial intelligence may converge to enable personalized, continuous, and clinically meaningful health monitoring beyond traditional wearables.

Short Bio



Dr. Carlo Massaroni is a Tenure-Track Assistant Professor in Biomedical Engineering at Università Campus Bio-Medico di Roma (UCBM), where he received his BSc and MSc in Biomedical Engineering and his Ph.D. in Bioengineering. His scientific activity is recognized in the fields of biomedical instrumentation, wearable sensing, and unobtrusive physiological monitoring, with particular expertise in printed and flexible sensors, fiber-optic technologies, additive manufacturing, and smart systems for healthcare. His research focuses on the design, development, and metrological validation of innovative sensing platforms for the estimation of

physiological and biomechanical parameters in clinical, occupational, sports, and real-world settings. He serves as Principal Investigator and Work Package Leader in several national and international projects dedicated to advanced wearable technologies and digital biomarkers. Dr. Massaroni is the author of more than 270 scientific publications and is actively involved in the international scientific community as a Senior Member of IEEE, Secretary of the IEEE Sensors Council Italy Chapter, Secretary of the IEEE Biometrics Council Italy Chapter, and Associate Member of the IEEE Engineering in Medicine and Biology Society Technical Committee on Wearable Biomedical Sensors and Systems. He also serves, among other roles, as Associate Editor for the *IEEE Sensors Journal* and *IEEE Sensors Letters*.

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