

# Reimagining: Cross-cultural Co-Creation of a Chinese Traditional Musical Instrument with Digital Technologies

Nick Bryan-Kinns  
Queen Mary University of London  
Mile End  
London, United Kingdom  
n.bryan-kinns@qmul.ac.uk

Zijin Li  
China Conservatory of Music  
Anxiang Rd. Chaoyang  
Beijing, China  
lzj@ccmusic.edu.cn

## ABSTRACT

There are many studies of Digital Musical Instrument (DMI) design, but there is little research on the cross-cultural co-creation of DMIs drawing on traditional musical instruments. We present a study of cross-cultural co-creation inspired by the Duxianqin — a traditional Chinese Jing ethnic minority single stringed musical instrument. We report on how we structured the co-creation with European and Chinese participants ranging from DMI designers to composers and performers. We discuss how we identified the ‘essence’ of the Duxianqin and used this to drive co-creation of three Duxianqin reimagined through digital technologies. Music was specially composed for these reimagined Duxianqin and performed in public as the culmination of the design process. We reflect on our co-creation process and how others could use such an approach to identify the essence of traditional instruments and reimagine them in the digital age.

## Author Keywords

Cross-cultural, Co-creation, Digital instrument, Tradition

## CCS Concepts

•Applied computing → Sound and music computing; Performing arts; •Human-centered computing → User centered design; Activity centered design;

## 1. INTRODUCTION

Research on New Interfaces for Music Expression has flourished in recent years [3]. Whilst most of this work happens in academic research centers situated within a Western musical aesthetic, some research has explored music and music making from other traditions, combining ethnic music elements into Digital Music Instrument (DMI) design such as Barbosa’s collaborations with musicians from the Brazilian Northeast [1]. Similarly, Kapur describes the creation of new interfaces that extend traditional Korean music and dance, resulting in the design of the eHaegum (Korean bowed instrument), eJanggu (Korean drum), and ZiOm wearable interfaces [5]. Cannon presents a new expressive electronic music controller based on the Irish Uilleann Pipes, a 7-note polyphonic reeded woodwind [4], and Young presents a prototype of a new musical interface for Japanese drumming [11].

However, there is very little research on the cultural collisions in co-designing DMIs across cultures. In this paper we reflect on a co-creation workshop we undertook in China bringing together participants from China and Europe with backgrounds in musicology, performance, composition, digital technology, and interactive design to explore the digital reimagining of the Duxianqin — a traditional minority musical instrument of southwest China. As cross-cultural co-creation of DMIs is underexplored in NIME we asked the following research questions:

RQ1: How to engage participants from a range of cultures and disciplines together in co-creation of DMIs inspired by a traditional music instrument?

RQ2: What is the ‘essence’ of the traditional Duxianqin that must be retained in reimagining through digital technologies?

### 1.1 Digitally Reimagining

Many traditional instruments, their performance practice, and cultural context are being lost as a result of socioeconomic changes across the world [6]. As well as taking steps to preserve and reinvigorate traditional cultural heritage we can use digital technologies to reimagine elements of traditional cultural heritage to raise their public profile and expose them to new audiences. We refer to the creation of new DMIs inspired by traditional instruments and the augmentation of traditional musical instruments as *reimagining* those instruments through digital technology. The key aspect of this *reimagining* is that the *essence* of the traditional instrument is retained somehow whilst being presented in a novel way or with new features added to an existing instrument. Importantly, there should be a recognizable link between features of the reimagined instrument and the traditional instrument. By *essence* here we refer to the characteristics which differentiate it from other instruments: the sound produced; how sound is produced; the playing technique; and cultural context of the instrument.

In the rest of this paper we introduce the Duxianqin, followed by our approach to cross-cultural co-creation. We then report on our workshop in China and the three reimagined Duxianqin that were produced. We reflect on the design process through observations, interviews, and questionnaires, and conclude with reflections on the findings and suggestions for those attempting such an endeavor.

## 2. THE DUXIANQIN

In our research we aim to explore how to engage DMI designers with musical traditions beyond their conventional and cultural experience. The Duxianqin was selected as the topic of our workshop as it is an unusual musical instrument which features a single string that is plucked to produce harmonics whose pitch can be modified by the player,



Licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0). Copyright remains with the author(s).

