Statement of published scientific articles and information on educational achievements, research cooperation, and science dissemination

Lorenzo Clemente

March 2019

I. Publications constituting the scientific achievement, as referred in the Art. 16 of the Act 2

A) Title of the scientific achievement

Adding time to infinite state systems.

B) Publications constituting the scientific achievement

[A] Lorenzo Clemente, Sławomir Lasota. *Binary reachability of timed pushdown automata via quantifier elimination.* In Proc. of ICALP'18, pages 118:1–118:14.

I proposed to study the binary reachability problem. The key novelty of the paper is the use of method of quantifier elimination to solve the binary reachability problem, which was proposed by me. I proved that quantifier elimination holds for clock constraints (Sec. 2). I come up with the definition of the model of timed pushdown automata with the general clock constraints we use (Sec. 3). I provided the reduction to fractional timed pushdown automata (Sec. 4), which is the technically most intricate part of the paper. Together with S. Lasota we proposed to use cyclic order atoms to study fractional clocks (Sec. 5). S. Lasota proposed to use a result by Verma et. al in order to represent Parikh images with small existential formulas. The writing and proofreading was done jointly. Estimated total contribution: 70%.

[B] Lorenzo Clemente, Sławomir Lasota, Ranko Lazić, and Filip Mazowiecki. *Timed pushdown automata and branching vector addition systems.* In Proc. of LICS'17, pages 1–12.

The main motivation of the paper is the study of timed-register pushdown automata, which was proposed by me and S. Lasota. The proposal of using set-integer equations (Sec. III) and showing their equivalence with timed-register pushdown automata (Sec. IV and V) is by me and S. Lasota. The idea of reducing pushdown automata/equations to branching VAS (Sec. VI and VII) is by me and S. Lasota. The solution of branching VAS in ExpTime (Sec. VIII) is by R. Lazić and F. Mazowiecki. Together with S. Lasota we wrote most of Sec. II–V and VII. Sec. VI and VIII were written by R. Lazić and F. Mazowiecki. R. Lazić wrote the introduction. All authors contributed comparably to proofreading of the whole manuscript. Estimated total contribution: 30%.

[C] Lorenzo Clemente, Sławomir Lasota. *Timed Pushdown Automata Revisited.* In Proc. of LICS'15, pages 738–749.

The study of timed-register pushdown automata was proposed by me and S. Lasota. I proved that dense-time pushdown automata are as expressive as their timeless stack variant (Sec. II), which is the main motivation behind the paper and the first main contribution. The technical development leading to the NExpTime upper bound is mostly by S. Lasota,

which is the other main contribution of the paper. The writing was split roughly evenly. Both authors proofread the whole paper. Estimated total contribution: 55%.

[D] Lorenzo Clemente and Sławomir Lasota. *Reachability Analysis of First-order Definable Pushdown Systems*. In Proc. of CSL'15, pages 244–259.

The main novelty of the paper is the study of pushdown automata in the general context of sets with atoms, which was proposed by me and S. Lasota. We discussed together the definitions in Sec. II and III, and the algorithmic results in Sec. IV and V. S. Lasota proposed Example 6 as an oligomorphic structure which is not homogeneous and proved Theorem 9. I worked out the details of Sec. VI and proposed to use the wreath product operation. The writing and proofreading was split equally. Estimated total contribution: 50%.

[E] Lorenzo Clemente, Frédéric Herbreteau, and Grégoire Sutre. *Decidable Topologies for Communicating Automata with FIFO and Bag Channels*. In Proc. of CONCUR'14, pages 281–296.

The main contribution of the paper is the study of communicating automata over arbitrary communication topologies mixing FIFO and bag channels, which was proposed by me together with F. Herbreteau and G. Sutre. The results were obtained in close collaboration by all three co-authors, including the definitions in Sec. 2, the transformation techniques of Sec. 3 and 4, and their application in Sec. 5 to the characterisation of decidable and undecidable topologies. The writing and proofreading was done in comparable proportions by all co-authors. Estimated total contribution: 40%.

