Activity Report 2015

Team POSET

Modèles pour la Programmation Structurée de l'Espace et du Temps

Inria teams are typically groups of researchers working on the definition of a common project, and objectives, with the goal to arrive at the creation of a project-team. Such project-teams may include other partners (universities or research institutions).

RESEARCH CENTER
Bordeaux - Sud-Ouest

THEME
Embedded and Real-time Systems

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Team POSET

Creation of the Team: 2015 January 01

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1. Members

Research Scientist

Sylvain Salvati [Inria, Researcher, HdR]

Faculty Members

David Janin [Team leader, INP Bordeaux, Associate Professor, HdR]
Myriam Desainte-Catherine [INP Bordeaux, Professor, HdR]
Anne Dicky [Univ. Bordeaux, Associate Professor]

Engineer

Jaime Eduardo Arias Almeida [Inria]

PhD Students

Simon Archipoff [Univ. Bordeaux]
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Etienne Dubourg [Univ. Bordeaux]
Jérôme Kirman [Univ. Bordeaux]
Pauline Mouawad

Administrative Assistant
Sabine Delarboulas Cusin [Inria]

Other
Edwin Buger

2. Overall Objectives

2.1. Overall Objectives

How to capture, analyse, mix, combine or transform temporal media streams as varied as sounds, animations, melodies, videos, control gestures? Modern technologies make it possible to produce complex multimodal artistic computerized systems, but require the support of specially trained technicians to turn artistic intentions into technical realizations. Since modern system designers are more often artists than software developers, we aim at developing system design tools directly accessible to the artists.

In this project, we try to offer simple, uniform formalisms and tools for the representation and the manipulation of temporal media streams. This is achieved by developing new models for the hierarchical and modular design of interactive timed systems, and applying these models to the realization of artistic interactive applications. Our concrete experiments, guided by formal models challenged by experimental needs, ensure the adequacy and the robustness of our proposals.

The resulting software methodologies and design tools for the creation of interactive pieces of art should be user-friendly and robust. In particular, the resulting technical constraints should no longer hide the inadequacy of ad hoc and immature interfaces, but address critical issues such as the coherence and compatibility of design objectives .

3. Research Program

3.1. Research Program

Our research programs is structured into three complementary research axis : models, languages and systems, allowing us to develop our multi-disciplinary approach while validating each progress in the related specific fields of computer science ranging among computer music, multi-modal system design, reactive and real-time programing, typed functional programming, formal languages, graph representation theory, applied algebra, logic in computer science, etc.

3.1.1. Models

Inverse semigroup theory has recently been shown [15], [24] to unify most string-based, tree-based or even graph-based modeling approaches. It thus provides a consistent and robust mathematical framework to model the sequential, parallel and reactive aspects of temporal media. Developing the mathematical foundations of our proposal amounts to:

- studying the combinatorial and algorithmic properties of the emerging algebra-based model of structured temporal media,
- developing formal techniques and tools for expressing and verifying properties of temporal media programs especially with a view towards capturing temporal media programing by constraint satisfaction approaches,
- deriving from the known generators of these models adequate sets of application-oriented modeling functions.

3.1.2. Languages

Functional programming is the key link between well-defined mathematical structures and their computerized realizations. Based on functional programming frameworks such as Haskell [1], we are prototyping a Domain Specific Language (DSL) [9] dedicated to the programming of interactive temporal media programming. In this research axis, we aim more specifically at

- designing a robust and modular software architecture that allows to reuse existing pieces of software as well as simply combining them together with new ones,
- defining and implementing a DSL for programming interactive multimedia systems via a simple algebra-based high-level and multi-scale control and combination layer,
- finding the right balance between generic views of temporal media when seen as abstract temporal frames and their specializations when representing concrete gestures, sound, audio, videos, animations, etc.

3.1.3. Systems

Multi-modal interactive systems gather various techniques to capture and analyze gestures, and to combine, transform and produce temporal media. Through regular experiments in collaboration with artists, we also aim at assessing, refining and extending the applicability of our proposal by:

- developing a robust and mathematically well-founded representation of systems and of their behaviors, both programmatic and visual,
- developing and evaluating the adequacy of the GUI induced by this representation when used by artists,
- relating the new models with more classical models of music formalisms and, beyond, other temporal media such as animations, videos, etc.