NIME’20, July 21-25, 2020, Royal Birmingham Conservatoire, Birmingham City University, Birmingham, United Kingdom.

and we were interested to explore how it could be adapted to contemporary music and digital technologies. Furthermore, the Duxianqin is one of the few traditional Chinese musical instruments which has already had some electronic modification through the inclusion of a pick-up on most contemporary Duxianqin (point 5 on Figure 1).

The Duxianqin has a long history. In the eighteenth year of Tang Zhenyuan period (AD 802), the Pyu city-states (present-day Burma) in South Asia provided the Tang Emperor (China) with musical composition and instruments as a tribute, among which there was Duxianqin. The New Book of Tang [10] records that “The one-stringed instrument is made of mottled bamboo. There is no decoration but an image of the head of Hui (a kind of poisonous snake in ancient books) carved from wood on it.” The Duxianqin is traditionally made of a large bamboo tube (three feet long and about four inches in diameter), with the opening part facing downwards, and a thin and long bamboo strip on the surface of the bamboo tube raised longitudinally as a string. Nowadays the Duxianqin is a traditional musical instrument in southwestern Guangxi province, China, mainly played by Jing ethnic minority people.

The Duxianqin is played by touching the harmonics point of the string (point 2 on Figure 1) with the outer side of the palm and plucking the string to generate an overtone. The left-hand moves joystick (Chinese colloquial translation; point 1 on Figure 1) to adjust the string’s tension, thus changing the pitch (approximately three intervals). The shape of Duxianqin varies slightly in different regions, but the playing method is the same. Traditionally the Duxianqin would be played outside and is used to produce music which is considered soft, romantic, and melancholy.

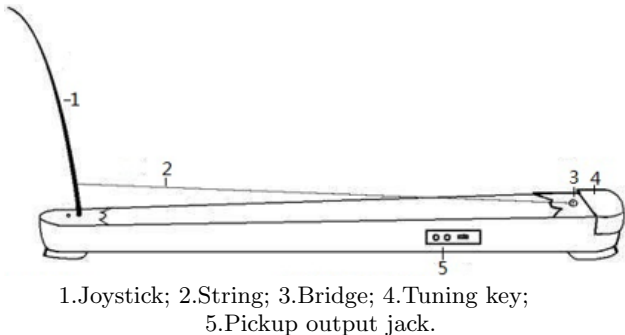


Figure 1: Duxianqin (credit: Chen Kunpeng).

### 3. CO-CREATION METHOD

Following previous cross-cultural co-creation practice [2] we structured the co-creation into four parts based on a traditional Chinese literature composition method (起承转合) followed by reflection.

**起 Qǐ: Introducing/ starting (2 months):** *Start by learning about each other.* The workshop leaders led two months of online pre-discussion and preparation work prior to the workshop through WeChat<sup>1</sup> as a way for Chinese and European participants to learn about each other and their cultures. This included discussing the feasibility of creative ideas as well as practicalities and what kind of software, hardware and equipment were required. On average the discussions lasted one hour once per week.

**承 Chéng: Following/ inheriting (1 day):** *Immersion in the traditional culture* of both Duxianqin and NIME.

<sup>1</sup>A Chinese multi-purpose messaging and social media platform <https://www.wechat.com>

Table 1: Participants in workshop

| No. | Background  | Reference                                      |
|-----|---|--|
| 2   | Workshop leaders (UK and China) with cross-cultural research experience             | WLUK, WLCN                                     |
| 6   | European doctoral students with design, electronic music, and DMI making experience | P1UK, P2UK, P3UK, P4UK, P5UK, P6UK             |
| 8   | Chinese students and teachers with interdisciplinary background                     | P1CN, P2CN, P3CN, P4CN, P5CN, P6CN, P7CN, P8CN |
| 4   | Traditional Duxianqin performers from Guangxi province in China                     | D1CN, D2CN, D3CN, D4CN                         |
| 4   | Composers from Beijing trained in traditional and electronic music composition      | C1CN, C2CN, C3CN, C4CN                         |

Participants spent one day at the Juntianfang Traditional Cultural Base of Guqin in Beijing. This was split into two parts: i) exposure to traditional Chinese music making and performance through the tradition of the Guqin; and ii) hands-on exposure to both Duxianqin and DMI construction, playing technique, and culture. At the end of the day, ideas for reimagination of the Duxianqin were brainstormed by the whole team to inform the design going forward.

