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Intelligent Music Interfaces: When Interactive Assistance and Augmentation Meet Musical Instruments

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ABSTRACT

The interactive augmentation of musical instruments to foster self-expressiveness and learning has a rich history. Over the past decades, the incorporation of interactive technologies into musical instruments emerged into a new research field requiring strong collaboration between different disciplines. The workshop "Intelligent Music Interfaces" consequently covers a wide range of musical research subjects and directions, including (a) current challenges in musical learning, (b) prototyping for improvements, (c) new means of musical expression, and (d) evaluation of the solutions.

CCS CONCEPTS

• **Human-centered computing → Interactive systems and tools**; **Interaction techniques**; **Interaction devices**.

KEYWORDS

Music Interfaces; Musical Instruments; Self-Expression; Augmented Instruments; Artistic Performance

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1 BACKGROUND & GOALS

Playing a musical instrument goes hand-in-hand with benefits, including a positive impact on mental health [12, 16] and dexterity [17]. The ongoing digitization resulted in novel technical devices with computation and network capabilities – the Internet of Things (IoT). Electronic elements were integrated into traditional musical instruments in the early 1930s to create instruments such as E-guitars, offering new ways of musical expression for artists. These music instruments evolved into IoT devices that provide networking and computation capabilities. These new capabilities can be leveraged to broaden further the artists' expressiveness [7, 13], enhance teaching scenarios [5, 6], support musicians with disabilities [2], allow remote collaboration of musicians, and even create entirely new musical instruments, such as synthesizers invented in the late 1930s.

Integrating interactive technologies into musical instruments has become an emerging field. Initial work in the domain of intelligent music interfaces focused on improving the play performance of students through learning-by-demonstration [8–11, 15] or by reflecting the performance directly to the student for real-time improvements [4]. Further, musical instruments were augmented by technologies to extend the musical sound space. For example, gestures and musical instruments can be combined to, for example, change the pitch of a sound [3, 7, 13]. We expect future musical instruments to integrate interactive features, effectively facilitating the learning of musical instruments, promoting self-expression, and changing stage performances.

The workshop "Intelligent Music Interfaces" lays the foundation for a research field concerning integrating interactive components into musical instruments and creating new ways of musical expression. We aim to connect recent research revolving in this field with the workshop to start, grow, and foster a community around intelligent musical interfaces. This includes the presentation, demonstration, and discussion of existing musical instruments that were modified to, for example, support students during learning, enable the expression of individual playstyles, or allow musicians to play sounds that were not possible before. In addition, the workshop encourages the presentation of novel musical instruments and prototypes. This includes new methods to create music.

Overall, the workshop "Intelligent Music Interfaces" offer various research topics in (a) investigating current issues in musical learning, (b) prototyping for improvements, (c) investigating new ways of musical expression, and (d) evaluation of the solutions. However, musical expertise is not required to participate in the workshop since we aim to connect researchers from different disciplines.

2 ORGANIZERS

The organizing committee consists of the following researchers and professional musicians. Each of them contributes long-term experiences in organizing workshops including Handling IoT in HCI (IoT '17), Reading the Mobile Brain (MUM '17) [1], Designing Assistive Environments for Manufacturing (PETRA '17 - '21)[1], SmartObjects '18 (CHI '18) [14], Body as Starting Point 4: Inbodied Interaction Design for Health Ownership (CHI '21) [18] as well as several local workshops for bands.

Karola Marky is a postdoctoral researcher at the University of Glasgow. Her research focuses on the intersection of cybersecurity and human factors, explicitly considering privacy aspects of ubiquitous technology and novel security interfaces based on tangible interaction. She further leverages novel interfaces and interaction techniques to improve musical instruments dedicated to beginners and students. In her free time, she plays the piano. She will coordinate the workshop organization and contribute with her expertise in evaluating novel intelligent music interfaces.

Annika Kilian is a master student at the Ludwig Maximilian University of Munich. She is interested in new, seamlessly integrable input modalities for musical instruments that aim to enhance a performer's expressiveness and elevate creativity. Annika will provide perspectives to the workshop from a practitioners' point of view.