4. Application Domains

4.1. Application Domains

4.1.1. Temporal media analysis and creation

Our first application domain concerns temporal media analysis and creation. Of course, many existing tools allow to create, combine and transform temporal media such as sounds, music, videos, animations. Strictly speaking, we do not aim at offering new possibilities. However, with an approach based on modern development theory and software technologies, we shall offer more reliable tools, that enjoy much higher productivity and reusability. As an immediate application, the fruit of our research may increase the quality of the technological assistance provided by Art & Science studios such as the SCRIME [2]. In this view, we shall concentrate our application perspectives on temporal media analysis (e.g. structure inference algorithms and learning tools) and on temporal media combination and synthesis (e.g. tools for music composition).

4.1.2. Interactive and distributed interfaces

Our second application domain lays in the field of interaction. New technologies already used in artistic installations are connected and interactive. But there is still a whole world to be discovered and equipped with adequate technologies to design tomorrow's interactive and distributed pieces of digital arts. In this perspective, we shall concentrate on developing techniques for the capture and the on-the-fly analysis of input streams, together with techniques to combine them and turn them into new media types.

[1] See [41] for an historical presentation of the Haskell programming language.
[2] Studio de Création et de Recherche en Informatique et Musiques Expérimentales

5. Highlights of the Year

5.1. Highlights of the Year

Two presentations, by D. Janin and S. Salvati, at ICALP 2013, a leading conference in the field of formal language theory and its applications to computer science, have eventually been selected among the 16 out of 120 papers for a complete version to appear this year in the associated special issue (see [15] and [16]).

6. New Software and Platforms

6.1. i-score

The *i-score* software, whose first definition dates back to 2005 [1], [6], aims at offering graphical views, aka *scores*, of interactive system. It has already been used to experiment various graphical user interface proposals to define time constraints between processes. It has been the subject of Jaime Arias's PhD [11]. Several formalizations of its semantics have been proposed [36], [20], [21], [19]. In 2016, especially within the ADT project "Tuilage", *i-score* independent modules should be identified and integrated as possible GUIs for the *T-calculus*.

6.2. T-calculus

Sketched in [9], the *T-calculus* is a Domain Specific Language [3] to provide simple and robust high-level description mechanisms of reactive systems. It will offer a programmatic view of the tile modeling paradigm [3], [8]. Its definition has been refined a number of times (see e.g. [9], [7] and [30], [18]). A prototype implementation of its reactive kernel has eventually been achieved in Haskell on top of the Euterpea libraries by the end of 2015. Its consolidation and further developments are now scheduled for 2016, especially within the ADT project "Tuilage". Graphical representation of tiles should give rise to a robust correspondance between programmatic and graphical representations of reactive systems.

7. New Results

7.1. Efficient interactive score

We have proposed a solution to the problem of real-time performance for interactive multimedia applications, specifically in the interpretation of interactive multimedia scores. For that, we have proposed a new parallel implementation of interactive scores on a reconfigurable hardware. We take advantage of the parallelism and reliability provided by Field Programmable Gate Arrays (FPGAs) to perform in real-time the hardware representation of scores. The results of the simulations show that our approach allows the system to react instantaneously to user interactions. Moreover, the real-time constraints of the score are satisfied [21].

7.2. Modeling with tile

In [3], [8] it has been observed that musical objects are conveniently modeled by tiles. These modeling experiments have been continued this year by showing, in particular, how both high-level music modeling and low-level signal combination can be modeled by means of tiles [23]. This has been further extended relating classical musical constructs with tile modeling features [34].

[3] See [40] for an early note by Hudak about the notion of Domain Specific Language, and see [39], [42] for application of this notion is computer music.

7.3. Tiles and inverse semigroups

In [10] it has already been observed that the theory of inverse semigroups [4] is the adequate mathematical framework to define and study tiles and their languages. In this direction, we have shown that strings, trees and even many types of graphs can be unified into a notion of higher-dimensional strings [24], [35]. Using techniques of partial algebra [4], this notion recovers advanced results on formal languages of graphs of bounded tree-width [5], which shows the robustness of the approach.