**转 Zhuǎn: Changing/ transferring (3 days):** *Co-creation and mutual inspiration* to reimagine the Duxianqin together. The goal of this part was to narrow down the scope of design ideas, further identify the ‘essence’ of the Duxianqin to inform DMI design, and to enable performers and composers work together. Outcomes of this section included: design concepts of reimagined Duxianqin; implementation of key parts of the design concepts; composition of music to be performed by the reimagined Duxianqin.

**合 Hé: Concluding/ combining (1 day):** *Refinement and production together* concluded the workshop, culminating in public performance with the reimagined Duxianqin where the shared goals of performance and innovation were realised.

### 3.1 Post-Workshop Evaluation

To capture participants’ response to our workshop we undertook interviews and deployed a questionnaire of 24 questions, covering topics of: cultural exchange; reimagined musical instruments; the final concert; and the overall impression of cross-cultural cooperation.

### 3.2 Participants

The authors built a team of 24 people (8 female, 16 male, average age: 32 years) from the UK (8) and China (16), whose expertise is summarised in Table 1. Participants volunteered their time in response to email and social media messages inviting participation. Participants included post-graduate students, researchers, and new media artists. Academic backgrounds included media arts, mathematics, psychology, musicology, music performance, industrial design, musical instrument manufacturing, and interaction design.

## 4. OUTCOMES

The key outcomes of the project are: identification of features of the ‘essence’ of the Duxianqin; three prototype reimagined Duxianqin; a public performance of reimagined Duxianqin; and feedback on the co-creation process itself.

**Table 2: Reimagined Duxianqin Features**

| Instrument | Joystick | Timbre | Overtone | Polyphony |
|------------|----------|--------|----------|-----------|
| Polyqin    | ✓        | ✓      | ✓        | ✓         |
| Digiqin    | ✓        | ✓      |          |           |
| Octoqin    | ✓        | ✓      |          |           |

## 4.1 The Essence of the Duxianqin

In 起(Qǐ) pre-workshop preparation we held interviews and led group discussions on what the essence of the Duxianqin is from the perspective of both expert and naïve Duxianqin players. For the European participants we shipped a Duxianqin to the UK to allow hands-on experience of the instrument. Key elements of the essence of the Duxianqin were identified in ranked order as:

1. **Joystick:** gesture control on joystick which can control the pitch and has a significant effect on performance technique;
2. **Timbre:** the soft sound of the Duxianqin which is produced by overtones and has special meaning in Chinese culture;
3. **Single string:** a key physical feature and limitation of the Duxianqin

## 4.2 Reimagined Duxianqin

In terms of reimagining the Duxianqin, we found that the traditional Chinese performers were more inclined to retain as many traditional Duxianqin features as possible — indeed, there are few musical instruments which rely solely on overtone and pitch bending. In contrast, the new media artists (European and Chinese) and non-musicians were more inclined to create new musical instruments with wider pitch range, and the possibility of polyphony.

We asked players of minority musical instruments which features of the Duxianqin they would like to improve — the biggest improvement proposed was the ability to play polyphonic music. Note that traditionally there was an aesthetic preference for monophonic music in Chinese culture [7], but from the 20th century, the polyphonic music system of Western music increased the Chinese interest in polyphonic music. Further proposed improvements were: i) easier to play; ii) more attractive to younger people; iii) wider range of sound produced; iv) wider range of pitches produced; v) louder/ clearer sound produced.

Three reimagined Duxianqin were designed and prototyped: *Polyqin*, *Digiqin*, and *Octoqin*. Each is described below and key features are summarised in Table 2. Each reimagined Duxianqin used Bela<sup>2</sup> to provide real-time sound sampling, sample playback, and pitch modification.

