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Personal information

Nationality: Portuguese

Gender: Male

Birth year: 1988

Position

I am currently an auxiliar professor at University of Minho. Previously I was a postdoctoral researcher at University College London, a postdoctoral researcher at INESC-TEC, and an invited teaching assistant at University of Minho.

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1 Education

PhD in Computer Science, Minho, Aveiro, and Porto Universities (MAP-i), **June 2018**. The jury awarded the maximum grade for the “*innovative nature and high scientific value*” of the thesis which “*covers a wide range of sophisticated topics*” and also for the “*exceptional performance*” at the thesis defence.¹

MSc in Informatics Engineering, Minho University, September 2013, final grade 18 (0-20).

Specialisations:

Software Design and Analysis, collaboration with **Delloite**.

Formal Methods in Software Engineering, collaboration with **MIT - CSAIL**.

Dissertation:

Proof support for hybridised logics, final grade 19 (0-20).

2 Research Interests

Cyber-physical systems: I am currently working on the development of languages, calculi, semantics, and tools for these devices. In this mission, and with several collaborators, I employed (and contributed to) different topics that intersect computer science, analysis, and control theory. Namely,

1. program semantics;
2. automata theory and coalgebra;
3. modal and dynamic logic;
4. category theory, in particular monads, locally presentable categories, and duality theory;
5. topology.

I got increasingly inspired by these four topics during the years. Currently, I investigate them not just for their powerful applications to the cyber-physical domain but also for their own theoretical interest.

Quantum computing: In 2018, I started working on languages and semantics for quantum computing. Note that the few quantum, compositional languages that possess a formal semantics assume an ideal quantum computer, which even though reasonable in the classical case is too strong for quantum computers in the foreseeable future. Me and collaborators are on working on formal foundations for quantum programming languages that do not make this assumption. More specifically, our goal is to provide semantics and both static and dynamic analysis techniques for quantum programs to avoid and optimise against quantum decoherence. Such a goal actually smoothly connects with my research interests on cyber-physical systems: in both cases we need to take into account some form of timing constraint, approximate behaviour, and corresponding syntax/semantics.

¹The excerpts were extracted from the proceedings of the thesis defence, which can be checked at the link <http://alfa.di.uminho.pt/~nevrenato/pdfs/proceedings.pdf>.

3 Publications

Journals

1. Dirk Hofmann, Renato Neves, and Pedro Nora.
Limits in Categories of Vietoris Coalgebras. *Mathematical Structures in Computer Science* Volume 29, 2019.
2. Renato Neves and Luís Soares Barbosa.
Languages and models for hybrid automata: A coalgebraic perspective. *Theoretical Computer Science.* Volume 744, 2018.
3. Dirk Hofmann, Renato Neves, and Pedro Nora.
Generating the algebraic theory of $C(X)$: the case of partially ordered compact spaces. *Theory and Applications of Categories*, 2018.
4. Renato Neves, Luís Barbosa, Dirk Hofmann and Manuel A. Martins.
Continuity as a computational effect. *Journal of Logic and Algebraic Methods in Programming.* Volume 85, number 5, 2016.
5. Renato Neves, Alexandre Madeira, Manuel A. Martins and Luís Barbosa.
Proof theory for hybrid(ised) logics. *Science of Computer Programming.* Volume 126, 2016.
6. Alexandre Madeira, Renato Neves and Manuel A. Martins.
An exercise on the generation of many-valued logics. *Journal of Logic and Algebraic Methods in Programming.* Volume 85, number 5, 2016.
7. Alexandre Madeira, Renato Neves, Luís Barbosa and Manuel A. Martins.
A method for rigorous design of reconfigurable systems. *Science of computer programming* Volume 132, 2016. **Note:** This article reports the design of an undergraduate course on formal software specification based on logic.
8. Luís Soares Barbosa, Manuel A. Martins, Alexandre Madeira, and Renato Neves.
Reuse and Integration of Specification Logics: The Hybridisation Perspective. *Theoretical Information Reuse and Integration.* Volume 446, 2016.

Conferences, workshops, and book chapters

1. Sergey Goncharov, Renato Neves, and José Proença.
Implementing hybrid semantics: from functional to imperative. *17th International Colloquium on Theoretical Aspects of Computing, ICTAC 2020.* **Note:** Online tool available in <http://arcatools.org/assets/lince.html#fulllince>.
2. Sergey Goncharov and Renato Neves.
An adequate while-language for hybrid computation. *21st International Symposium on Principles and Practice of Declarative Programming, PPDP 2019.*
3. Sergey Goncharov, Julian Jakob, and Renato Neves.
A semantics for hybrid iteration. *29th International Conference on Concurrency Theory, CONCUR 2018.*

