Challenges and Prospects in Remote Cross-cultural Musical Interface Design

Tim-Tarek Grund
Dept. of Music Acoustics
mdw – Universität für Musik und darstellende Kunst Wien
Vienna, Austria
grund@mdw.ac.at

Luong Hue Trinh
Independent Artist
Accra/Paris/Hanoi, Ghana/France/Vietnam
huetrinh.luong@gmail.com

Alex Hofmann
Dept. of Music Acoustics
mdw – Universität für Musik und darstellende Kunst Wien
Vienna, Austria
hofmann-alex@mdw.ac.at

ABSTRACT

Roles in the context of live-electronic music performance are often overlapping. We used a cross-cultural collaboration between a Vietnamese live-electronic composer-performer and a German instrument maker to study the development of roles. We followed the approach of building a digital music instrument inspired by existing acoustic instruments and conducted a case study with the task of developing a granular effect sample player, the Grain Bau, inspired by the Vietnamese monochord zither đàn Bầu. We analyzed the milestones, tasks and remote collaboration strategies and assessed the depth of participation. We found that in-person collaborative work tended to dissolve role definitions, while remote working emphasised them. We examine our strategies for remote working and discuss the influence of gender on our role development.

Author Keywords

Gestural repertoire, Practice-based research, Collaboration, Roles, Vietnamese instruments, Granular synthesis, Novel controllers

CCS Concepts

•Human-centered computing → Collaborative and social computing; •Applied computing → Sound and music computing; Performing arts;

1. INTRODUCTION

In the context of live-electronic music performance, responsibilities and activities of roles are often overlapping. This conflation of roles is in contrast to Western art music, where a clearer distinction between composer, performer, and instrument maker exists [9]. This is of particular interest to researchers: Fiebrink [6] uses the term "composers" for instrument makers in order to address that instrument development or mapping are processes, that give shape to musical ideas. Emerson and Egermann interviewed performers, that build their own digital music instruments (DMI) [4].

In the field of DMI several approaches for gestural input of instruments have been proposed, drawing from embodied cognition [5], acousmatic music practice [11], and physical modeling [2]. Another approach, that has been utilised in various DMIs, is drawing inspiration from existing gestural repertoire of acoustic instruments [1, 10, 12]. Modeling the full extent of possible motion as well as some of the underlying physical affordances of the instrument serves two purposes: On one hand it allows for skill transfer from the source instrument, on the other hand it implies a strong communicative ability. Findings from the field of embodied cognition imply that listeners are able to assess performer skill based on the causal relationship between action and sound production [3, 9].

Following this approach, we present the process of developing the Grain Bau, a granular effect sample player, whose gestural input is inspired by the action repertoire of the Vietnamese monochord zither đàn Bầu (Figure 1). The Grain Bau setup consists of a gestural interface (Figure 2), an auxiliary device, as well as a graphical user interface, that contains the sound production code, written in Pure Data (PD). It has been developed in a collaborative effort between an instrument maker (the first author) and a Vietnamese composer-performer (the second author). Over the course of several months, there is a collaborative effort with the goal of performing a composition written for a new DMI. Tasks and milestones of this project are recorded and analyzed towards identifying roles and causes for role changes. To better understand the extent of the collaboration, we assess the depth of participation of individual working phases using the participation framework proposed in [8]. Furthermore, we reflect on challenges and prospects during the remote cross-cultural collaborative process.

2. CASE STUDY

As a case study, we initiated a collaboration between a Vietnamese composer-performer and an German instrument maker with the goal of developing a DMI and performing a composition with it in a concert. The project lasted from a kick-off meeting in April 2023 to a concert performance in October 2023. The result of this collaborative effort is the Grain Bau, the score for the composition, and a concert performance. The duration of this case study has been divided into four main work phases outlined in Figure 3.

2.1 Planning

During the first week-long in-person visit of the second author to our lab, the groundwork for the case study was laid out. In a brainstorming session, a variety of ideas for a DMI were discussed, as well as thoughts about remote collabo-

NIME'24, 4–6 September, Utrecht, The Netherlands.

Figure 1: The đàn Bầu, a Vietnamese monochord zither. Its gestural repertoire serves as the foundation for our DMI.