### 4.2.1 Polyqin

Polyqin is an augmented Duxianqin that can play multiple sounds simultaneously. The bela samples the output of a traditional Duxianqin in realtime and can infinitely sustain up to 6 notes controlled by piezoelectric sensors attached to the top of the Duxianqin as illustrated in Figure 2. Five participants worked on the Polyqin. The location of the sensors for triggering and ending sustained notes was determined in co-design with Duxianqin expert performers and resulted in the emergence of an exaggerated gestural style for operating the sustain during performance. In this way the essence of the Duxianqin and its playing style is retained completely, and the new feature of polyphony is added.

<sup>2</sup><https://bela.io/>

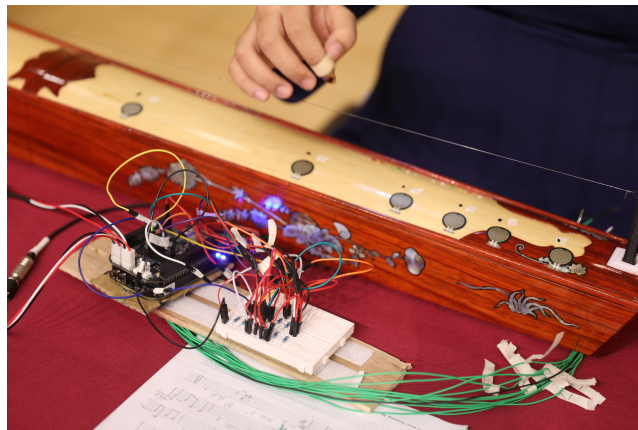


Figure 2: Polyqin

### 4.2.2 Digiqin

Digiqin retains the Duxianqin essence of joystick and timbre, and replaces the single string with touch sensitive strips (Figure 3) to trigger playback of individual sampled notes by Bela to make the reimagined Duxianqin easier to play. Copper tape strips were attached to a bamboo tube to connect with the traditional materials of the Duxianqin, and the selection of pitches and number of notes was co-designed with expert Duxianqin performers with the musical scale being selected as the Chinese pentatonic scale of 宫(gōng), 商(shāng), 角(jué), 徵(zhǐ), 羽(yǔ) to allow the Digiqin to perform Chinese traditional repertoire easily.

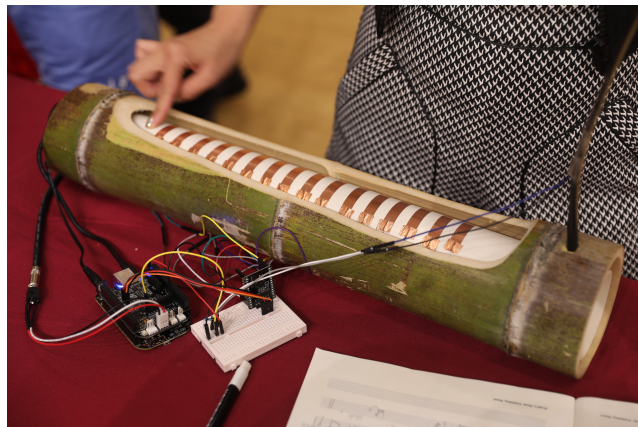


Figure 3: Digiqin

### 4.2.3 Octoqin

The Octoqin is a radical reimagining of the Duxianqin and yet retains enough of the essence for it to function in ensemble performance. The Octoqin is made from an Octopus-shaped doll (see Figure 4), with six cloth pressure sensors sewn inside six of the legs to map to the six overtone positions on the string of a traditional Duxianqin. When the legs of the Octoqin are squeezed a recording of the note from a traditional Duxianqin is played by Bela with strength of squeeze mapped to volume. Movement of the Octoqin's head modifies pitch of the note produced, much like the joystick in the traditional Duxianqin.

## 4.3 Concert

The workshop culminated with a public concert at the Central Conservatory of Music, Beijing. The goal of the con-

cert was to showcase the features of the reimagined Duxianqin. The composers created special compositions to explore the expressive potential of each reimagined instrument. All pieces are works with Chinese traditional music style, based on traditional composition techniques, incorporating a small number of modernist and electronic music elements.



