Well-Tempered P Systems: Towards a Membrane Computing Environment for Music Composition

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Summary. A proposal of designing a membrane computing environment for music composition is outlined.

1 Introduction

We outline a proposal of designing a membrane computing environment for music composition, where a basic theoretical concept for this environment is a notion of a well-tempered P system with the adjective "well-tempered" understood here in a similar way as in the title of *Well-tempered computer* of [12] and with the notion of a P system defined as in [9]. The notion of a well-tempered P system is explained in the next section as a result of a synthesis of some known concepts.

2 Well-tempered P systems

The notion of a well-tempered P system is proposed to be a result of synthesis of the following known concepts, ideas, and notions:

- the notion of a λP system due to N. Jonoska and M. Margenstern, cf. [1] and [6],
- a concept of a music score, written or analyzed, in terms of music calculi having common features with (type-free) lambda calculus, cf. [8] and [7],
- the idea of sounding P system, cf. [3],

with a regard to M. Steedman's categorical grammar approach to jazz improvisation, cf. [13].

More precisely, a well-tempered P system is aimed to represent a score of a music piece, e.g. fuge, written in terms of a music calculus, cf. [8] and [7], like λP systems represent λ terms, respectively, where a reduction process of a λ term

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corresponds to an evolution process generated by the lambda P system representing this λ term, cf. [1] and [6].

We do not exclude other approaches to the notion of a well-tempered P system, where:

- a P system for modelling higher plants, cf. [10], could represent a score of music piece expanding in time like plants with some probability factor like in [5],
- a P system for fractal generation, cf. [4], could represent a score of music piece expanding in time like cellular automata generating fractals, cf. [11].

Therefore the P-Lingua tools, cf. [2] and [14], could provide an appropriate software for an environment for music composition designed in the frames of membrane computing by using well-tempered P systems.

References

- Colson, L., Jonoska, N., Margenstern, M., λP systems and typed λ-calculus, in: Membrane Computing, LNCS 3365, Springer, Berlin, 2005, pp. 1–18.
- Díaz-Pernil, D., Pérez-Hurtado, I., Pérez-Jiménez, M. J., Riscos-Núñez, A., A P-Lingua Programming Environment for Membrane Computing, in: Membrane Computing, LNCS 5391, Springer, Berlin, 2009, pp. 187–203.
- Garcia-Quasimodo, M., Gutiérrez-Naranjo, M. A., Ramírez-Martínez, D., How does a P system sound?, in: Eight Brainstorming Week on Membrane Computing, Seville 2010, ed. M.A. Martinez-del-Amor et al., RGNC Report 01/2010, Seville University, pp. 123–132.
- Gutiérrez-Naranjo, M. A., Pérez-Jiménez, M. J., Fractals and P systems, in: Fourth Brainstorming Week on Membrane Computing, Seville 2006, vol. II, ed. C. Graciani et al., Fenix Editora, 2006, pp. 65–86.
- Hiller, L. A., Isaacson, L. M., Experimental Music Composition with Electronic Computer, McGraw-Hill, 1959.
- 6. Jonoska, N., Margenstern, M., Tree operators in P systems and λ -calculus, Fundamenta Informaticae 59 (2004), pp. 67–90.
- Letz, S., Faber, D., Orlarey, Y., The role of lambda abstraction in elody, in: Proceedings ICMC'98, 1998.
- Orlarey, Y., Faber, D., Letz, S., Bilton, M. Lambda calculus and music calculi, in: Proceedings ICMC'94, San Francisco, 1994.
- 9. Păun, Gh., Rozenberg, G., Salomaa, A., The Oxford Handbook of Membrane Computing, Oxford, 2009.
- Romero-Jiménez, A., Gutiérrez-Naranjo, M. A., Pérez-Jiménez, M. J., Graphical modelling of higher plants using P systems, in: Membrane Computing, LNCS 4361, Springer, Berlin, 2006, pp. 496–506.
- Solomos, M., Cellular automata in Xenakis music. Theory and practice, in: Proceedings of the International Symposium Iannis Xenakis (Athens, May 2005), ed. A. Georgaki and G. Zervos, pp. 120–138.
- Steedman, M., *The well-tempered computer*, Philosophical Transactions: Physical Sciences and Engineering 349 (1994), no. 1689, pp. 115–131.
- Steedman, M., The blues and the abstract truth: music and mental models, in: Mental Models in Cognitive Science, ed. A. Garnham and J. Oakhill, 1996.
- 14. The P-Lingua website, http://www.p-lingua.org