Mediating Trust in Musical Collaboration Through Spatial Communication with Intelligent Systems

Applicant: **Yichen Wang**
Advisors: Florent Berthaut, Ken Déguernel

1 Research Program

1.1 Context

Trust is a critical component of successful collaboration, whether between humans [10] or in hybrid human-machine contexts [11, 1, 14]. In human interactions, it develops through prolonged engagement [11], mutual responsiveness and shared practices [8]. The integration of intelligent systems can support decision-making [25], coordination [26, 18], and social dynamics [19], and influences how human expertise is expressed and share, reshaping how people perceive contributions and negotiate authority. Prior HCI research has explored these dynamics through responsible AI [6, 4], system design [22], and studies of multi-agent collaboration [18, 26, 25], including creative domains [9, 3].

A persistent challenge is ensuring that intelligent systems do not obscure human contributions [1, 4], but instead foster transparency, interpretability [20] and responsiveness that strengthen collaboration [7]. This challenge is particularly visible in creative domains such as musical collaboration, which provides an ideal context for addressing it, as it demands real-time coordination, continuous negotiation of trust, and shared sense-making between expert performers [1, 23]. Within computational creativity research, proactivity, autonomy, and adaptation have been identified as key features of agency in co-creative systems [13] : when made transparent, these behaviours can clarify how systems listen, react, or lead [21]. Visual augmentation and spatial visualisation further support this by making hidden processes perceptible, enhancing audience experience [5] and restoring trust and supporting skilled coordination and trust among performers [24, 2].

In this project, we will employ augmented reality (AR) to reveal the AI system's real-time behaviours and decision-making during performance, making them perceptible and usable for collaborators. We will adopt a mixed-methods approach, combining first-person design, user evaluation, and public performances to support both early exploration and long-term, in-situ investigations. For example, a successful scenario would involve two musicians performing alongside a musical agent through real-time AR visualisations of the evolving musical structures. Musicians may use acoustic or electronic instruments that reflect on their individual expertise, with audio or MIDI input communicated to the musical agent accordingly. The co-creative system will listen, learn and respond through temporal musical phrases derived from the human input, generating complementary or novel materials in return. Group cohesion and engagement emerge through patterns of interaction and post-session reflections. Through this scenario, the project will contribute to understanding how prolonged use of such systems can scaffold trust and sustain human expertise, demonstrating how transparency and shared process in co-creation can support the responsible use of intelligent tools in creative and cultural contexts.

1.2 Originality and Objectives

This project advances the study of intelligent systems in human-human collaboration through three main contributions. First, it investigates how AI mediation can foster trust and shared agency in highly skilled, socially enriched musical collaboration, a testbed where expertise, coordination and trust are continuously negotiated [1]. Second, it introduces AR visualisation as an interface to make the AI system's processes perceptible, bridging its decision-making with human perception to support communication and

sense-making – an approach rarely applied in co-creative system design. Third, it adopts a long-term perspective, examining repeated use across performances and sessions to reveal how trust, expertise and collaboration evolve over time, moving beyond the short, task-based studies common in this field [3, p44], .

Accordingly, the project aims to :

1. Investigate how transparency and responsiveness in AI mediation support trust, shared agency and skilled coordination in extended human-human collaboration.
2. Explore spatial AR interface designs that reveal adaptive AI system's processes to enhance engagement and mutual understanding over repeated use.
3. Evaluate how prolonged interaction with AI-mediated co-creative systems shapes collaboration, trust, and decision-making, and derives design insights to reduce risks of over-reliance or diminished critical thinking.

1.3 Approach and Methods

This research will follow a mixed-methods approach in two stages : an early exploratory design phase and a set of user studies.

Stage One will adopt first-person research methods (e.g., autobiographical / autoethnographic design) [12]. As both researchers and musicians, we three all will undertake practice sessions with the AI system and reflect on these experiences. Similar to previous works in co-creative musical systems [23, 16], these sessions will shape the AR system design, supported by recordings, interviews and staged public performances. The AI part will be built on DYCI2 [16], in which the advisor is involved, ensuring development is grounded in practice and responsive to the conditions under which trust is negotiated. In details, the system will combine reactive listening (responding to musicians' actions) and generative behaviours (introducing new ideas), creating a balance between following and initiating behaviours.