Figure 4: Octoqin

The first piece, called *Duxianqin and Piano*, is an ensemble of the traditional Duxianqin and piano to highlight the characteristics of traditional Duxianqin and provide contrast for the reimagined instruments. The second piece is called *The River Islet Rosy Cloud Splendour* with Digiqin as the main instrument and the Polyqin using techniques of counterpoint, imitation and inversion, to explore the traditional and reimagined instrument combinations.

The third piece, *Octopus Dreaming*, was an ensemble for Polyqin, Digiqin and Octoqin. The first part introduced the Digiqin following the theme of repetition and change within the pentatonic alternating scale to reach a climax. The second part developed the Octoqin as the main instrument, and finally the Polyqin as the enhanced instrument, with the Digiqin and Octoqin re-enacting the theme. Emphasis was placed on the overlay of traditional melody using polyphonic layering of sounds and effects, especially with the Polyqin. The piece attempts to embody the personality of the three instruments and emphasize the fusion of Octoqin as a sound effect instrument with Polyqin and Digiqin.

## 4.4 Feedback

After the final performance we conducted 19 interviews (6 European participants interviewed face-to-face, and 13 Chinese participants interviewed by video call) to collect feedback about the overall plan and structure of the workshop, cultural exchange, reimagined musical instruments, the final concert and the overall impression of cross-cultural communication and cooperation. Quotes are attributed anonymously to participants in Table 1 and participation followed the Chinese institution’s ethics procedures.

### 4.4.1 Communication and Design Process

Unsurprisingly, nearly all participants felt that language was the biggest obstacle in the entire co-creation process. This is a common problem encountered in cross-cultural co-creation activities [2] which we had attempted to mitigate through the extended 起(Qi) pre-workshop phase. Throughout the process, there were always a few participants who could play the role of translators scattered among various groups, though this was reported to create additional strain on multi-lingual participants.

All participants thought that the schedule was ‘quite tight’ (P2CN). We attempted to mitigate the short co-located workshop time with two months of online preparatory work using WeChat text message and video call. Ten Chinese participants found WeChat convenient for their communication e.g. ‘The WeChat was useful for breaking the ice in becoming aware of the other participants’ (P1CN). However, three Chinese participants believed that it was difficult to communicate in-depth in Wechat (C1CN), and five European participants believed that WeChat communication was too ‘troublesome, messy and superficial’ (P5UK). Indeed, we found that information exchanged on WeChat is often fragmented, and so the host must both lead the discussions and summarize after each brainstorming which reduces the effectiveness of the exchange.

Participants commented that they thoroughly enjoyed the cooperation with most people taking a multi-disciplinary approach (P2UK) to ‘complement each other, promote each other, work closely together, and have a fruitful results’ (P5CN). However, two European participants thought that there were few mutual understandings, which made collaboration beyond basic cultural opinions very hard and limited the participation in co-creation (P1UK).

### 4.4.2 Culture and Digital Technology Immersion

All participants felt that the 承 Chéng cultural immersion was ‘good’ and stated that the program was full of Chinese cultural factors. However, nine people thought that the relationship between the Duxianqin and traditional Chinese culture was unclear (P2CN). In terms of cultural exchanges between the two sides, the Chinese personnel felt that the communication time was short and it was not easy to understand each other’s culture (P8CN). The UK side felt that they did not have enough information and time to understand the Duxianqin culture in advance (P6UK).

Regarding digital technology, Chinese participants noted their surprise at the sophisticated digital technology brought by UK participants, but felt that they could not fully learn the digital technology (P4CN) despite several Chinese participants having relevant technical skills, while the UK participants believed that the Chinese personnel did not provide good technical assistance (P1UK). Three Chinese performers reported that the new technology left them at a complete loss despite the workshop using Pure Data which several Chinese participants had experience of and which is intended to be an accessible platform for digital music. Indeed, the unevenness of the relationship is reflected in the view that ‘The UK side is a bit like a mentor and adventurer, who experiences the Chinese culture and makes some new works; the Chinese side is a bit like a student and traveller, who learns new digital technologies and witnessed the birth of new works while sightseeing a part of Chinese culture together with foreigners’ (P3CN).

