GUEST EDITORS' NOTE
Special Issue on the Internet of Sounds

Part I

Current sound-based practices and systems point to convergent research trends that bring together the field of Sound and Music Computing with that of the Internet of Things (IoT). These endeavors are spurring the emergence of the Internet of Sounds (IoS) research area. The IoS relates to the network of devices capable of sensing, acquiring, processing, actuating, and exchanging data serving the purpose of communicating sound-related information. IoS can be seen as the union of two paradigms: the Internet of Musical Things [1] and the Internet of Audio Things [2], which respectively address musical and non-musical domains in networked contexts.

The IoS area has increasingly attracted the attention of researchers in both industrial and academic contexts. This motivated researchers to initiate an annual gathering dedicated to the IoS, the "International Workshop on the Internet of Sounds," (IWIS), and us to organize this special issue, which was welcomed by the Journal of the Audio Engineering Society (JAES). Some of the articles contained in this issue are extensions of the contributions submitted to IWIS.

This special issue aimed to present high-quality original research reporting the current state of the art of IoS systems and their interactions with end-users. We were interested in submissions covering different aspects related to the use of sound and music processing in relation to local or remote networks, including technological, perceptual, and artistic perspectives. The response of the IoS community has been strong and encouraging: we received 17 submissions. Of these, five were selected for the first volume of this special issue, and other papers will be published in a second volume. Such selected articles present an overview of what is possible today with the IoS.

The first article, "Benchmarking Networked Music Performance Tools With the NMP-Bench Model and Architecture" by Gori and Ceccarelli [3], proposes the Networked Music Performance Benchmark, an approach to systematically analyze and compare the performance of Networked Music Performance (NMP) tools at the technical level. The benchmark was validated by means of experimental procedures.

The second article, "Toward Professional Distributed Performances: Effects of a Global Metronome on Networked Musical Ensemble Interactions" by Hupke et al. [4], assessed the utilization of an auditory and visual global metronome within an NMP with a professional music ensemble. Results showed that the metronome had a positive effect in terms of tempo stability at high latency levels, whereas synchrony strongly depended on the individual coping strategy of each musician. Moreover, a perceivable positive effect of the metronome was discernible for the musicians at all latency levels.

The third article, "Experimenting With Adaptive Metronomes in Networked Music Performances" by Battello et al. [5], proposes three different techniques that try to contrast the latency issue in NMPs by relying on adaptive metronomes. These are metronomes capable of tracking the tempo of the musicians by means of a beat-tracking technique. The authors assessed the investigated techniques via experiments with both professional and amateur musicians. Results suggested that such techniques represent a promising approach for contrasting the impact of latency.

The fourth article, "Technical performance assessment of the Ableton Link protocol over Wi-Fi" by Turchet and Rinaldo [6], investigated how the performance of the Ableton Link synchronization protocol over a Wi-Fi link is affected by the number of connected devices, the kind of Wi-Fi access point utilized, and connecting or disconnecting the nodes. Experimental results indicated that the use of Ableton Link over Wi-Fi is not suitable for ensuring synchronization in ecosystems with a high number of nodes.

The fifth article, "Supporting Creative Practice in Wireless Distributed Sound Installations Given Technical Constraints" by Bown et al. [7], presents insights on practice-led research into building large, scalable artworks in which many heterogeneous networked devices control lights and speakers. The authors provided a reflection on technical and creative constraints associated with the challenge of coding complex multi-device behaviors.

It is an honor to introduce the latest research on the IoS to the AES community and for the IoS community to have been given the opportunity to share their work at JAES in this curated issue. We are truly grateful to all researchers who participated in the review process. We thank the JAES editorial team, with special thanks to the Editor-in-Chief Prof. Vesa Välimäki, for their expertise, their constant help and professional advice, and the opportunity to publish this special issue in one of the most prestigious journals in the field.

As the number and variety of papers listed above demonstrate, currently there is a flowering of scholarly interest in the IoS. We feel privileged to contribute to this conversation and introduce the work of the authors represented in this special issue. We hope that the emerging IoS community will find this special issue to be an informative and useful collection of articles, which facilitates the productive exchange and cross-fertilization of ideas, methods, approaches, and solutions across the multiple research disciplines that underly the IoS.

Luca Turchet
George Fazekas
Cristina Rottondi
Carlo Fischione

REFERENCES

[1] L. Turchet, C. Fischione, G. Essl, D. Keller, and M. Barthet, "Internet of Musical Things: Vision and Challenges," IEEE Access, vol. 6, pp. 61994–62017 (2018 Sep.).

[2] L. Turchet, G. Fazekas, M. Lagrange, H. S. Ghadikolaei, and C. Fischione, "The Internet of Audio Things: State of the Art, Vision, and Challenges," IEEE Internet Things J., vol. 7, no. 10, pp. 10233–10249 (2020 Oct.).

[3] M. Gori and A. Ceccarelli, "Benchmarking Networked Music Performance Tools With the NMP-Bench Model and Architecture," J. Audio Eng. Soc., vol. 69, no. 10, pp. 708–719 (2021 Oct.).

[4] R. Hupke, M. Nophut, S. Preihs, and J. Peissig, "Toward Professional Distributed Performances: Effects of a Global Metronome on Networked Musical Ensemble Interactions," J. Audio Eng. Soc., vol. 69, no. 10, pp. 720–736 (2021 Oct.).

[5] R. Battello, L. Comanducci, F. Antonacci, G. Cospito, and A. Sarti, "Experimenting With Adaptive Metronomes in Networked Music Performances," J. Audio Eng. Soc., vol. 69, no. 10, pp. 737–747 (2021 Oct.).

[6] L. Turchet and E. Rinaldo, "Technical Performance Assessment of the Ableton Link Protocol over Wi-Fi," J. Audio Eng. Soc., vol. 69, no. 10, pp. 748–756 (2021 Oct.).

[7] O. Bown, S. Ferguson, A. Dias Pereira dos Santos, and K. Mikolajczyk, "Supporting Creative Practice in Wireless Distributed Sound Installations Given Technical Constraints," J. Audio Eng. Soc., vol. 69, no. 10, pp. 757–767 (2021 Oct.).