

Call for Papers

Special Issue on Bio-Inspired Multi-modal Sensors: Electronic Nose, Tongue, and Skin

Electronic Nose, Electronic Tongue, and Electronic Skin technologies have become increasingly important in recent years as sensor research moves beyond the detection of isolated physical or chemical parameters toward more integrated, bio-inspired perception systems. This transition is being driven by the growing need for sensing platforms that can operate reliably in complex and dynamic environments, such as point-of-care healthcare, environmental surveillance, food quality assessment, agriculture, robotics, wearable electronics, human-machine interfaces, soft prosthetics, and smart manufacturing. In these application spaces, relevant information is rarely confined to a single signal or sensing domain. Instead, chemical, biological, tactile, thermal, mechanical, humidity-related, and physiological cues often coexist, interact with one another, and are influenced by background conditions, sample matrix, user variability, and operating environment. Therefore, the development of intelligent artificial sensory systems requires a broader approach in which multiple forms of sensory information are acquired, correlated, and interpreted together.

Bio-inspired sensor platforms provide a natural foundation for such a direction because they emulate three essential dimensions of biological perception: olfaction, gustation, and somatosensation. Electronic Nose systems are capable of capturing volatile and gaseous signatures; Electronic Tongue systems provide access to liquid-phase chemical and biochemical information; and Electronic Skin systems enable the detection of tactile, pressure, strain, temperature, humidity, and electrophysiological responses. Individually, each of these technologies has demonstrated significant promise. However, many real-world sensing problems demand a more complete sensory picture than any single modality can provide. For example, reliable healthcare screening may require simultaneous interpretation of biochemical, mechanical, and physiological markers; food and environmental monitoring may require combined analysis of volatile, liquid-phase, and surface-related signatures; and robotic or wearable systems may require the fusion of chemical awareness with tactile and contextual feedback. This makes multi modal integration not merely an extension of existing sensor research, but a necessary step toward robust, adaptive, and application-relevant artificial perception.

This issue will showcase advances in bio-inspired multimodal sensors that emulate olfaction, gustation, and somatosensation—commonly known as Electronic Nose, Electronic Tongue, and Electronic Skin. The primary focus of this Special Issue is on integrated and multimodal Electronic Nose–Tongue–Skin platforms, rather than routine standalone sensing demonstrations. We seek contributions that push the state of the art in materials and transduction mechanisms, device physics and modeling, array and system integration, hybrid sensor architectures, edge intelligence, data fusion, and learning-enabled signal processing. Submissions should present rigorous, device-centric innovation with quantitative evaluation under realistic operating conditions, clear bench marking against relevant baselines, and transparent discussion of limitations, reproducibility, stability, and deployment challenges.

Topics

To clearly distinguish this issue from regular submissions on standard Electronic Nose, Electronic Tongue, or Electronic Skin sensors, purely conventional single-modality studies will be considered within scope only when they demonstrate a clear contribution beyond routine sensing performance. Such contributions may include multimodal coupling, cross-modal signal interpretation, system-level integration, cross-sensitivity exploitation, sensor-array-level intelligence, or data-fusion-enabled functionality. The intention is to highlight work in which different sensing modalities, signal domains, or information layers are brought together to improve selectivity, reduce false positives, enhance contextual interpretation, and support more reliable decision-making in practical environments. By emphasizing multimodal integration and intelligent interpretation, this Special Issue aims to capture the ongoing transition from individual sensor development toward adaptive, human-inspired sensory systems with broad impact across healthcare, environmental monitoring, food quality, robotics, wearable technologies, and human-machine interaction.

Manuscripts should report statistically meaningful datasets, appropriate controls and interferents, and clearly defined test conditions (e.g., humidity, temperature, flow, pH, ionic strength). Where applicable, authors should include ablation/fusion studies to justify multimodal gains, provide comparisons to certified or gold-standard references, and disclose data and code sufficient to enable replication. Purely algorithmic studies without a clear link

to sensor hardware, or application notes lacking quantitative device analysis, are generally out of scope. Original research contributions and review papers are sought related areas including (but not limited to):

- **Transducers & Materials:** chemiresistors; FET/ISFET and electrochemical (potentiometric/ampereometric/impedimetric) sensors; SAW/QCM; micro-cantilevers; capacitive, piezoresistive, piezoelectric, and triboelectric e-skin; metal oxides, conducting polymers, MXenes, 2D materials, MOFs/COFs, hydrogels, MIPs, enzymes/aptamers.
- **Device Physics & Modeling:** adsorption/charge-transfer kinetics coupled to drift-diffusion; interface traps and band-bending; percolation and composite transport; visco-tactile mechano-transduction; stochastic noise and LOD modeling; multi-physics/TCAD linked to reaction models.
- **Arrays, Packaging & Integration:** cross-reactive arrays; micro-heaters and thermal management; micro-fluidics for taste; anti-fouling/encapsulation; flexible/stretchable interconnects; wearable form factors; wireless and low-power readout; energy harvesting.
- **Intelligent Signal Processing:** feature engineering; domain adaptation and calibration transfer; drift, humidity, and temperature compensation; early/mid/late sensor-fusion; interpretable ML and TinyML/edge inference.
- **Metrology & Standards:** uncertainty budgets; inter-lab reproducibility; cross-sensitivity matrices; long-term stability/aging; reference methods and certified standards; open datasets and protocols.
- **Applications:** diagnostics and monitoring (breath/saliva/sweat), food authenticity and spoilage, environmental monitoring, human-robot touch, prosthetics, industrial safety.

Important dates (tentative)

January 31, 2027	Deadline for Manuscript Submission
March 31, 2027	Completion of Final Review
May 31, 2027	Publication

Upon acceptance papers appear as Early Access (preprints) in IEEEExplore and are fully citable.

Guest Editors

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Submission and Peer Review of Papers

Manuscripts submitted to the special issue should maintain an explicit focus on sensors or sensor systems, to be considered within the scope of the IEEE Sensors Journal (please check full journal scope). All manuscripts must be submitted on-line, via the *IEEE Author Portal*, see <https://ieee.atyponrex.com/journal/sensors>. Choose the special issue listed in the drop-down menu during submission. For manuscript preparation and submission, please follow the guidelines in the *Information for Authors* at the IEEE Sensors Journal web page, <https://ieee-sensors.org/ieee-sensors-journal/for-authors>