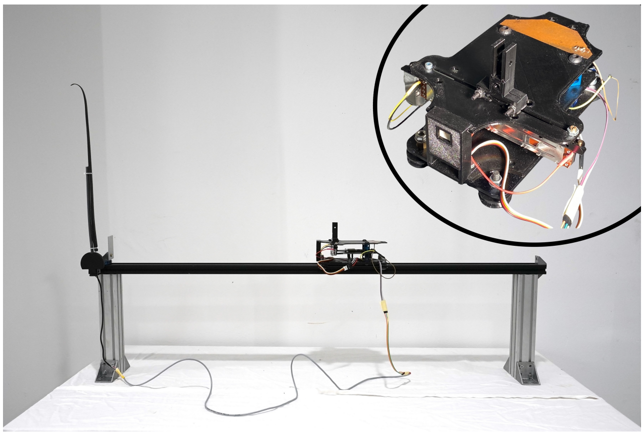


Figure 2: The gestural interface of the Grain Bau is inspired by the đàn Bầu. On the top right: A close-up of the cart with distance sensor, fader potentiometer, and capacitive copper plate is shown.

ration. We assigned the role definition of a composer and performer to the second author and the instrument maker role to the first author, who has permanent access to the music acoustics lab at mdw.

One of the options discussed was building or augmenting a traditional Vietnamese instrument, such as the đàn Tranh or the đàn Bầu. Potential designs of the signal path and sound FX (e.g. reverb, randomization) were discussed. Of importance for the development of the DMI were the option of including a granular effect section, a front panel with control elements, and a bending bar to control a pitch transformation.

Due to the limitations of working remotely over some parts of the collaboration, it was decided to develop a graphical user interface (GUI) alongside the physical gestural interface so that progress could be evaluated without having the physical interface present. PD was designated as the platform for sound synthesis and GUI design. During this phase we also acquired a đàn Bầu and talked to Ngô Trà My, an expert đàn Bầu performer, to gain insight into the instrument tradition and to learn basic playing technique.

2.2 Prototyping

The prototyping phase was completely remote due to the touring schedule of the second author. It started with experiments in feedback synthesis. During this phase, a major shift towards alternative sound production occurred. It was recognized that for a successful remote collaboration the sound production method needed to be contained in-the-box. Feedback synthesis was impractical, since feedback instruments require interfacing points in the form of microphones/pickups and speakers/exciters. Thus it was decided to focus on sample-based granular synthesis instead, since a granular effect section was already planned for the processing of the feedback instrument. It also opened up the possibility of using recordings of the đàn Bầu as material for the sound production ensuring the ability to still incorporate the original instrument's sound.

At this point, the setup of the DMI consisted only of the gestural interface and the GUI in PD. The gestural interface (shown in Figure 2) is the part of the DMI, that is based on the gestural repertoire of the đàn Bầu. The đàn Bầu (in Figure 1) is a monochord zither, whose single string is tied to a loop and hooked on a bending rod on one end. Traditionally, it is played by plucking the overtones with a pluck, while the other hand controls string tension using the bending rod in order to allow for pitches outsides the harmonic series and ornamentation. The overtones are excited by resting the plucking hand the string and plucking from below by moving the whole arm upwards. The designed gestural interface emulates these gestures. Erdem et al. classify sound-producing actions into excitation actions and modification actions [5]. The Grain Bau delegates excitation tasks to the right hand: When moving the fader on top of the cart (shown in the top right in Figure 2) across a threshold (a virtual string to be plucked), a looped sample playback is triggered. A distance sensor measures the position of the cart. The sample playback starts from a playback position relative to the distance of the cart to the left end. The left hand is assigned to modifying the pitch by bending the pitch rod, which is captured using a rotary potentiometer with a built in spring.

2.3 Polishing

The polishing phase was characterized by frequent exchanges of PD patches, feedback and feature requests between first and second author. Four main developments were: 1) Adding sustaining and looping functionality for sample playback; 2) inclusion of a MIDI keyboard as an auxiliary device into the formal setup; 3) a remote-playable version of the DMI; 4) change of performer role.

Previously, the DMI would play sounds with a fixed duration once plucked (one-shot). However, the possibility of continuing the sound was requested in order to explore interesting parts of the samples once encountered. This led to the implementation of a sustaining feature (referenced as "hold"in Table 1 and in the composer-performer's notes in Figure 5). Whenever the plucking hand rests on the cart, the sustain is triggered, which draws further inspiration from the plucking motion of the đàn Bầu. A looping mechanism was implemented to allow layering of different samples.