Andreas Weiß has over twenty years of experience as a musician and music teacher. He is part of several band projects and co-owns the music school Schallkultur in Kaiserslautern, Germany. In addition, he collaborates with several research institutions by contributing his expertise as a musician to develop and evaluate new smart music interfaces, such as Let's Frets [10]. The practical didactic experience of Andreas will allow workshop attendees to quickly identify challenges and opportunities when using interactive technologies in learning scenarios.

Jakob Karolus is a postdoctoral researcher at the Ludwig Maximilian University of Munich. His research focuses on the design of proficiency-aware systems leveraging ubiquitous sensing technologies. In addition, he is interested in the design qualities of sensor-augmented musician-instrument interaction. His expertise in rapid design, prototyping, and evaluation of novel musical instruments will benefit the workshop.

Matthias Hoppe is a PhD student at the Ludwig Maximilian University of Munich, where he focuses on mixed reality as a new medium and investigates the importance of haptic feedback in virtual reality. Therefore, he is also interested in how such novel interactions can enhance experiences with novel music interfaces. Matthias has experience in evaluating supportive tools while practicing musical instruments.

Paweł W. Woźniak is a full professor at the Chalmers University of Technology in Sweden. He is interested in how supportive, interactive technologies integrated into music instruments influence the musician's playstyle and motivation. His knowledge in evaluating the musician's motivation, experience, and playstyle is necessary to supervise workshop attendees in choosing their evaluation paradigm.

Max Mühlhäuser is a professor at the Technical University of Darmstadt. In the past, he investigated several music interfaces, also contributing a long-term interactive music exhibit called "virtual conductor" to the House of Music in Vienna[2].

Thomas Kosch is a postdoctoral researcher at the Technical University of Darmstadt. His research focuses on physiological interaction, including designing, prototyping, and evaluating physiological user interfaces. In addition, he is an expert in integrating physiological sensing into musical instruments to implicitly and explicitly augment musicians. Thomas is deeply interested in new ways to create music, augment existing instruments, and create tools and feedback mechanisms supporting musical students. He will provide his experience in prototyping and evaluating novel music interfaces.

3 WEBSITE

The workshop website will be available under the domain team-darmstadt.de/imi. The website includes a workshop description, objectives, and possible topics for submissions. It also hosts the call for participation, a link to the submission system, the workshop schedule, further organizational information, and information about the workshop organizers. Accepted papers will be made publicly available on the website before the conference to maximize the preparation time for the workshop and foster discussions.

4 PRE-WORKSHOP PLANS

We will distribute information and materials on the workshop website. Information includes the intention, motivation, and potential outcomes of the workshop. Furthermore, the website serves as a platform to advertise and acquire potential workshop participants. Finally, workshop participants will regularly receive updates about the workshop via email.

5 IN-PERSON, HYBRID, OR VIRTUAL ONLY

We plan an in-person workshop to stream the content to the online participants (e.g., YouTube, Zoom). We are prepared to switch to a full virtual participation if the circumstances do not allow physical

[1]www.petrae.org/workshops/DAEM.html 16-December-2021

[2]https://www.hausdermusik.com/en/museum/4-etage-der-virtuelle-dirigent accessed 16-December-2021

participation. Details for that are given in the workshop structure below. In both cases, we require a live transcription service in the respective streaming and communication platform (i.e., physical or virtual event). We plan an interactive session where participants can engage with several intelligent music interfaces to foster discussion. The exhibits are from workshops participants and the organizers, such as the Let's Frets smart guitar [10] or EMPiano system [3]. The organizers will ensure that there are enough exhibits to fill this workshop part. In the case of an exclusively virtual workshop, this part is based on videos of the exhibits that can be discussed in several breakouts rooms that participants can choose. Authors of an interactive demo will submit a short video before the conference that will also be available to participants.

6 ASYNCHRONOUS ENGAGEMENT

We will offer the presenter slides, papers, video recordings, and results on the website. Participants and interested persons can view the materials after the workshop. Additionally, we will provide a Discord server where participants can discuss their research, group work, and feedback about past projects. The Discord server will feature one channel per talk and group work project, where slides, papers, and results will be linked to the channels.