[F] Lorenzo Clemente, Frédéric Herbreteau, Amelie Stainer, and Grégoire Sutre. *Reachability of Communicating Timed Processes*. In Proc. of FOSSACS'13, pages 81–96.

The main contribution of the paper is the study of the reachability problem for timed communicating automata over arbitrary communication topologies, which was proposed by me together with F. Herbreteau and G. Sutre. The precise identification of the model was done by me, F. Herbreteau, and G. Sutre (Sec. 2). The reduction to counter automata was done by me, and the inverse reduction by G. Sutre (Sec. 3). The reduction of dense to discrete time was done by F. Herbreteau and A. Stainer (Sec. 4). I wrote the introduction (Sec. 1) and contributed actively to the writing and proofreading of the whole paper. Estimated total contribution: 30%.

II. Other published research articles (not listed in item I) and indicators of scientific achievements

A) Scientific articles published in journals listed in Journal Citation Reports (JRC)

- Lorenzo Clemente and Richard Mayr, *Efficient reduction of nondeterministic automata with application to language inclusion testing*, Logical Methods in Computer Science, Volume 15, Issue 1 (2019), 73 pages.

  This is the greatly extended journal version of our previous POPL'13 paper.

- Parosh Aziz Abdulla, Lorenzo Clemente, Richard Mayr, and Sven Sandberg, *Stochastic Parity Games on Lossy Channel Systems*, Logical Methods in Computer Science, Volume 10, Issue 4 (2014), 21 pages.

  This is the journal version of our previous QEST'13 paper, which was invited in a special journal issue about selected QEST'13 papers.

B) Inventions and designs with secured rights, exhibited at international and national exhibitions and fairs

None.

C) Monographs, scientific articles in international and national journals not present in JCR

Papers published after obtaining PhD degree:

1. Lorenzo Clemente, Wojciech Czerwinski, Slawomir Lasota, and Charles Paperman, *Regular Separability of Parikh Automata*, In Proc. of ICALP, 2017.
2. Lorenzo Clemente, Wojciech Czerwinski, Slawomir Lasota, and Charles Paperman, *Separability of Reachability Sets of Vector Addition Systems*, In Proc. of ICALP, 2017.
3. Lorenzo Clemente, Pawel Parys, Sylvain Salvati, and Igor Walukiewicz, *The Diagonal Problem for Higher-Order Recursion Schemes is Decidable*, In Proc. of LICS, 2016.
4. Lorenzo Clemente, Pawel Parys, Sylvain Salvati, and Igor Walukiewicz, *Ordered Tree-Pushdown Systems*, In Proc. of FSTTCS, 2015.
5. Lorenzo Clemente and Jean-François Raskin, *Multidimensional beyond Worst-Case and Almost-Sure Problems for Mean-Payoff Objectives*, In Proc. of LICS, 2015.
6. Lorenzo Clemente and Richard Mayr, *Advanced automata minimization*, In Proc. of POPL, 2013.
7. Parosh Aziz Abdulla, Lorenzo Clemente, Richard Mayr, and Sven Sandberg, *Stochastic Parity Games on Lossy Channel Systems*, In Proc. of QEST, 2013.

Papers published before obtaining PhD degree:

1. Parosh Aziz Abdulla, Yu-Fang Chen, Lorenzo Clemente, Lukás Holík, Chih-Duo Hong, Richard Mayr, and Tomás Vojnar, *Advanced Ramsey-Based Büchi Automata Inclusion Testing*, In Proc. of CONCUR, 2011.
2. Lorenzo Clemente, *Büchi Automata Can Have Smaller Quotients*, In Proc. of ICALP, 2011.
3. Parosh Aziz Abdulla, Yu-Fang Chen, Lorenzo Clemente, Lukás Holík, Chih-Duo Hong, Richard Mayr, and Tomás Vojnar, *Simulation Subsumption in Ramsey-Based Büchi Automata Universality and Inclusion Testing*, In Proc. of CAV, 2010.
4. Lorenzo Clemente and Richard Mayr, *Multipebble Simulations for Alternating Automata - (Extended Abstract)*, In Proc. of CONCUR, 2010.

