Can We Achieve Togetherness with an Artificial Partner? Insights and Challenges from Developing an Automatic Accompaniment System

Carlos Cancino-Chacón, Silvan Peter and Gerhard Widmer

Institute of Computational Perception, Johannes Kepler University Linz, Austria
carlos_eduardo.cancino_chacon@jku.at

1 Background

What does togetherness mean in the context of human-computer interaction? While it is clear that, with the current generation of artificial intelligence, a computer partner cannot *experience* togetherness, the question whether humans can experience togetherness with a machine does not have a clear answer.

With advances in machine learning, there is a rising interest in developing interactive interfaces that allow people (both musicians and non-musicians) to explore music performance. One such kind of interface is an *automatic accompaniment system*.

In the context of the ERC funded Con Espressione Project, we developed an automatic accompaniment system, the ACCompanion, that is able to perform duets with a human partner on a computer controlled grand piano. The system has gone through several incarnations, from being a system that could only deal with monophonic music, to the current state where the model is able to play polyphonic music. Based on our experience developing and performing music with the ACCompanion, we would like to argue that humans could experience togetherness with an artificial partner.

2 Aims

The aims of this paper are two-fold: first, we want to discuss the properties of automatic accompaniment systems that could allow humans to experience togetherness with them and second, we want to address some of the main technical challenges of creating a truly musical artificial partner.

3 Main Contribution

In the context of score-based music (e.g., Western classical music), Dannenberg (1984) identifies three tasks that accompaniment systems must solve in order to successfully perform together with a human:

1. *Detecting the solo part*, i.e., capturing a human performance in real time (either from a microphone or a MIDI instrument) and identifying the performed notes.

2. *Score following*, i.e., matching these performed notes to notes in the score (also in the presence of errors).

3. *Generating an expressive accompaniment part.*

In our experience, however, a missing fourth point should be added to this list: *modeling the feedback loop with the human partner.* For example, is that if the system "believes" that the human is slowing down (even when they are not), it will slow down, which will cause the human to slow down, and then it will slow down even more in response. In this case, the systems responds differently from how a human partner would respond, decreasing the feeling of togetherness.

In order to address the feedback loop with the human partner, certain technical challenges would need to be overcome. In particular, the system needs to be not entirely *reactive*, but *predict* what the human will do, as well as to understand when to follow (i.e., be more reactive) and when to "lead".

The development of accompaniment systems requires an interdisciplinary team that can understand both the musical as well as the technical problems. In spite of the challenges of developing truly musical accompaniment systems, we believe these systems could provide a way to understand togetherness in humans, by serving as a platform in which to test hypotheses about the process of togetherness, as well as being a useful tool for music education and foment the engagement of non-musicians with music. These models can also be fun to play with.

References

Dannenberg, R. B. (1984). An On-Line Algorithm for Real-Time Accompaniment. In *Proceedings of the 1984 international computer music conference* (pp. 193–198). Paris, France.