7.4. Reactive programming with tile

The first step towards programming music with tiles is proposed as a Domain-Specific Language : the T-calculus [9]. Further collaboration with Paul Hudak [7] led us to various implementation experiments on top of Haskell [30], [33], [29]. Within the ADT "Tuilage" and S. Archipoff's PhD thesis in progress, we eventually managed to integrate tile modeling into reactive programming as illustrated, in December 2015, by the first concert of the Idex Arts & Science project "Sound of Algorithm" in collaboration with the musician Edwin Buger.

7.5. Behavioral properties of higher-order programs

In a series of results [28], [27], we have been able to cast to traditional denotational semantics the behavioral properties captured by Monadic Second Order Logic (MSOL) and weak MSOL. The main difficulty was to represent infinitary properties in finitary models. From a foundational point of view, these results exhibit once more the robustness of approaches based on recognizability to capture complex properties of programs. They also make salient the problem of program evaluation in finite models as a milestone towards effective model-checking of higher-order programs.

7.6. Art & Science project

This year has seen the members of PoSET involved in a number of Art & Science projection, especially some granted by Idex Bordeaux, including but not limited to : *Illumination* created Aurelio Edler-Copes, in partnership with compagnie Eclats, performed in November 2015 at Molière Theater, *Mobiles* and *Le Chant du filament #2* respectively created by Renaud Rubiano and Nicolas Villenave, performed or displayed in November 2015 during FACTS festival, the Art and Science Festival of Bordeaux University, and, *Le son des algorithmes* with Edwin Buger that led to a first musical performance in December 2015.

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- PhD Grant CIFFRE, 2015-2018, for Jean-Michael Célérier, in partnership with Blue Yeti (Royan),

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. SCRIME

The Studio de Création et de Recherche en Informatique et Musiques Expérimentales (SCRIME) located on Bordeaux University Campus, is a *Groupement d'Intérêt Scientifique et Artistique (GIS&A)* gathering Université de Bordeaux, CNRS, Bordeaux INP, Ministère de la Culture et de la Communication, Ville de Bordeaux and Région Aquitaine. It is a privileged partner of the PoSET project. Most PoSET artistic projects are organized in cooperation with the SCRIME.

[4] See [43] for general presentation of inverse semigroup theory, and [45], [44] for graph-based representation of inverse semigroup elements.

[5] See [38] for an up-to-date presentation of the formal language theory of graphs.

9.1.2. Idex Bordeaux

- 4 *Arts & Science* projects of Bordeaux eventually granted in 2015 by the Initiative of Excellence (Idex) of Bordeaux,

9.2. National Initiatives

9.2.1. ANR

- ANR INEDIT, *Interactivité dans l'Ecriture De l'Interaction et du Temps*, coordinated by Ircam (Paris), 3 years, from 2012 to 2015, together with GRAME (Lyon); this project aimed at developing and integrating the existing formalisms to represent and perform interactive pieces of art,
- ANR OSSIA, *Open Scenario System for Interactive Application*, coordinated by GMEA (Albi), 3 years, from 2012 to 2015, together with Blue Yeti (Royan), ENJMIN (Poitiers), RSF (Toulouse); this project aimed at offering software services, especially within the Jamoma platform, to design, implement and perform open, non-linear and multi-user scenarios.

9.3. International Initiatives

9.3.1. Inria International Partners

PoSET members have regular though often informal collaboration with various international teams including:

- Camillo Rueda, Universidad Javaneria, Cali, Colombia,
- Paul Hudak, University of Yale, New-Haven, USA,
- Gregory M. Kobele, University of Chicago, USA,
- Makoto Kanazawa, National Institute of Informatics, Tokyo, Japan.

9.4. International Research Visitors

9.4.1. Visits of International Scientists

- Shlomo Dubnov, UCSD (USA), visiting Scholar from November 2015 until June 2016,
- Eduardo Mirando, University of Plymouth, UK, invited professor from May the 15th until June the 15th.

9.4.2. Visits to International Teams

- D. Janin visiting Stuart Margolis, Bar Illan (Israël), April 2015,

10. Dissemination

10.1. Promoting Scientific Activities

10.1.1. Scientific events organisation

10.1.1.1. General chair, scientific chair

- D. Janin was general chair of the workshop "Modélisation et représentation musicale", GDR ESARS, Bordeaux,

10.1.2. Scientific events selection

10.1.2.1. Chair of conference program committees

- D. Janin, PC Chair of ACM Workshop on Functional Art, Music, Modeling and Design (FARM), Vancouver (Canada), associated with ICFP,

10.1.2.2. Member of the conference program committees

- M. Desainte-Catherine, PC member of Journées d'Informatique Musicale (JIM 2015), Montréal (Canada),
- M. Desainte-Catherine, PC member of Sound and Music Computing (SMC 2015), Maynooth (Ireland),
- M. Desainte-Catherine, PC member of International Conference on Digital Audio Effects (DAFX 2015), Trondheim (Norway).