D) Collective publications, collection catalogs, documentation of research, technical opinions, songs and works of art

- Lukás Holík, Lorenzo Clemente (Eds.). *Proceedings 15th International Workshop on Verification of Infinite-State Systems, INFINITY 2013, Hanoi, Vietnam, 14th October 2013,* Electronic Proceedings in Theoretical Computer Science (EPTCS) 140, 2014.

  Editorship of conference proceedings.

- Romain Brenguier, Lorenzo Clemente, Paul Hunter, Guillermo A. Pérez, Mickael Randour, Jean-François Raskin, Ocan Sankur, and Mathieu Sassolas, *Non-Zero Sum Games for Reactive Synthesis.*, In Proc. of LATA, 2016.

  This is a survey article for LATA'16 about our previous work on stochastic games.

E) Total impact factor based on the Journal Citation Report (JCR) according to the year of publication

0.865

Based on the following figures: Logical Methods In Computer Science 2017, IF 0.508 (later data not available); Logical Methods In Computer Science 2014, IF 0.357.

F) Number of citations according to Web of Science (WoS)

46 (with self-citations: 52)

Google Scholar: 285(with self-citations), Arnetminer 90 (with self-citations), Scopus: 150 (with self-citations).

G) Hirsch Index according to Web of Science (WoS)

5

Google Scholar: 11, Arnetminer: 4, Scopus: 8.

H) Managing and participation in international and national research projects

Managing research projects:

1. *Understanding recursion* (*Zrozumieć rekursję*), 04/2018–04/2021, grant 2017/26/D/ST6/00201 from the National Science Center (Narodowe Centrum Nauki, Polska).

Participation in research projects:

1. *Symbolic computations on first-order definable objects* (*Obliczenia symboliczne na obiektach definiowalnych w logice pierwszego rzędu*), 02/2017–02/2020, grant 2016/21/B/ST6/01505 from the National Science Center (Narodowe Centrum Nauki, Polska).

2. *The separability problem in automata theory* (*Problem separacji w teorii automatów*), 02/2017–02/2019, grant 2016/21/D/ST6/01376 from the National Science Center (Narodowe Centrum Nauki, Polska).

3. *Limits of automatic verification: New methods for the analysis of infinite-state systems* (*Granice automatycznej weryfikacji: nowe metody analizy systemów nieskończenie stanowych*), 03/2014–03/2017, grant 2013/09/B/ST6/01575 from the National Science Center (Narodowe Centrum Nauki, Polska).

4. *Limits of decidability in automata theory* (*Granice rozstrzygalności w teorii automatów*), 07/2013–07/2016, grant 2012/07/D/ST6/02443 from the National Science Center (Narodowe Centrum Nauki, Polska).

5. *Validation of the control of critical systems by coupling simulation and formal methods* (*Validation de la commande des systèmes critiques par couplage simulation et méthodes d'analyse formelle (VACSIM)*), 10/2011–03/2015, grant ANR-11-INSE-004 from the National Research Agency (Agence nationale de la recherche, France).

6. *inVEST: Foundations for a Shift from Verification to Synthesis*, 01/2012–09/2017, grant ERC 279499 from the European Research Council (ERC).

I) International and national awards for achievements in science or art

International awards: None.

National awards::

- Award "Sebastiano e Rita Raeli" for the 300 best laurates of Università di Roma "Tor Vergata" (Italy) in the year 2008.

