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for Special Issue on

IEEE TRANSACTIONS ON COGNITIVE AND DEVELOPMENTAL SYSTEMS

A PUBLICATION OF THE IEEE COMPUTATIONAL INTELLIGENCE SOCIETY AND THE IEEE ROBOTICS AND AUTOMATION SOCIETY

Bridging the Gap between Machine and Brain in Speech Processing

AIM AND SCOPE: Speech processing technologies play a vital role in various domains, enabling applications such as voice assistants, smart hearing aids, and robots. These technologies enhance human-computer interaction, accessibility, and productivity. However, deep learning-based approaches, while successful in many aspects of speech processing, currently face several challenges. These include the need for high-performance computing and privacy-preserving, limited interpretability, and difficulty in handling speech and environment variations. A brain-inspired approach offers a promising solution to address these challenges. By drawing inspiration from the brain's neural structure and mechanisms involved in speech processing, it can offer more efficient, interpretable, and robust speech processing solutions.

The human brain exhibits remarkable efficiency, operating on a power budget of approximately 20 watts while performing complex cognitive tasks like sensing, planning, control, and learning. In contrast, conventional AI systems require significantly more power to achieve even a fraction of these functionalities. However, the emergence of neuromorphic computing chips, such as Intel Loihi and Tianjic, offers a promising solution. These chips mimic the brain's structure and operating mechanisms, resulting in a drastic reduction in power consumption. This efficiency improvement leads to extended battery life and enables the development of smaller device form factors. These advantages are particularly valuable for power-constrained devices like smart speakers, headsets, earbuds, hearing aids, and cochlear implants.

Brain-inspired models often prioritize interpretability, aiming to provide insights into how the human brain processes speech. They strive to uncover the underlying mechanisms and representations involved in speech perception and production, allowing researchers to gain a deeper understanding of the cognitive processes at play. Furthermore, human speech exhibits significant variability due to factors like speaker characteristics, speaking styles, and environmental conditions. Brain-inspired models aim to capture this variability by incorporating feedback adaptation and online learning mechanisms for robust speech processing, making them more adaptable to diverse real-world scenarios. Additionally, the human brain is capable of learning from limited examples. Brain-inspired models attempt to capture these qualities by incorporating mechanisms for plasticity and adaptation. This allows them to learn from small amounts of data, generalize to unseen conditions, and adapt to changing environments.

This Special Issue offers a platform to nurture interdisciplinary collaboration and facilitate the co-design of neuromorphic algorithms and hardware for speech processing. Its primary objective is to advance the theories and models for brain-inspired speech processing while also promoting the widespread implementation of neuromorphic speech processing systems. By bringing together expertise from various fields, we strive to drive innovation in brain-inspired speech processing and pave the way for practical applications in the future. We cordially invite researchers and engineers from academia and industry to share state-of-the-art approaches and recent advancements in related topics, with the aim of exploring the full potential of brain-inspired speech processing.

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TOPICS:

- Neural encoding strategies for effective and efficient representation of audio and speech signals.
- Brain-inspired neuron model and network structure for audio and speech processing.
- Neuromorphic learning theory and algorithms for sequential modelling.
- Computational modelling for the auditory system.
- Biosignals analysis (e.g., EEG, ECoG, or fMRI) to unravel the neural codes and mechanisms underlying spoken communication.
- Hardware implementations for low-power and real-time neuromorphic speech processing system.
- Neuromorphic speech processing benchmarks and software libraries.

SUBMISSION: Manuscripts should be prepared according to the guidelines in "Submission Guidelines" of the IEEE Transactions on Cognitive and Developmental Systems in https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=7274989. Submissions should be done through the journal submission website: https://mc.manuscriptcentral.com/tcds-ieee, by selecting the Manuscript Type of "Bridging the Gap between Machine and Brain in Speech Processing" and clearly marking "Bridging the Gap between Machine and Brain in Speech Processing" in the comments to the Editor-in-Chief. Submitted papers will be reviewed by domain experts. Submission of a manuscript implies that it is the authors' original unpublished work and is not being submitted for possible publication elsewhere.

IMPORTANT DATES:

Paper Submission Deadline	Sep 30, 2024
First Review Notice	Oct 30, 2024
Revision Due	Nov 31, 2024
Final Decision	Jan 31, 2025
Expected Publication Date	Apr 30, 2025

GUEST EDITORS:

Jibin Wu, The Hong Kong Polytechnic University, HKSAR, China, jibin.wu@polyu.edu.hk
Haizhou Li, The Chinese University of Hong Kong, Shenzhen, China, haizhouli@cuhk.edu.cn
Shih-Chii Liu, Institute of Neuroinformatics, University of Zurich and ETH Zurich, Switzerland, shih@ini.uzh.ch
Jonathan Timcheck, Intel Labs, USA, jonathan.timcheck@intel.com
Sumit Bam Shrestha, Intel Labs, USA, sumit.bam.shrestha@intel.com