10.1.2.3. Reviewer

Members of the project are yearly reviewers for a number of international conferences including LICS, ICALP, STACS, MFCS, FST&TCS, in theoretical computer science, and ICMC, SMC, NIME, FARM, TENOR, JIM in computer music.

10.1.3. Journal

10.1.3.1. Member of the editorial boards

- S. Salvati is editor of the Journal of Logic Language and Information (JoLLI); since the end of 2015, he has been promoted as Editor in Chief,
- M. Desainte-Catherine is editor of the Revue francophone d'informatique musicale (RFIM).

10.1.3.2. Reviewer - Reviewing activities

Members of the project are regular reviewers for a number of international journal including ACM Computers In Entertainment (CIE), Iranian Journal of Fuzzy Systems (IJFS), Journal of New Music Research (JNMR), Journal of Logic Language and Information (JoLLI), Revue francophone d'informatique musicale (RFIM), Discrete Mathematics &Theoretical Computer Science (DMTCS), International Journal of Foundations of Computer Science (IJFCS), Information & Computation (I&C) ...

10.1.4. Invited talks

- S. Salvati, LIF seminar, "Formal language theory and lambda-calculus", February 2015
- M . Desainte-Catherine, Albi Seminar *Les nouveaux territoires de la création*, "Jouer avec le temps", March 2015,
- S. Salvati, Chocola meeting, "Model construction for higher-order model-checking", April 2015
- S. Salvati was an invited speaker of the conference Finite State Methods in Natural Language Processing, "Context-freeness, automata and denotational semantics", June 2015
- S. Salvati, NII seminar "Model construction for higher-order model checking", July 2015,
- D. Janin, Dagstuhl Seminar *Verification of Evolving Graph Structures*, "Higher dimensional strings", November 2015,
- D. Janin, RNSC MuSICAL meeting, "Visualisation et programmation musicale via l'algèbre", December 2015,
- D. Janin, workshop GDR Esthétique Arts et Science (ESARS), "Représentation musicale et algèbre", Novembre 2015,
- M. Desainte-Catherine, colloque A& S FACTS, "Projet A& S le chant du filament", with Nicolas Villenave, November 2015,
- M. Desainte-Catherine and J.-M. Celerier, workshop GDR Esthétique Arts et Science (ESARS), "Structuration du temps avec i-score", Bordeaux, November 2015.

10.1.5. Leadership within the scientific community

- M. Desainte-Catherine is president of the Association Française d'Informatique Musicale (AFIM)
- S. Salvati is the secretary of the Foundation for Logic Language and Information (FoLLI).

10.1.6. Scientific expertise

- Expertise of Art and Science projects of Diagonale Paris-Saclay.
- Expertise of projects for the young researcher award of Science and Music colloque at the University of Rennes.

10.1.7. Research administration

- M. Desainte-Catherine, directrice adjointe du LaBRI,
- M. Desainte-Catherine, directrice scientifique et administrative du SCRIME,
- M. Desainte-Catherine, responsable du thème SI de l'équipe image et son du LaBRI,
- D. Janin, membre commission recherche Bordeaux INP/ENSEIRB-MATMECA.

10.2. Teaching - Supervision - Juries

10.2.1. Teaching

Licence: Myriam Desainte-Catherine, *Programmation fonctionnelle*, 44 h, L3, Software Engineering department, Bordeaux INP, France,

Licence: Myriam Desainte-Catherine, *Projet d'algorithmique et de programmation*, 25 h, L3, Software Engineering department, Bordeaux INP, France,

Licence: Anne Dicky, *Algorithmique des graphes*, 30 h, L3, Computer Science Departement, Paris VI University, Vietnam,

Licence: Anne Dicky, *Probabilités et combinatoire*, 75 h, L3, Computer Science Departement, Bordeaux University, France,