J) Presentations at international conferences

- ICALP 2018: 45th International Colloquium on Automata, Languages, and Programming, July 9–13 2018, Prague (Czech Republic); *Binary reachability of timed pushdown automata via quantifier elimination.*
- HIGHLIGHTS 2018: Highlights of Logic, Games, and Automata, September 18–21 2018, Berlin (Germany); *Ternary reachability of timed pushdown automata via quantifier elimination and cyclic order atoms.*
- INFINITY 2018: 20th International Workshop on Verification of Infinite-State Systems, July 9 2018, Prague (Czech Republic); *Decidability of Timed Communicating Automata.*
- HIGHLIGHTS 2017: Highlights of Logic, Games, and Automata, September 12–15 2017, London (United Kingdom); *Regular separability of Parikh automata languages.*
- LICS 2016: 31th Annual ACM/IEEE Symposium on Logic in Computer Science, July 9–10 2016, New York (United States of America); *The Diagonal Problem for Higher-Order Recursion Schemes is Decidable.*
- FSTTCS 2015: 35th IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science, December 16–18 2015, Bengaluru (India); *Ordered Tree-Pushdown Systems.*
- HIGHLIGHTS 2015: Highlights of Logic, Games, and Automata, September 15–18 2015, Prague (Czech Republic); *Reachability analysis of first-order definable pushdown systems.*
- CSL 2015: 24th EACSL Annual Conference on Computer Science Logic, September 7–10 2015, Berlin (Germany); *Reachability analysis of first-order definable pushdown systems.*
- LICS 2015: 30th ACM/IEEE Symposium on Logic in Computer Science, July 6–10 2015, Kyoto (Japan); *Multidimensional beyond worst-case and almost-sure problems for mean-payoff objectives.*
- CONCUR 2014: 25th International Conference on Concurrency Theory, September 1–6 2014, Rome (Italy)); *Decidable Topologies for Communicating Automata with FIFO and Bag Channels.*
- FOSSACS 2013: 16th International Conference on Foundations of Software Science and Computation Structures, March 16–24 2013, Rome (Italy); *Reachability of communicating timed processes.*
- GAMES 2011: Annual Workshop of the ESF Networking Programme on Games for Design and Verification, September 2011, Paris (France); *Efficient algebraic approaches to Büchi automata inclusion checking.*
- CONCUR 2011: 22nd International Conference on Concurrency Theory, September 6–9 2011, Aachen (Germany); *Advanced Ramsey-based Büchi automata inclusion test.*
- ICALP 2011: 38th International Colloquium on Automata, Languages and Programming, July 4–8, Zürich (Switzerland); *Büchi Automata Can Have Smaller Quotients.*
- CONCUR 2010: 21st International Conference on Concurrency Theory, August 31–September 3 2010, Paris (France); *Multipebble simulations preorders for alternating Büchi automata.*
- GAMES 2009: Annual Workshop of the ESF Networking Programme on Games for Design and Verification, September 14–17 2009, Udine (Italy); *Multipebble simulation games for alternating automata.*

III. Achievements in education and science dissemination, and international cooperation

A) Participation in European and other international and national programmes

None.

B) Participation in international and national scientific conferences

Only participation without presentation (participation with presentation is listed in item II.J):

- ICALP 2017: 44th International Colloquium on Automata, Languages, and Programming, July 10–14 2017, Warsaw (Poland); presentation of the joint paper *Regular Separability of Parikh Automata* given by a co-author.
- LICS 2017: 32nd Annual ACM/IEEE Symposium on Logic in Computer Science, June 20–23 2017, Reykjavik (Iceland); presentation of the joint paper *Timed pushdown automata and branching vector addition systems* given by a co-author.
- LICS 2015: 30th ACM/IEEE Symposium on Logic in Computer Science, July 6–10 2015, Kyoto (Japan); presentation of the joint paper *Timed Pushdown Automata Revisited* given by a co-author.
- POPL 2013: 40th ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages, January 23–25 2013, Rome (Italy); presentation of the joint paper *Advanced automata minimization* given by a co-author.
- CAV 2010: 22nd International Conference on Computer Aided Verification, July 15–19 2010, Edinburgh (United Kingdom); presentation of the joint paper *Simulation Subsumption in Ramsey-Based Büchi Automata Universality and Inclusion Testing* given by a co-author.