During the mapping process it became evident that certain parameters needed to be changed quickly to find sample positions with satisfying sonic responses. This led to a mapping on an auxiliary device (Arturia MiniLab Mk II). Knobs were mapped to synthesis parameters and keys to switching between samples and starting or stopping the loop function. In the beginning of the planning phase, when different DMI ideas were discussed, the notion of having a dedicated control panel for sound parameters was evaluated highly by

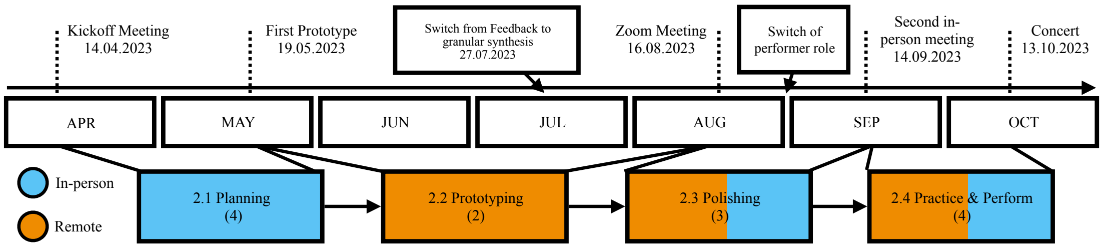


Figure 3: Timeline of the collaboration with important milestones (top) and relevant working phases (bottom) of the case study. The numbers below the working phases refer to mean ratings by first and second author of the depth of participation according to the participation framework in [8].

the second author. Later, the exploration of synthesis possibilities became an even more important part of the DMI's character, when turning knobs was extensively tested as a performance technique. It was decided to merge gestural interface, GUI and auxiliary device into one setup.

Since the first and second author were not situated in the same country, a method had to be devised, that allowed for testing features without access to the gestural interface. It was decided to use a MIDI keyboard controller as a substitute, since these controllers are highly standardized, available, and often come with built-in pitch bend interface elements.

Also due to the remote collaboration process, the second author only had limited access to the gestural interface. While the remote MIDI keyboard version was intended to allow an assessment of the synthesis process, it did not properly translate the gestural repertoire of the gestural interface. This made it difficult for the composer-performer to accustom herself to the DMI, in contrast to the instrument maker, who continuously attuned to, evaluated, and adjusted it. Therefore, we changed the role assignment of the performer from the second author to the first author one month before the concert.

2.3.1 Playing technique & sound material

The second in-person visit also falls within this phase. It was mainly concerned with testing playing techniques and sound material. In the beginning, different samples were grouped together by the instrument maker and the composer. Over the course of the stay, these were tested, and processing decisions were made: which samples would be included or removed from the list, which were deemed too homogeneous and subsequently merged together and which ones need further editing. Initially, the selection of sounds was driven by the intention of establishing a structural framework for the composition. This framework aimed to showcase the DMI's capabilities, progressing from simpler effects and techniques to more intricate ones, encompassing both single and complex sounds. However, a shift in perspective occurred during the second in-person meeting following numerous tests. The revised approach prioritized the identification and inclusion of the most expressive sound characters. This shift was motivated by the recognition that a DMI should not solely emphasize roughness, powerfulness, and loudness. Instead, it should also embrace qualities of delicacy, smoothness, and softness. Consequently, some sounds underwent refinement, involving cutting and merging with others to broaden the overall sonic landscape.