Licence: Anne Dicky, *Algorithmique et structures de données*, 50h, L2, Computer Science Departement, Bordeaux University, France,

Licence: Anne Dicky, *Fondamentaux pour les mathématiques et l'informatique*, 35 h, L1, Computer Science Departement, Bordeaux University, France,

Master: Sylvain Salvati, *Logique*, 12h, M1, Computer Science Departement, Bordeaux University, France,

Licence: David Janin, *Projet d'algorithmique et de programmation*, 25 h, L3, Software Engineering department, Bordeaux INP, France,

Licence: Sylvain Salvati, *Analyse syntaxique et projet de programmation 3*, 37,5 h, niveau L3, Computer Science Departement, Bordeaux University, France,

Master: Myriam Desainte-Catherine, *Compilation*, 14 h, M1, Software Engineering department, Bordeaux INP, France,

Master: Myriam Desainte-Catherine, *Projet de Génie Logiciel*, 25 h, M1, Software Engineering department, Bordeaux INP, France,

Master: Myriam Desainte-Catherine, *Informatique musicale contrôle et composition*, 25 h, M2, Software Engineering department, Bordeaux INP, France,

Master: Anne Dicky, *Recherche operationelle*, 70 h, M1, Computer Science Departement, Bordeaux University, France,

Master: David Janin, *Projet de Génie Logiciel*, 25 h, M1, Software Engineering department, Bordeaux INP, France,

Master: David Janin, *Compilation*, 20 h, M1, Network and System Engineering department (RSI), Bordeaux INP, France,

Master: David Janin, *Tutorat*, 15 h, M1, M2, Network and System Engineering department (RSI), Bordeaux INP, France,

Doctorat: Sylvain Salvati, *Initiation à CoQ*, 12 h, Ecole Doctorale Mathématique et Informatique, Bordeaux University, France.

10.2.2. Supervision

HdR : Sylvain Salvati, “Lambda-calculus and formal language theory”, Université de Bordeaux, defended in december 2015,

PhD : Jaime Arias, “Formal Semantics and Automatic Verification of Hierarchical Multimedia Scenarios with Interactive Choices”, Universite´ de Bordeaux, defended in november 2015, supervised by M. Desainte-Catherine,

PhD : Jérôme Kirman, “Mise au point d’un formalisme syntaxique de haut niveau pour le traitement automatique des langues”, Université de Bordeaux, defended in december 2015, supervised by Bruno Courcelle, Lionel Clément, Sylvain Salvati,

PhD in progress : Pauline Mouawad, “Analyse et modélisation de l’émotion musicale”’, started in september 2012, supervised by M. Desainte-Catherine,

PhD in progress : Etienne Dubourg, “Contribution a` la the´orie des langages de tuiles”, started in november 2012, supervised by D. Janin,

PhD in progress : Jean-Michaël Célérier, “Outils d’écriture spatiale pour les partitions interactives”, started in january 2015, supervised by M. Desainte-Catherine,

PhD in progress : Simon Archipoff, “Modélisation et programmation tuilée réactive”, started in september 2015, supervised by D. Janin,

10.2.3. Juries

- M. Desainte-Catherine was a member and a reviewer of the PhD jury of Olivier Perrotin, “Chanter avec les mains : Interfaces chironomiques pour les instruments de musique numériques”, Université Paris-Saclay(LIMSI), Septembre 2015,
- M. Desainte-Catherine was a member and a reviewer of the PhD jury of Ko Yi Chun, “L’espace sensible :expérience inter-sensorielle et corporelle, à partir des dispositifs musicaux interactifs”, Université Vincennes Saint-Dennis, Novembre 2015,
- D. Janin was a member and the president of the PhD jury of Jaime Arias: “Formal Semantics and Automatic Verification of Hierarchical Multimedia Scenarios with Interactive Choices”, Universite´ de Bordeaux (LaBRI), November 2015,
- S. Salvati was a member of the PhD jury of Yann Salmon: “Analyse d’atteignabilité pour les programmes fonctionnels avec stratégie d’évaluation en profondeur”, Université de Rennes 1, December 2015.