7 WORKSHOP STRUCTURE

We plan a one-day workshop for 20 participants and the following schedule:

(1) **Workshop introduction** (15 min): the organizers introduce themselves, the workshop topic, and the schedule. For online participants, this will be streamed via Zoom.
(2) **Moderated speed dating** (approx. 15 min): the workshop attendees participate in speed dating sessions to get to know each other, either physically grouping them or by grouping them in Zoom breakout rooms.
(3) **Introduction of interactive session** (10 min): the organizers introduce the interactive session and answer questions. For online participants, this will be streamed via Zoom. Interactive presentations and demonstrations will be set up before the workshop start.
(4) **Interactive music session** (60 min): hands-on experience with different intelligent music interfaces for the participants. The authors will be asked to submit a video made available before the workshop. While we aim to stream each demo for online participants, we also allocate time for them to talk to the presenters via Zoom
(5) **Short break** (5 min)
(6) **Keynote** (20 min + 10 min discussion): for online participants, the keynote will be streamed via Zoom, questions will be collected on Slido
(7) **Lunch break** (60 min)
(8) **Art Pieces** (approx. 3×10 min): participants perform their art piece, which will be streamed for online participants, or a video recording is played.
(9) **Short break** (5 min)
(10) **Pitch presentations** of short papers and research statements (total 70 min): 5 Research Statements 3+2 min (25 min), short break (5 min), and 6 Short Paper 5+2 minutes (42 min). The presentations will be streamed, and questions will be collected via Slido.
(11) **Coffee break** (10 min)
(12) **Moderated discussion and closing** (60 min): the organizers moderate a discussion based on the pitch presentations, art pieces, and interactive demonstrations. Participants in Zoom will be projected to foster their engagement in the discussion if they wish. Questions and comments from the live and online audiences will be discussed. Finally, the workshop is closed.

8 POST-WORKSHOP PLANS

After the workshop, we encourage researchers to rework their research statements and position papers based on the discussions and feedback from the workshop. We will support researchers in submitting their final statements and papers to either arXiv or preprints on our website. Recorded pitches and the keynote will be uploaded on YouTube after seeking the presenter's permission. Based on the group work and moderated discussion, the organizers plan to distill critical aspects and the workshop's outcomes into a position paper published open access. The anticipated results are available to research questions concerning prototyping, the study design, and the evaluation of intelligent music interfaces. The feedback of the workshop attendees accompanies these research questions to inspire researchers who are interested in tackling the research questions. Based on the interest of the workshop attendees, we plan to organize regular meetups. We plan to establish a long-term format with a potential future invitation for the authors to contribute to a journal.

9 CALL FOR PARTICIPATION

Playing a musical instrument goes hand-in-hand with many benefits, such as positively impacting mental health or dexterity. Electronic elements have been integrated into traditional musical instruments in the early 1930s to create instruments, such as E-guitars, that offer new ways of music expression. Electric instruments evolved by combining networking and computational capabilities. These new capabilities can be leveraged to further broaden artists' expressiveness, enhance learning scenarios, allow remote collaboration of musicians, and even create entirely new musical instruments.

In this workshop, we will discuss and interact with intelligent music interfaces of any form. Novel music interfaces could be a new adaption of a traditional musical instrument, an interface for learning, or even supporting software. The workshop is planned to be held in person while offering to participate virtually.

Submissions should follow the ACM two-column format with a maximum page length of three pages, excluding references. Information about submitting papers can be found on the workshop website[3]. The talks and presentations will be streamed for virtually attending participants. Participants will be selected based on the merit of their contribution to the workshop. We support and encourage authors to make their research available on arXiv[4] after the workshop. At least one author of each accepted submission must attend the workshop. All participants must register for both the

[3]https://teamdarmstadt.de/imi accessed 16-December-2021
[4]https://arxiv.org accessed 16-December-2021

workshop and at least one day of the conference. We solicit the following types of submissions: position papers, research statements, art pieces, and interactive demonstrations. The duration of an art piece is limited to 10 minutes. As interactive demonstrations, we consider demonstrating an intelligent musical interface that workshop participants can try out during the workshop. The authors of interactive demonstrations and art pieces are invited to present a prototype in the interactive workshop session.

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