INScore expressions to compose symbolic scores

G. Lepetit-Aimon **D. Fober** **Y. Orlarey** **S. Letz**
Grame
Centre nationale de cration musicale
Lyon - France
gabriel.lepetit.aimon@grame.fr

ABSTRACT

INScore is an environment for the design of augmented interactive music scores turned to non-conventional use of music notation. The environment allows arbitrary graphic resources to be used and composed for the music representation. It supports symbolic music notation, described using Guido Music Notation or MusicXML formats. The environment has been extended to provided score level composition using a set of operators that consistently take scores as arguments to compute new scores as output. INScore API supports now *scores expressions* both at OSC and at scripting levels. The work is based on a previous research that solved the issues of the notation consistency accross scores composition. This paper focuses on the language level and explains the different strategies to evaluate score expressions.

1. INTRODUCTION

Contemporary music creation poses numerous challenges to the music notation. Spatialized music, new instruments, gesture based interactions, real-time and interactive scores, are among the new domains that are now commonly explored by artists. Classical music notation doesn't cover the needs of these new musical forms and numerous research and approaches have recently emerged, testifying to the maturity of the music notation domain, in the light of computer tools for music notation and representation. Issues like writing spatialized music [1], addressing new instruments [2] or new interfaces [3] (to cite just a few), are now subject of active research and proposals.

Interactive music and real-time scores are also representative of an expanding domain in the music creation field. The advent of the digital score and the maturation of the computer tools for music notation and representation constitute the basement for the development of this musical form, which is often grounded on non-traditional music representation [4] [5] but may also use the common music notation [6, 7].

In order to address the notations challenges mentionned above, INScore [8, 9] has been designed as an environment opened to non-conventional music representation (although it supports symbolic notation), and turned to real-time and interactive use [10, 11]. It is clearly focused on music representation only and in this way, differs from tools integrated into programming environments like Bach [12] or MaxScore [13].

INScore has been extended with *score expressions* that provide symbolic scores composition features (e.g., putting scores in sequence or in parallel). Building new scores from existing scores at symbolic level is not new. Haskell is providing such features with the `music-xxx` package... (???). Freeman and Lee proposed score composition operations in a real-time and interactive notation context [14]. Regarding the score operations used by INScore, they are imported from a previous work [15] that was focusing on the music notation consistency through arbitrary composition.

The novelty of the proposed approach relies on the dynamic aspects of the scores composition operations, as well as on the persistence of the score expressions. A score may be composed as an arbitrary graph of score expressions and equipped with a fine control over the changes propagation.

The paper introduces first the score composition expressions. Next, the different evaluations strategies are explained and illustrated with examples. The articulation with the INScore environment is presented in detail and followed by concrete use cases. A generalization of this approach is finally proposed in the concluding section.

2. TYPESET TEXT

3. HEADINGS

First level headings are in Times 12pt bold, centered with 1 line of space above the section head, and 1/2 space below it. For a section header immediately followed by a subsection header, the space should be merged.

3.1 Second Level Headings

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4.1 Equations

Equations of importance, or to which you refer later, should be placed on separated lines and numbered. The number should be on the right side, in parentheses.

$$E = mc^{2+\delta}. \quad (1)$$

Refer to equations like so: As (1) shows, I do not completely trust Special Relativity.

4.2 Figures, Tables and Captions

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5. CONCLUSIONS

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Acknowledgments

You may acknowledge people, projects, funding agencies, etc. which can be included after the second-level heading "Acknowledgments" (with no numbering).

6. REFERENCES

[1] E. Ellberger, G. Toro-Perez, J. Schuett, L. Cavaliero, and G. Zoia, "A paradigm for scoring spatialization notation," in *Proceedings of the First International Conference on Technologies for Music Notation and Representation - TENOR2015*, M. Battier, J. Bresson, P. Couprie, C. Davy-Rigaux, D. Fober, Y. Geslin, H. Genevois, F. Picard, and A. Tacaille, Eds. Paris, France: Institut de Recherche en Musicologie, 2015, pp. 98–102.