11. Bibliography

Major publications by the team in recent years

[1] A. ALLOMBERT, M. DESAINTE-CATHERINE. *Interactive scores : A model for specifying temporal relations between interactive and static events*, in "Journal of New Music Research (JNMR)", 2005, vol. 34, n^{o} 4, pp. 361–374

[2] J. ARIAS, M. DESAINTE-CATHERINE, C. RUEDA. *Modelling Data Processing for Interactive Scores Using Coloured Petri Nets*, in "14th International Conference on Application of Concurrency to System Design", Tunis, Tunisia, June 2014 [*DOI :* 10.1109/ACSD.2014.23], https://hal.archives-ouvertes.fr/hal-01095176

[3] F. BERTHAUT, D. JANIN, B. MARTIN. *Advanced synchronization of audio or symbolic musical patterns: an algebraic approach*, in "International Journal of Semantic Computing", 2012, vol. 6, n° 4, pp. 409-427 [*DOI :* 10.1142/S1793351X12400132], http://hal.archives-ouvertes.fr/hal-00794196

[4] A. BLUMENSATH, D. JANIN. *A syntactic congruence for languages of birooted trees*, in "Semigroup Forum", 2014 [*DOI :* 10.1007/s00233-014-9677-x], http://hal.archives-ouvertes.fr/hal-00947972

[5] A. CLAY, N. COUTURE, E. DECARSIN, M. DESAINTE-CATHERINE, P. VULLIARD, J. LARRALDE. *Movement to emotions to music: using whole body emotional expression as an interaction for electronic music generation*, in "In proceedings of the 12th conference on New Instruments for Musical Expression (NIME)", 2012

[6] M. DESAINTE-CATHERINE, A. ALLOMBERT, G. ASSAYAG. *Towards a Hybrid Temporal Paradigm for Musical Composition and Performance: The Case of Musical Interpretation*, in "Computer Music Journal", 2013, vol. 37, n° 2, pp. 61–72

[7] P. HUDAK, D. JANIN. *Tiled Polymorphic Temporal Media*, in "Work. on Functional Art, Music, Modeling and Design (FARM)", ACM Press, 2014, pp. 49-60 [*DOI :* 10.1145/2633638.2633649], http://hal.archives-ouvertes.fr/hal-00955113

[8] D. JANIN, F. BERTHAUT, M. DESAINTE-CATHERINE. *Multi-scale design of interactive music systems : the libTuiles experiment*, in "Sound and Music Comp. (SMC)", 2013, pp. 123 – 129, http://hal.archives-ouvertes.fr/hal-00813313

[9] D. JANIN, F. BERTHAUT, M. DESAINTE-CATHERINE, Y. ORLAREY, S. SALVATI. *The T-Calculus : towards a structured programming of (musical) time and space*, in "Work. on Functional Art, Music, Modeling and Design (FARM)", ACM Press, 2013, pp. 23-34 [*DOI :* 10.1145/2505341.2505347], http://hal.archives-ouvertes.fr/hal-00789189

[10] D. JANIN. *Towards a higher dimensional string theory for the modeling of computerized systems*, in "Int. Conf. on Current Trends in Theo. and Prac. of Comp. Science (SOFSEM)", LNCS, Springer, 2014, vol. 8327, pp. 7–20 [*DOI :* 10.1007/978-3-319-04298-5_2], http://hal.archives-ouvertes.fr/hal-00879463

Publications of the year

Doctoral Dissertations and Habilitation Theses

[11] J. ARIAS. *Formal Semantics and Automatic Verification of Hierarchical Multimedia Scenarios with Interactive Choices*, Université de Bordeaux, November 2015, https://hal.archives-ouvertes.fr/tel-01245370

[12] J. KIRMAN. *A high-level formalism for natural language processing*, Université de Bordeaux, December 2015, https://tel.archives-ouvertes.fr/tel-01251668

[13] S. SALVATI. *Lambda-calculus and formal language theory*, Université de Bordeaux, December 2015, Habilitation à diriger des recherches, https://hal.archives-ouvertes.fr/tel-01253426

Articles in International Peer-Reviewed Journals

[14] A. DICKY, D. JANIN. *Two-way automata and regular languages of overlapping tiles*, in "Fundamenta Informaticae", 2015, vol. 142, pp. 1-33 [*DOI :* 10.3233/FI-2015-1280], https://hal.archives-ouvertes.fr/hal-00717572

[15] D. JANIN. *On labeled birooted tree languages: algebras, automata and logic*, in "Journal of Information and Computation", 2015, vol. 243, pp. 222 - 248 [*DOI :* 10.1016/J.IC.2014.12.016], https://hal.archives-ouvertes.fr/hal-00982538