Stage Two we will conduct two complementary studies with musicians. The first study will focus on the examination of visualisation and trust. Groups of three musicians (two humans with the AI system) will perform with different AR visualisation designs to compare their effects on trust and perceived agency. Each group will participate in a single session, evaluated through questionnaires and interviews. The second study will focus on longitudinal collaboration. Groups of three musicians will engage in multiple sessions to examine how trust, coordination, and choice of visualisation evolve over time. Data will be collected through observation and post-session interviews.

Both studies will use the same co-creative system, which integrates audio, and MIDI input from musical instruments. The AR interface will visualise these real-time processes, including internal mechanisms (memory, processes) and external actions (discrete and continuous controls) of the human collaborator and AI agent. This visibility will make collaborators' actions perceptible in-moment and support shared interpretation among performers.

1.4 Anticipated Results

The research will advance understanding of how intelligent systems support human collaboration in long-term creative use.

1. **Publications** : we will produce research outputs at each stage, each addressing a different focus and audience. System design for co-creative AI(computational creativity venues such as *ICCC*), autobiographical design with AR interfaces (HCI conferences *DIS*,*NIME*), practice-based reflection (*NIME*/*computer music journal*), user studies(HCI venues *CHI*, *TOCHI* journal).
2. **Software / System Release** : the systems developed in this project will be open-sourced.
3. **Scientific and Community Outputs** : we will actively share results with academic and music communities, including seminars, IRCAM Forum, local groups, and international venues such as NIME and ICMC. We will hold performances to demonstrate artistic and social impact while studying the AI system's role in shaping collaboration.

1.5 Challenges and Potential Solutions

This proposal addresses two key challenges in co-creative system design. First, studies of AI-mediated musical collaboration using AR interfaces have noted a cognitive shift in attention and mental workload from auditory to visual feedback [23]. Similar effects appear in human-human collaboration [24]. We will mitigate this issue through iterative design of adaptive visualisation that reveals internal and external processes without overwhelming performers, allowing them to adjust visual focus and control as needed.

Secondly, sustaining long-term trust in co-creative systems is difficult, as it is negotiated in real time rather than explicitly defined [17]. We will design adaptive engagement structures that make system behaviour interpretable while leaving space for negotiation, enabling trust to develop dynamically over time, following design considerations noted in [15, 1, 20].

2 Project Organisation

We propose a 24-month project in partnership with the Music Department at Université de Lille and the Muzzix improvisation collective. It is supported by the applicants' expertise in AR and co-creative systems and access to musicians and facilities for design and field studies.

2.1 Milestones

The project will progress from exploratory design and iterative prototyping to user studies, refinement, and in-the-wild research through concerts and workshops, as shown in Table 1.

Table 1 – Project Gantt Chart

	Year 1				Year 2			
	1	2	3	4	1	2	3	4
In-lab Design & Experiments								
Initial Design and Ideation								
Iterative Prototype Developments (Software Releases by Phases)								
User Studies (Visualisation & Longitudinal)								
In-the-Wild Research								
Public Concerts								
Public Workshop and Seminar								

3 Adequacy with the objectives of PEPR eNSEMBLE and of the selected PC : Theme 3

This project aligns closely with **Theme 3**, addressing prolonged use of intelligent systems and their effects on expertise, trust and collaboration. Its central focus is on human collaboration mediated by AI, using music performance as a testbed of highly skilled and embodied practice where trust is continuously negotiated. By employing AR to reveal the system's real-time behaviours, the project promotes transparency and shared authority, ensuring that the intelligent system supports rather than obscures human contributions. Through extended engagements, user studies, and public performances, it will generate insights into how intelligent systems can scaffold trust, sustain shared agency, and mitigate the risks of deskilling in human collaboration over time. More importantly, this project is uniquely situated across disciplines in HCI within computer science, and the humanities of musical practice. By drawing on methods and insights from these fields, we believe combining technical design with social and cultural inquiry can enable us to understand the long-term use of intelligent systems that respect, amplify and engage with human collaboration in profound ways.

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