### 4.4.3 Views on the Reimagined Duxianqin

*Polyqin*: Chinese musicians reported that it retained the traditional playing style and is easier for professional musicians to use than the other reimagined instruments — a ‘more practical musical instrument with more traditional features retained’ (D2CN). However, it is a pity that other functions discussed in the design sessions such as harmony, discrete notes, key changes, and screen display, were not realized. Three electronic music composers thought that Polyqin was more like a built-in effects unit on traditional Duxianqin, but does not have the potential for creating modern music pieces (C1CN).

*Digiqin*: Performers reported that the discrete key sound from the bamboo tube solves the problem of too few over-

tone positions, which is of great significance to the innovation of the Duxianqin (D2CN) and composer noted that it is practical for making music (C1CN, C4CN). P1UK noted that ‘it is more like an instrument because it makes the performance more precise and the score playing more controllable. However, due to time limits, it is severely constrained in terms of subtlety and intimacy’.

*Octoqin*: Twelve participants reported that it is a creative, touchable, interesting, attractive, and novel instrument. However, Chinese performers and composers reported that ‘according to the definition of a musical instrument used for performance, it can only be used as an instrument for performing special effects’ (D1CN). Foreign participant P1UK noted that it is ‘more like a novel sound toy. It makes some sound, but it lacks dexterity, subtlety and intimacy, which is essential for a true instrument’. Duxianqin performers and educators reported that ‘it can play a certain role in Children’s musical enlightenment... school-age children can learn vibrato or a certain range of pitches, with fun added’ (D2CN) and a Chinese non-musician thought that it is very cute and could be a good product for children, and possibly good for use in music therapy.

#### 4.4.4 Views on the Musical Performance

The UK and Chinese participants both reported that the performance was ‘great, and exciting’, ‘I really enjoyed it, and was surprised by the quality of the performance’ (P5UK), and were honoured to be able to participate (P8CN). However, one UK participant commented that the music was not experimental enough (P1UK), and similarly, one Chinese composer reported that the digital instruments could have been used more boldly (C2CN) as discuss below.

## 5. REFLECTIONS AND SUGGESTIONS

As with other cross-cultural NIME researchers such as Barbosa [1], we tried to engage participants in co-creation of DMIs inspired by cross-cultural heritage. In contrast to [1], we i) focused on co-creation in which traditional composers and performers take part from the beginning; ii) undertook initial cross-cultural work remotely; iii) tried to find a balance in the co-creation between contributing cultures.

In this section, we reflect on our research questions in light of our observations above, and suggest of how future cross-cultural musical instrument co-creation might be approached based on our experience.

### 5.1 RQ1: How to Engage Participants

Our first research question was how to engage participants from a range of cultures and disciplines in co-creation.

#### 5.1.1 Clear Goals and Constraints

Setting a **public performance** as the end goal (much like [1] and [2]) provided a concrete end-point for participants to aim towards and was reported as a positive outcome of the workshop by participants. However, this also sets a challenge for the composers who must compose for an instrument the does not yet exist. In our workshop the composers were included in the co-creation activities to help inform their composition process before the instruments were completed, and also to inform the design of the instruments themselves e.g. informing what pitch range and timbre should be used. This can lead to new design suggestions, for example, one composer (C1CN) proposed using the Digiqin as a controller to map more synthetic sounds with Max. However, it can also lead to unbalanced collaboration in the early DMI build stages where composers cannot contribute to the technical aspects and also are not

able to start composing as they do not know the nuanced capabilities of the instruments being created.

As with other design methodologies [2], we found that imposing **narrow design constraints** supported focused design work, and in our case, supported co-creation as well as cross-cultural cooperation. Selecting a specific musical instrument to explore (Duxianqin) prior to any design work provided concrete boundaries within which our diverse set of participants could design. Our co-creation process could have been improved by restricting the initial set of design features to **just one or two design features** per reimagined instrument to focus the design work further.

#### 5.1.2 Balancing Backgrounds

We found that balancing backgrounds was especially important for the stages of 转(Zhuǎn) and 合(Hé) as our participants came from a wide range of backgrounds and disciplines — not only composers but also performers, technicians, non-musicians, even the composers had different backgrounds: traditional music composers, electronic music composers, and experimental artists.

