Sensors and Materials

Special Issue on Sensing Beyond Transduction: Materials, Devices, and Signal Processing for Intelligent Sensory Systems

Call for papers

Biological sensory systems have an incredible ability to perceive things, such as discriminating different textures, recognizing subtle odors, and interpreting complex acoustic environments, through a highly parallel, nonlinear, and dynamic neural architecture. It is said that biological sensory receptors not only transduce physical stimuli into electrical signals, but also actively encode, filter, and partially process information at the receptor level.

This concept of sensor-level signal processing is attracting increasing attention as a way of reducing the computational load on central processing units. By performing preliminary signal processing close to the sensing element, often called edge computing, it is possible to reduce the amount of data transmitted, leading to savings in wiring complexity and energy consumption. This approach is particularly valuable in applications where a large number of sensors are used, such as in robotics, wearable systems, and environmental monitoring.

Recent studies suggest that physical sensor materials with nonlinear dynamic properties, such as viscoelastic polymers, piezoelectric films, and micro/nanostructured devices, have the potential to realize such edge-level computation. These materials exhibit history-dependent and time-varying responses to input stimuli, which are characteristics that can be applied for temporal signal processing in a manner analogous to neuromorphic or reservoir computing architectures. Although the full realization of sensor-integrated physical reservoir computing remains an active area of research, the underlying principles offer a promising direction for next-generation smart sensing systems.

This special issue invites submissions of original research articles exploring the intersection of multisensory devices and neuromorphic or brain-inspired signal processing. Topics may include various sensing modalities such as tactile, visual, acoustic, olfactory, and taste sensations.

Scope:

- Tactile, visual, acoustic, olfactory, and taste sensor devices and systems
- Functional materials for sensing applications, including polymers, ceramics, and composites
- Flexible and stretchable sensor devices for wearable and soft robotic applications
- MEMS and micro/nanodevices for physical, chemical, and biological sensing
- Multimodal and sensor fusion systems
- Signal processing and feature extraction for sensory data
- Machine learning and AI-based approaches for sensor data analysis
- Brain-inspired and neuromorphic approaches to sensory signal processing
- Kansei (affective/perceptual quality) measurement and evaluation
- Sensing systems for healthcare, robotics, and environmental monitoring

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Submission due date: September 30, 2026

Publication date: First quarter of 2027

Journal website: https://myukk.org/

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