C) Membership in international and national conference's organizing committees

Programme committees of international conferences:

- HIGHLIGHTS 2018: Highlights of Logic, Games, and Automata, September 18–21 2018, Berlin (Germany).
- INFINITY 2013: 15th International Workshop on Verification of Infinite-State Systems, October 14 2013, Hanoi (Vietnam); co-chair of the PC.

Organizing committees:

- INFINITY 2013: 15th International Workshop on Verification of Infinite-State Systems, October 14 2013, Hanoi (Vietnam); co-chair of the organisign committee.

D) Other awards and honours (not listed in item II.I)

None.

E) Participation in consortia and research networks

None.

F) Managing projects carried out in collaboration with researchers from other Polish and foreign institutions, and in cooperation with entrepreneurs, other than those mentioned in item II.H

None.

G) Editorial committees and research councils

None.

H) Membership in international and national organizations and scientific societies

None.

I) Achievements in education and science dissemination

Tutorials/problem sessions in courses taught at the University of Warsaw:

- Tutorials/problem sessions:
  - Languages, Automata, and Computation 2018/19.
  - Formal Semantics of Programming Languages 2016/17–2018/19.
  - Probability and Statistics 2016/17–2017/18.
  - Algorithmic Game Theory 2017/18.
  - Computational Complexity 2017/18.
  - Logic for computer scientists 2015/16–2016/17.
  - Concurrent and Distributed Programming 2016/17.
- Lab classes:
  - Logic for computer scientists 2017/18–2018/19.
  - Programming Languages and Paradigms 2016/17–2017/18.
  - Concurrent and Distributed Programming 2016/17.
  - Probability and Statistics 2016/17–2018/19.

Other courses taught:

- Logique et Preuve (demonstrator), ENSEIRB, Université de Bordeaux I, France, 2011/12.
- Functional Programming (demonstrator), School of Informatics, University of Edinburgh, UK, 2008/09–2010/11.
- Computability and Intractability (demonstrator), School of Informatics, University of Edinburgh, UK, 2009/10.

J) MSc supervision and tutorship

I supervised the following MSc theses at the University of Warsaw:

- Stanisław Purgał, *Learning regular languages online from a positive sample*, 09/2018.

K) PhD supervision and tutorship

None.

L) Postdoctoral positions and visiting fellowships at universities and research institutions abroad

- University of Warsaw, Poland; post-doc, 2 years, 07/2014–06/2016.
- Libre Université de Bruxelles (ULB), Belgium; post-doc, 7 months, 12/2013–07/2014.
- Université de Bordeaux, LaBRI, France; post-doc, 2 years, 12/2011–11/2013.

M) Technical opinions and other commissioned work

None.

N) Participation in groups of experts and juries

None.

O) Reviewing international and national projects

None.

P) Reviewing scientific articles

Reviewing for journals:

- Logical Methods in Computer Science (LMCS) 2013, 2014, 2017, 2018.
- Theoretical Computer Science (TCS) 2012.
- Fundamenta Informaticae 2018.
- Acta Informatica 2013.
- Information Processing Letters (IPL) 2012.
- International Journal on Software Tools for Technology Transfer (STTT) 2017

Reviewing for conferences:

- FORMATS 2009;
- LICS 2011, 2015, 2017, 2018, 2019;
- TACAS 2011, 2017;
- FSTTCS 2012, 2016;
- ICALP 2012, 2014, 2015, 2016, 2017, 2018;
- INFINITY 2013;
- STACS 2013, 2015, 2016, 2017;
- AAAI 2014;
- CAV 2014;
- CSR 2014, 2015;
- FOSSACS 2014, 2015;
- LATA 2014, 2016 (special issue);
- DLT 2015;
- RP 2015;
- CONCUR 2016, 2017;
- MFCS 2017, 2018;
- CSL 2018;
- ESOP 2018;
- HIGHLIGHTS 2018.

Q) Other achievements, not listed in Sections III.A - III.P

None.