[16] G. M. KOBELE, S. SALVATI. *The IO and OI hierarchies revisited*, in "Information and Computation", 2015, vol. 243, pp. 205-221 [*DOI :* 10.1016/J.IC.2014.12.015], https://hal.archives-ouvertes.fr/hal-01251097

[17] S. SALVATI. *MIX is a 2-MCFL and the word problem in $\mathbb{Z}^2$ is solved by a third-order collapsible pushdown automaton*, in "Journal of Computer and System Sciences", 2015, vol. 81, n^{o} 7, pp. 1252 - 1277, https://hal.inria.fr/inria-00564552

International Conferences with Proceedings

[18] S. ARCHIPOFF. *An Efficient Implementation of Tiled Polymorphic Temporal Media*, in "ICFP FARM", Vancouver, Canada, Proceedings of the 3rd ACM SIGPLAN International Workshop on Functional Art, Music, Modelling and Design, ACM SIGPAN, September 2015 [*DOI :* 10.1145/2808083.2808089], https://hal.archives-ouvertes.fr/hal-01214101

[19] J. ARIAS, M. DESAINTE-CATHERINE, C. OLARTE, C. RUEDA. *Foundations for Reliable and Flexible Interactive Multimedia Scores*, in "Fifth Biennial International Conference on Mathematics and Computation in Music", London, United Kingdom, Lecture Notes in Computer Science, June 2015, vol. 9110, pp. 29-41 [*DOI :* 10.1007/978-3-319-20603-5_3], https://hal.archives-ouvertes.fr/hal-01129394

[20] J. ARIAS, M. DESAINTE-CATHERINE, C. RUEDA. *A Framework for Composition, Verification and Real-Time Performance of Multimedia Interactive Scenarios*, in "15th International Conference on Application of Concurrency to System Design", Brussels, Belgium, June 2015 [*DOI :* 10.1109/ACSD.2015.8], https://hal.archives-ouvertes.fr/hal-01136252

[21] J. ARIAS, M. DESAINTE-CATHERINE, C. RUEDA. *Exploiting Parallelism in FPGAs for the Real-Time Interpretation of Interactive Multimedia Scores*, in "Journées d'Informatique Musicale 2015", Montréal, Canada, May 2015, https://hal.archives-ouvertes.fr/hal-01129316

[22] L. CLEMENTE, P. PARYS, S. SALVATI, I. WALUKIEWICZ. *Ordered Tree-Pushdown Systems*, in "FSTTCS 2015", Bangalore, India, 35th IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science, Schloss Dagstuhl–Leibniz-Zentrum fuer Informatik, December 2015, vol. 45, https://hal.archives-ouvertes.fr/hal-01145598

[23] D. JANIN, M. DESAINTE-CATHERINE. *Des signaux aux symphonies : pour une modélisation homogène des objets sonores*, in "Journées d'Informatique Musicale (JIM 2015)", Montréal, Canada, May 2015, https://hal.archives-ouvertes.fr/hal-01183097

[24] D. JANIN. *Inverse monoids of higher-dimensional strings*, in "12th International Colloquium on Theoretical Aspects of Computing (ICTAC 2015)", Cali, Colombia, Lecture Notes in Computer Science, Springer, 2015, vol. 9399, https://hal.archives-ouvertes.fr/hal-01165724

[25] D. JANIN. *Walking automata in free inverse monoids*, in "42nd International Conference on Current Trends in Theory and Practice of Computer Science (SOFSEM)", Harrachov, Czech Republic, January 2016, https://hal.archives-ouvertes.fr/hal-00738793

[26] P. MOUAWAD, M. DESAINTE-CATHERINE, J.-L. ROUAS. *Multilabel Classification of Non-Verbal Communication of Emotions*, in "8th International Workshop on Machine Learning and Music", Vancouver, Canada, 2015, https://hal.archives-ouvertes.fr/hal-01230566

[27] S. SALVATI, I. WALUKIEWICZ. *A model for behavioural properties of higher-order programs*, in "24th EACSL Annual Conference on Computer Science Logic, CSL 2015", Berlin, Germany, Schloss Dagstuhl - Leibniz-Zentrum fuer Informatik, September 2015, vol. 41 [*DOI :* 10.4230/LIPICS.CSL.2015.229], https://hal.archives-ouvertes.fr/hal-01145494