Firstly, the background of the composers and **the style of the final performance** needs to be carefully balanced. The more experimental the form of music performance, the higher the tolerance for error, the higher the improvisation and interactivity, and the more innovative the control methods and mapping of musical instruments and the expression of sound can be. In our case it was especially important to maintain the Duxianqin’s gesture control methods. Whilst the final performance was reported by some participants as too experimental, others reported that it was not experimental enough, which in part was due to the lack of rehearsal time leading to a more conservative composition and performance style.

Secondly, as with other design research [9], we found that **physical making** was an inclusive co-creation activity which involved both European and Chinese participants in contrast to the software development which was undertaken solely by European participants and reported as difficult to engage with by Chinese participants. The workshop would have been more inclusive if we had more provided more opportunities for a range of physical computing making such as combining simple circuits and software making along with the advanced Bela and Pure Data work.

#### 5.1.3 Managing Time and Distance

The short time constraint on the making process was frustrating for participants (P8CN). However, given the features of the reimagined Duxianqin produced it is not clear whether having, say 10 days instead of 5 days for the workshop would have produced more design features, or simply more refined versions of the designs. The challenge here is whether the purpose of the workshop is to explore design features and cross-cultural making, or whether it is to create refined and finessed interactive systems. We spent 2 months using WeChat to build an initial relationship between participants in Europe and China. This had mixed results and although services such as WeChat can feel alien and difficult to use to European participants, we suggest that they should be embraced as an integral part of contemporary Chinese culture. We used these pre-workshop activities to begin to identify the essence of the Duxianqin and help to inform a concrete set of design constraints. This process would have been improved by creating a shared repository<sup>3</sup> of design ideas and critique prior to the workshop.

<sup>3</sup>Note that document sharing services such as Dropbox are not available in China, and Chinese sharing services such as Baidu netdisk are not accessible to non-Chinese speakers

## 5.2 RQ2: The Essence of the Duxianqin

The aim of identifying the essence of traditional instruments is to help us to innovate with DMI design whilst at the same time respecting heritage and tradition. Our long term aim is to develop a methodology for the reimagining of traditional instruments using digital technology.

In general, we can separate an instrument into gesture control interface, sound, ergonomics, and appearance [1]. The key essence of the Duxianqin was identified through pre-workshop discussions and then validated in the 承 (Cheng) cultural immersion day: joystick control for pitch modification; soft timbre through overtones; single string. Identifying these features requires **interviews** with expert performers as **domain experts**, in conjunction with **observations** and analysis of the physical instrument itself by **designer experts** who are non-expert with the instrument. In this way we capture the essence from cultural experts and also from an analysis of the physical affordances which may have become tacit knowledge to experts. Through the workshop we found that gesture control (joystick) was most important element of the essence of Duxianqin, followed by sound (timbre from the overtone), and finally appearance and ergonomics, resulting in us selecting the joystick and timbre as core essence of the Duxianqin for our reimagining. It is worth noting that the core essence of Duxianqin was identified as its sound and sound control, not how it looks.

The essence of the Duxianqin is essentially the boundary of the DMI design — the closer we are to the traditional essence, the smaller design space. The essence of Duxianqin was used to constrain the co-creation activities in our workshop and are evident in each of the reimagined Duxianqin to different extents. When we kept more of the essence (e.g. the Polyqin) we could only augment the traditional instrument and add some requirements from traditional musicians. Conversely, when we subtract elements from the essence (e.g. subtracting the single string — Digiqin), we have enough design space to move away from the traditional whilst still recognizing its essence. Indeed, when we remove most of the Duxianqin essence (e.g. the Octoqin, which is furthest from tradition) we are free to explore an open design space, but the result was considered unsuitable for use on stage by professional musicians, though it had potential to become a music therapy tool for children.