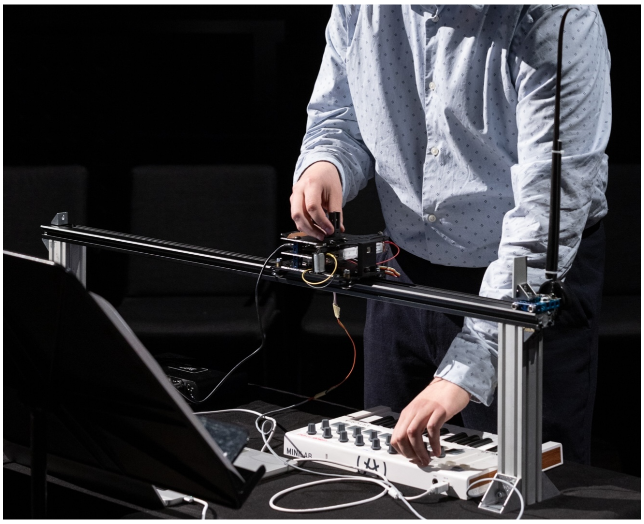


Figure 4: The Grain Bau gestural interface and auxiliary device played by the first author during the premiere of "How can I be tender?"© Stephan Polzer, modified by the first author.

Some of the explored techniques focused on controlling the pitch playback using the pitch rod mechanism. Glissando, vibrato and ornamental motions were examined. Techniques for interacting with looped material were also investigated. Since looped material did not require further input on the gestural interface, techniques for interacting with the knobs on the auxiliary device were tested. One example of this is the simultaneous control of loop grain size and loop reverb by gliding with the hands and arms alongside one of the sides of the knob in order to turn them faster than with regular finger-turning. Notes on the interplay of techniques and sound material can be found in Figure 5, alongside commentary on which samples should be further processed.

2.3.2 Final implementation

The final setup for the Grain Bau consists of three elements: A custom-built gestural interface, an auxiliary standard MIDI device with keys/buttons and faders/knobs, and a GUI in PD. PD patches, sound material, and supplementary material can be found on Github[7]. A picture of the Grain Bau during performance is shown in Figure 4. A mapping of control elements to synthesis parameters is shown in Table 1.

Gestural Interface		
Name	Input	Description
Pluck	Fader potentiometer	Fader mounted on top of the cart. When crossing threshold, a note is sent with a velocity according to the speed. Velocity controls grain size.
Pitch rod	Rotary potentiometer	Stick mounted on a rotary potentiometer with a spring. Transposes one octave down or up.
Hold	Capacitive plate	When held, blocks "note off" and "pitch bend" messages to last played voice. When released, sends a "note off" to all voices.
Distance	Distance sensor	Measures the distance from cart to end and controls the sample playback position.

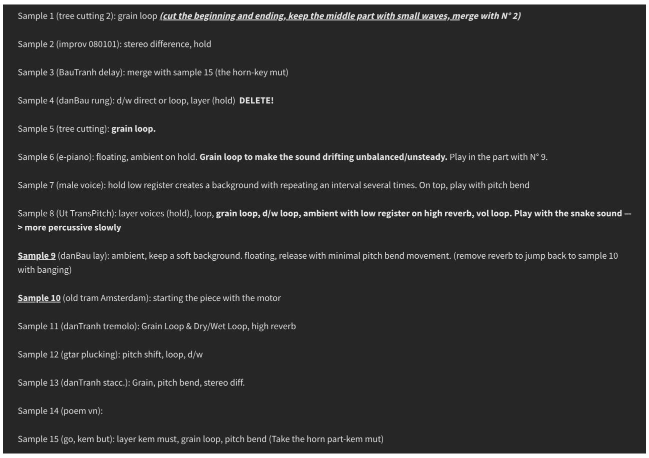
Auxiliary Interface		
Name	Input	Description
Vol Loop	Knob	Controls volume of loop section.
Grain Loop	Knob	Controls grain size of loop section.
Rev Amount	Knob	Controls amount of reverb
D/W Loop	Knob	Controls dry-wet reverb mix of loop section.
D/W Direct	Knob	Controls dry-wet reverb mix of direct signal.
Stereo Diff.	Knob	Controls size of random values added to grain size of left and right channel
Pitch range	Knob	Controls range of pitch rod.
Rand grain size	Knob	Controls size of random values added to grain size.
Rand grain pos	Knob	Controls size of random values added to grain position.
Loop	Key	Starts/stops Loop.

Table 1: Mapping of input control elements to synthesis parameters.

In addition to the interface elements presented above, the final implementation of the gestural interface includes a capacitive copper area (shown in top right in Figure 2), that is used for detecting, whether a hand is resting on it. If a hand is detected, the last played sample is sustained until the hand is lifted off the copper area.