[2] T. Mays and F. Faber, "A notation system for the karlax controller," in *Proceedings of the International Conference on New Interfaces for Musical Expression*. London, United Kingdom: Goldsmiths, University of London, June 2014, pp. 553–556. [Online]. Available: http://www.nime.org/proceedings/2014/nime2014_509.pdf

[3] W. Enstr"om, J. Dennis, B. Lynch, and K. Schlei, "Musical notation for multi-touch interfaces," in *Proceedings of the International Conference on New Interfaces for Musical Expression*, E. Berdahl and J. Allison, Eds. Baton Rouge, Louisiana, USA: Louisiana State University, May 31 – June 3 2015, pp. 83–86. [Online]. Available: http://www.nime.org/proceedings/2015/nime2015_289.pdf

[4] R. R. Smith, "An atomic approach to animated music notation," in *Proceedings of the First International Conference on Technologies for Music Notation and Representation - TENOR2015*, M. Battier, J. Bresson, P. Couprie, C. Davy-Rigaux, D. Fober, Y. Geslin, H. Genevois, F. Picard, and A. Tacaille, Eds. Paris, France: Institut de Recherche en Musicologie, 2015, pp. 39–47.

[5] C. Hope, L. Vickery, A. Wyatt, and S. James, "The decibel scoreplayer - a digital tool for reading graphic notation," in *Proceedings of the First International Conference on Technologies for Music Notation and Representation - TENOR2015*, M. Battier, J. Bresson, P. Couprie, C. Davy-Rigaux, D. Fober, Y. Geslin, H. Genevois, F. Picard, and A. Tacaille, Eds. Paris, France: Institut de Recherche en Musicologie, 2015, pp. 58–69.

[6] R. Hoadley, "Calder's violin: Real-time notation and performance through musically expressive algorithms," in *Proceedings of International Computer Music Conference*, ICMA, Ed., 2012, pp. 188–193.

[7] ——, "December variation (on a theme by earle brown)," in *Proceedings of the ICMC/SMC 2014*, 2014, pp. 115–120.

[8] D. Fober, Y. Orlarey, and S. Letz, "Inscore – an environment for the design of live music scores," in *Proceedings of the Linux Audio Conference – LAC 2012*, 2012, pp. 47–54.

[9] ——, "Augmented interactive scores for music creation," in *Proceedings of Korean Electro-Acoustic*

Music Society's 2014 Annual Conference [KEAM-SAC2014], 2014, pp. 85–91.

[10] D. Fober, S. Letz, Y. Orlarey, and F. Bevilacqua, "Programming interactive music scores with inscore," in *Proceedings of the Sound and Music Computing conference – SMC'13*, 2013, pp. 185–190. [Online]. Available: fober-smc2013-final.pdf

[11] D. Fober, Y. Orlarey, and S. Letz, "Representation of musical computer processes," in *Proceedings of the ICMC/SMC 2014*, 2014, pp. 1604–1609. [Online]. Available: inscore-processes-final.pdf

[12] A. Agostini and D. Ghisi, "Bach: An environment for computer-aided composition in max," in *Proceedings of International Computer Music Conference*, ICMA, Ed., 2012, pp. 373–378.

[13] N. Didkovsky and G. Hajdu, "Maxscore: Music notation in max/msp," in *Proceedings of International Computer Music Conference*, ICMA, Ed., 2008.

[14] S. W. Lee and J. Freeman, "Real-time music notation in mixed laptop-acoustic ensembles," *Computer Music Journal*, vol. 37, no. 4, pp. 24–36, Dec. 2013. [Online]. Available: http://dx.doi.org/10.1162/COMJ_a_00202

[15] D. Fober, Y. Orlarey, and S. Letz, "Scores level composition based on the guido music notation," in *Proceedings of the International Computer Music Conference*, ICMA, Ed., 2012, pp. 383–386. [Online]. Available: icmc12-fober.pdf