Our last question about the essence of Duxianqin is: **Who decides which elements of tradition are important?** In feedback we found two positions: i) Performers, who input the gesture; and ii) audience who receive the output (sound) cf. [8]. We found that all professional performers preferred to play the Polyqin because it was nearer to traditional Duxianqin. The non-musicians liked to try different ways to perform and were more accepting of the other reimagined Duxianqin. In contrast, the audience's perception of what was 'traditional' was more holistic — not only timbre and gesture of the instruments, but also the music style, the stage layout, and the performers' clothes contributed to the sense of what was traditional.

## 6. CONCLUSION

In this paper we presented our approach to reimagining the Duxianqin through digital technology. We undertook co-creation activities remotely and co-located to identify the 'essence' of the Duxianqin and co-created three reimagined Duxianqin. These reimagined Duxianqin captured some of the essence of the Duxianqin, and were performed in public with specially composed music.

In future activities we would impose a more constrained design space and attempt to engage composers and per-

formers in more of the digital aspects of the making. The cross-cultural collaboration would be improved by offering more chances for participants to experiment, and the provision of shared repositories for richer communication.

## 7. ACKNOWLEDGMENTS

Thanks to the Giacomo Lepri, Lia Mice, Jon Pigrem, Jack Ratcliffe, Francesco Soave, Mei Zhang from Queen Mary University of London and all the participants from Central Conservatory of Music, the China Conservatory of Music, the Xi'an Conservatory of Music, Peking University, Tongji University, the Chinese Academy of Sciences, China University of Geosciences (Wuhan), the Guangxi Academy of Art, and the Ministry of Culture and Tourism. Thanks to Dr. Liang Xiaojing for preparing the workshop. Thanks to Prof. Li Xiaobing and teachers and students of the Central Conservatory of Music for their organization.

Funded by: EPSRC+AHRC Media and Arts Technology Centre for Doctoral Training (EP/L01632X/1); National Endowment for the Arts: Digital Museum of Chinese Musical Instrument Creation; First-class Discipline Construction of Central Conservatory of Music.

## 8. REFERENCES

- [1] J. Barbosa, J. T. F. Calegario, G. Cabral, G. Ramalho, and M. Wanderley. Designing dmis for popular music in the brazilian northeast: Lessons learned. In *NIME 2015 Proceedings of International Conference on New Interfaces for Musical Expression*, pages 277–280, 2015.
- [2] N. Bryan-Kinns, W. Wang, and T. Ji. Exploring interactivity and co-creation in rural china. *Interacting with Computers*, 30(4):273–292, 2018.
- [3] F. Calegario. 'Challenges in Designing DMIs', *Designing Digital Musical Instruments Using Probatio: A Physical Prototyping Toolkit*. Springer International Publishing, Cham, Switzerland, 2019.
- [4] C. Cannon, S. Hughes, and S. O'Modhrain. Epipe: Exploration of the uilleann pipes as a potential controller for computer-based music. In *NIME 2013 Proceedings of International Conference on New Interfaces for Musical Expression*, pages 3–8, 2013.
- [5] A. Kapur, D.H.Kim, R.Kapur, and K.Eom. New interfaces for traditional korean music and dance. In *NIME 2013 Proceedings of International Conference on New Interfaces for Musical Expression*, pages 5–8, 2013.
- [6] R. Letts. *The Protection and Promotion of Musical Diversity*. International Music Council, 2006.
- [7] Z. Li, X. Fu, and J. Zhu. Sound quality evaluation methodology of traditional string musical instrument. *Chinese Music*, 10(3):157–163, 2018.
- [8] E. R. Miranda and M. M. Wanderley. *New Digital Musical Instruments: Control and Interaction Beyond the Keyboard*. A-R Editions, Cham, Switzerland, 2006.
- [9] E. Sanders and P. Stappers. Probes, toolkits and prototypes: Three approaches to making in codesigning. *CoDesign*, 10(1):5–14, 2014.
- [10] Q. Song and X. Ouyang. *Nan Man Lie Zhua*. New Tangshu, Cham, Switzerland, Ming Dynasty (1638-1644).
- [11] D. Young and I. Fujinaga. Aobachi : A new interface for japanese drumming. new interface for japanese drumming. In *NIME 2004 Proceedings of International Conference on New Interfaces for Musical Expression*, pages 23–26, 2004.