In the beginning, the use of an auxiliary device was employed to accommodate the need for remote collaboration tools and for fine-tuning synthesis parameters. In its final implementation, the auxiliary device handles changing samples, controlling the looping process, and adjusting FX parameters. However, the remote collaboration aspect was always maintained, so it is possible to play the Grain Bau without the physical gestural interface.

The GUI patch was realized in PD and contains the mapping and sound synthesis code. Sensor data are displayed, such as the position of the cart along the rail in reference to the sample playback position. The GUI also displays the sample waveform and parameter states for orientation.



Sample 1 (tree cutting 2): grain loop ***(cut the beginning and ending, keep the middle part with small waves, merge with N° 2)***

Sample 2 (improv 080101): stereo difference, hold

Sample 3 (BauTranh delay): merge with sample 15 (the horn-key mut)

Sample 4 (danBau rung): d/w direct or loop, layer (hold) **DELETE!**

Sample 5 (tree cutting): **grain loop.**

Sample 6 (e-piano): floating, ambient on hold. **Grain loop to make the sound drifting unbalanced/unsteady.** Play in the part with N° 9.

Sample 7 (male voice): hold low register creates a background with repeating an interval several times. On top, play with pitch bend

Sample 8 (Ut TransPitch): layer voices (hold), loop, **grain loop, d/w loop, ambient with low register on high reverb, vol loop. Play with the snake sound —> more percussive slowly**

Sample 9 (danBau lay): ambient, keep a soft background. floating, release with minimal pitch bend movement. (remove reverb to jump back to sample 10 with banging)

Sample 10 (old tram Amsterdam): starting the piece with the motor

Sample 11 (danTranh tremolo): Grain Loop & Dry/Wet Loop, high reverb

Sample 12 (gtar plucking): pitch shift, loop, d/w

Sample 13 (danTranh stacc.): Grain, pitch bend, stereo diff.

Sample 14 (poem vn):

Sample 15 (go, kem but): layer kem must, grain loop, pitch bend (Take the horn part-kem mut)

Figure 5: Screenshot of composer's notes on sound material, playing technique and further processing.

Figure 6: The first page of the composition "How can I be tender?", written by the second author for this project. © Stephan Polzer

2.4 Practice & Perform

During this phase, which started remotely, most of the activities related to concert preparations. Based on the comments provided in Figure 5, a new sound bank was created by the second author, reducing the number of samples down to 12. A first version of the score for the concert composition was presented, the score was then reworked several times (see final score in Figure 6). One week before the concert, the third in-person meeting started, where the score was explained. In a trial-and-error fashion, the composition called "How can I be tender?" was played by the first author with feedback on the artistic vision by the second author. Notes were taken on the score, which influenced later iterations. A meta-document containing waveform representations of each sound material was created by the first author, where the important parts in each sample were marked in order to have a fixed reference point for practicing. The collaboration concluded with a concert at Klangtheater/Future Art Lab, mdw [1] in October 2023.

[1] A video of the performance is shown here: https://www.youtube.com/watch?v=JkPikiA5B68

3. REFLECTIONS AND TAKEAWAYS

In this paper we presented a cross-cultural remote collaborative artistic research process to develop a new DMI, a score and a live-electronic music performance. We have three key takeaways: 1) remote working was challenging as it tended to emphasise role definitions; 2) inaccessibility of the full DMI hindered remote collaboration; 3) in-person collaborative work tended to dissolve role definitions and supported co-creativity and participation.

West and Leung [12] reported on roles of collaboration during later stages of the development of a DMI based on a traditional instrument, describing their cooperation as a "collaboration between a technically competent artist [...] and an artistically competent technician [...]." This collaborative setup strongly resembles the authors' working arrangement. In our case, it even invites us to reflect on gender roles during the development of DMIs: Although in-person working allowed us to steer away from traditional stakeholder definitions, background and especially remote working considerations led us to fall back into traditional gender roles of assigning the (technical) development of the DMI to the male author and the artistic role of composing to the female author.

An unexpected event was the change of assignment of the performer role from the composer to the instrument maker. We believe availability of access to and experience with the gestural interface was an important factor. We realized that the option of a remote keyboard version of the DMI was not adopted by the composer. While it could provide insight into the synthesis process, it ultimately failed in providing an embodied access to the sound material. Future work might therefore focus on creating multiple copies of a travel-size version of the gestural interface in order to support remote collaboration.