[28] S. SALVATI, I. WALUKIEWICZ. *Typing weak MSOL properties*, in "FOSSACS'15", London, United Kingdom, FOSSACS 2015, April 2015, https://hal.archives-ouvertes.fr/hal-01061202

National Conferences with Proceedings

[29] S. ARCHIPOFF, D. JANIN. *Pour un raffinement spatio-temporel tuilé*, in "Journées Francophones des Langages Applicatifs", Saint-Malo, France, January 2016, https://hal.archives-ouvertes.fr/hal-01247424

[30] T. BAZIN, D. JANIN. *Flux média tuilés polymorphes: une sémantique opérationnelle en Haskell*, in "Journées Francophones des Langages Applicatifs (JFLA)", Val d'Ajol, France, January 2015, https://hal.archives-ouvertes.fr/hal-01091736

Conferences without Proceedings

[31] J.-M. CELERIER, P. BALTAZAR, C. BOSSUT, N. VUAILLE, J.-M. COUTURIER, M. DESAINTE. *OSSIA: Towards a unified interface for scoring time and interaction*, in "TENOR2015", Paris, France, May 2015, https://hal.archives-ouvertes.fr/hal-01245957

[32] S. SALVATI. *Non-linear Second order Abstract Categorial Grammars and deletion*, in "NLCS 2015: Natural Language and Computer Science", Kyoto, Japan, Makoto Kanazawa, 2015, https://hal.archives-ouvertes.fr/hal-01251127

Research Reports

[33] P. HUDAK, D. JANIN. *From out-of-time design to in-time production of temporal media*, LaBRI - Laboratoire Bordelais de Recherche en Informatique, February 2015, https://hal.archives-ouvertes.fr/hal-01182995

[34] D. JANIN. *A robust algebraic framework for high-level music programming*, LaBRI - Laboratoire Bordelais de Recherche en Informatique, December 2015, https://hal.archives-ouvertes.fr/hal-01246584

[35] D. JANIN. *Free inverse monoids up to rewriting*, LaBRI - Laboratoire Bordelais de Recherche en Informatique, July 2015, https://hal.archives-ouvertes.fr/hal-01182934

Other Publications

[36] J. ARIAS, J.-M. CELERIER. *Le séquenceur interactif multimédia i-score*, June 2015, Journées Développement Logiciel de l'Enseignement Supérieur et de la Recherche, Poster, https://hal.archives-ouvertes.fr/hal-01245350

[37] S. SALVATI, I. WALUKIEWICZ. *A model for divergence insensitive properties of lambdaY-terms*, June 2015, working paper or preprint, https://hal.archives-ouvertes.fr/hal-01169352

References in notes

[38] B. COURCELLE, J. ENGELFRIET. *Graph structure and monadic second-order logic, a language theoretic approach*, Encyclopedia of mathematics and its applications, Cambridge University Press, 2012, vol. 138

[39] P. HUDAK. *The Haskell School of Music : From signals to Symphonies*, Yale University, Department of Computer Science, 2013

[40] P. HUDAK. *Keynote Address - The Promise of Domain-Specific Languages*, in "Proceedings of the Conference on Domain-Specific Languages (DSL)", 1997

[41] P. HUDAK, J. HUGUES, S. PEYTON JONES, P. WADLER. *A History of Haskell: Being Lazy With Class*, in "Third ACM SIGPLAN History of Programming Languages (HOPL)", ACM Press, 2007

[42] P. HUDAK, D. QUICK, M. SANTOLUCITO, D. WINOGRAD-CORT. *Real-time Interactive Music in Haskell*, in "Work. on Functional Art, Music, Modeling and Design (FARM)", ACM, 2015, pp. 15–16

[43] M. V. LAWSON. *Inverse Semigroups : The theory of partial symmetries*, World Scientific, 1998

[44] J. MEAKIN. *Groups and semigroups: connections and contrasts*, in "Groups St Andrews 2005, Volume 2", London Mathematical Society, Lecture Note Series 340, Cambridge University Press, 2007

[45] J. STEPHEN. *Presentations of inverse monoids*, in "Journal of Pure and Applied Algebra", 1990, vol. 63, pp. 81-112