

ON CONTROL OF INTERACTION FOR COMPUTER ASSISTED IMPROVISATION: FORMULATING ADVANCED MUSIC QUERIES WITH FINITE AUTOMATA

FIVOS MANIATAKOS, CARLOS AGON
MUSIC REPRESENTATIONS GROUP
IRCAM UMR -STMS 912

Modeling of musical style and stylistic re-injection strategies based on the recombination of learned material have already been elaborated in music machine improvisation systems ([2], [4]). Case studies have shown that content-dependant regeneration strategies have great potential for a broad and innovative sound rendering. With respect to existing systems, our interest is to enhance the role of the computer user from the one of supervisor to the one of performer. More precisely, we are interested in the study of the principles under which stylistic reinjection could be sufficiently controlled, in other words, a framework that would permit the person behind the computer to guide the machine improvisation process under a certain logic.

In this scope, instead of controlling only low level parameters of computer 's improvisation, the user is set responsible of providing the computer with musical, expressive information concerning the structure and evolution of the improvisation. Inversely, the computer has a double role: first, the one of an augmented instrument, which understands the language of the performer and can regenerate patterns in a low level and articulate phrases coherent to user's expressive instructions, and second, the one of an independent improviser, able to respond reflexively to specific changes of music context or to conduct an improvisation process with respect to a pre-specified plan. In [1] we analyzed this three party interaction scheme among the instrument player, the computer and the computer user. Stylistic re-injection and music sequence scheduling strategies, formalized with the help of automata and graph theory, permit the use of already played music material as a basis for regeneration of new musical patterns.

In this work we extend these formalisms to include *contextual* control of pattern generation by stylistic re-injection. Whereas sequence scheduling concerns the strategies for pattern regeneration in a temporal level, contextual control refers to the motivic properties of the generated pattern. Lexicographical methods based on automata theory have already been employed for music pattern matching and relevant problems in the fields of computer improvisation and computational musicology. We discuss different methods dealing with the indexing problem for musical sequences, such as those based on suffix trees and the factor oracle. We study the advantages and drawbacks of these methods for online learning, as well as their flexibility and efficiency as a tool for lancing queries about the already learned material, in terms of space and time complexity. We then present Multi

Factor Graph (MFG), a new structure for the indexing of musical sequences. We propose algorithms for its online construction, for all-pairs and sorted pairs problem, as well as the exact matching and repetition problem, exact matching with binary don't cares etc. The algorithms for these basic problems construct a set of elementary queries-tools called *primitives*. We finally show how with the help of primitives and other strategies mentioned above we can give answers to more complex pattern regeneration problems that can be employed in computer-assisted improvisation within the three party interaction scheme.

REFERENCES

- [1] Maniatakos, F., Assayag, G., Bevilacqua, F., Agon, C., "On architecture and formalisms for computer assisted improvisation", Proceedings of the Sound and Music Computing conference SMC 2010, Barcelona, 2010.
- [2] Assayag, G., Dubnov, S., "Using Factor Oracles for Machine Improvisation", Soft Computing - A Fusion of Foundations, Methodologies and Applications, Volume 8, Number 9, 2004.
- [3] Collins, N., McLean, A., Rohrhuber, J., Ward, A., "Live coding in laptop performance", Organized Sound, 8:3:321-330, 2003.
- [4] Pachet, F., "The continuator: Musical interaction with style". In proceedings of International Computer music Conference, Gotheborg (Sweden), ICMA, 2002.
- [5] Allauzen C., Crochemore M., Raffinot M., "Factor oracle: a new structure for pattern matching, Proceedings of SOFSEM'99, Theory and Practice of Informatics, J. Pavelka, G. Tel and M. Bartosek ed., Milovy, Lecture Notes in Computer Science 1725, pp 291-306, Berlin, 1999.