In a post-collaboration inquiry both the first and the second author rated the participation depth for the individual phases. Results show that the given ratings were identical for both authors. We observed a trend of larger participation depth ratings (≥ 3) during in-person visits (see Fig. 3). In-person visits were defined by joint decision-making, while the main mode of remote collaboration phases was consultative. During in-person meetings, we observed collaborative efforts on tasks, that could be ascribed to the performer role (scrutinizing performance techniques) as well as the composer role (choosing and discussing potential sound material). This suggests that role definitions are fluid, which is in line with considerations about the DMI building process as a compositional task [6].

In the planning phases we had the opportunity to talk to an expert đàn Bầu musician about the instrument and its role in Vietnamese culture. We emphasize that we do not see the Grain Bau as a 'modernization' of the đàn Bầu. Armitage et al. [1] see instrument development based on historical and cultural instruments as an entry point to becoming established in a local setting. We hope that this DMI can serve as a starting point for discussions with performers and the community about places for culturally inspired instruments. In [1], the development of a DMI as a research probe into social dynamics was presented. They utilized the instrument as a lens with which they could examine their research methodology. In a similar context we regard our development of the Grain Bau as a window, that sheds light on cross-cultural collaborative practices in the field.

4. ACKNOWLEDGMENTS

This research was funded in whole by the Austrian Science Fund (FWF) [10.55776/AR743]. For open access purposes, the author has applied a CC BY public copyright license to any author accepted manuscript version arising from this submission. We would like to thank Ngô Trà My for an introduction to the đàn Bầu and helpful instructions.

5. AUTHORS' CONTRIBUTIONS

TTG wrote the code, built the gestural interface, and wrote the paper. TTG and LHT wrote section 2.3.1 together. AH supervised the research. The authors read and approved the final manuscript.

6. ETHICAL STANDARDS

This project adheres to the standards of the NIME Principles & Code of Practice on Ethical Research. Project files for the Grain Bau are released as open source.

7. REFERENCES

[1] J. Armitage, T. Magnusson, V. Shepardson, and H. Ulfarsson. The proto-langspil: Launching an icelandic nime research lab with the help of a marginalised instrument. In NIME, 2022.

[2] R. DuPlessis. A virtual instrument for physics-based musical gesture: Chon. In NIME, 2022.

[3] G. Emerson and H. Egermann. Gesture-sound causality from the audience's perspective: Investigating the aesthetic experience of performances with digital musical instruments. Psychology of Aesthetics, Creativity, and the Arts, 12(1):96, 2018.

[4] G. Emerson and H. Egermann. Exploring the motivations for building new digital musical instruments. Musicae scientiae, 24(3):313–329, 2020.

[5] C. Erdem, Q. Lan, J. Fuhrer, C. P. Martin, J. Tørresen, and A. R. Jensenius. Towards playing in the'air': Modeling motion-sound energy relationships in electric guitar performance using deep neural networks. In Proceedings of the SMC Conferences, pages 177–184. Axea sas/SMC Network, 2020.

[6] R. Fiebrink. Machine learning as meta-instrument: Human-machine partnerships shaping expressive instrumental creation. Musical Instruments in the 21st Century: Identities, Configurations, Practices, pages 137–151, 2017.

[7] T.-T. Grund. Grain bau, Apr. 2024. Zenodo. (code: https://github.com/grundton/grain_bau/tree/main). https://doi.org/10.5281/zenodo.10992539.

[8] M. K. Harder, G. Burford, and E. Hoover. What is participation? design leads the way to a cross-disciplinary framework. Design Issues, 29(4):41–57, 2013.

[9] A. R. Jensenius. Sound actions: conceptualizing musical instruments. MIT Press, 2022.

[10] J. Ramos, E. R. Calcagno, R. o. Vergara, P. Riera, and J. Rizza. Bandoneon 2.0: an interdisciplinary project for research and development of electronic bandoneons in Argentina. In NIME, 2022.

[11] E. Tomás, T. Gorbach, H. Tellioğlu, and M. Kaltenbrunner. Embodied Gestures: Sculpting Energy-Motion Models into Musical Interfaces. In NIME, 2021.

[12] T. West and K. Leung. Early prototypes and artistic practice with the mubone. In NIME, 2022.