4. Alexandre Madeira, Renato Neves, Manuel A. Martins, and Luís Barbosa.
Hierarchical hybrid logic. *12th Workshop on Logical and Semantic Frameworks with Applications, LSFA 2017.*
5. Renato Neves and Luís Barbosa.
Hybrid automata as coalgebras. *13th International Colloquium on Theoretical Aspects of Computing, ICTAC 2016.*
6. Renato Neves, Alexandre Madeira, Luís Soares Barbosa, and Manuel A. Martins.
Asymmetric combination of logics is functorial: A survey. *23rd IFIP WG 1.3 International Workshop on Recent Trends in Algebraic Development Techniques, WADT 2016.*
7. Alexandre Madeira, Renato Neves, Manuel A. Martins, and Luís Barbosa.
A logic for robotics? *12th International Conference of Numerical Analysis and Applied Mathematics, ICNAAM 2015.*
8. Renato Neves.
On a monadic encoding of continuous behaviour. *Student Track of the 15th International Conference on Relational and Algebraic Methods in Computer Science, 2015.*
9. Alexandre Madeira, Renato Neves, Manuel A. Martins and Luis S. Barbosa.
A dynamic logic for every season. *17th Brazilian Symposium on Formal Methods: Foundations and Applications, SBMF 2014.*
10. Manuel A. Martins, Alexandre Madeira, Luis S. Barbosa and Renato Neves.
Paradigm integration in a specification course. *15th IEEE International conference on information reuse and integration, IRI 2014.*
11. Renato Neves, Luis S. Barbosa, Alexandre Madeira, and Manuel A. Martins.
An institution for Alloy and its translation to second-order logic. *Integration of Reusable Systems – volume 263 of Advances in Intelligent Systems and Computing, 2014.*
12. Renato Neves, Manuel A. Martins and Luis S. Barbosa.
Completeness and decidability results for hybrid(ised) logics. *17th Brazilian Symposium on Formal Methods: Foundations and Applications, SBMF 2014.*
13. Alexandre Madeira, Renato Neves, Manuel A. Martins, and Luis S. Barbosa.
When even the interface evolves. *7th International Symposium on Theoretical Aspects of Software Engineering, TASE 2013.*
14. Renato Neves, Alexandre Madeira, Manuel A. Martins, and Luis S. Barbosa.
Hybridisation at work. *5th International Conference on Algebra and Coalgebra in Computer Science, CALCO 2013.*
15. Renato Neves, Luis S. Barbosa, Alexandre Madeira, and Manuel A. Martins.
Giving Alloy a family. *14th IEEE International conference on information reuse and integration, IRI 2013.*

Abstracts

1. Liu Ai, Renato Neves, Luis Barbosa, and Sun Meng.
Effectful components and program equivalence. *25th International Workshop on Algebraic Development Techniques, WADT 2020.*
2. Vítor Fernandes, Renato Neves, and Luis Barbosa.
A type system for simple quantum processes. *26th International Conference on Types for Proofs and Programs, TYPES 2020.*
3. Renato Neves.
Logics and calculi for cyber-physical components. *5th International Conference on Algebra and Coalgebra in Computer Science, CALCO 2015.*
4. Alexandre Madeira, Renato Neves, Manuel Martins, and Luis Barbosa
Introducing hierarchical hybrid logic. *Advances in Modal Logic 2014, AIML 2015.*

Software packages

1. **Lince** - Analysis of hybrid programs using simulation and estimation of approximation errors caused by small perturbations. The tool is available at <http://arcatools.org/assets/lince.html#fulllince>. The curricula of the recent ‘Cyber-Physical Computation’ course@MieFis,UM integrates this tool as well as the tools **Uppaal** and **dReach**.
2. **Hybrid Hets** - A software package that extends logics implemented in **Hets** into hybridised logics with the typical capabilities of hybrid logics. This package was later integrated into the main tool **Hets**, which is quite well-known in the system modelling/theorem proving community. The main tool is available at <http://hets.eu/>.

4 Research Projects

Project proposals

I am a coauthor of the following successful research project proposals:

1. **Ibex - Quantitative methods for cyber-physical programming** (PI), 2021. Accepted for funding (249k euros) by the Portuguese Foundation of Science and Technology (FCT).
2. **Quantitative Algebraic Reasoning of Hybrid Programs** (co-I), 2020. Accepted for funding (77542 GBP) by the Research Institute in Verified Trustworthy Software Systems (VeTSS), hosted at Imperial College.
3. **Klee - Coalgebraic Modeling and Analysis for Computational Synthetic Biology** (co-I), 2018. Accepted for funding (238171 euros) by the Portuguese Foundation of Science and Technology (FCT).

Project participation

I am/was a member of the following research projects:

1. Ibex – Quantitative methods for cyber-physical programming (hosted at INESC-TEC and CISTER-ISEP) January 2022 - December 2024.
2. Quantitative Algebraic Reasoning of Hybrid Programs (hosted at UCL) October 2020 - March 2021.
3. DaVinci – Distributed Architectures: Variability and Interaction for Cyber-Physical Systems (hosted at INESC-TEC & CISTER-ISEP), 2018 - 2021. Industrial partnership with the Belgian company *Altreonic*, specialised in the development of vehicular systems.
4. Klee – Coalgebraic Modeling and Analysis for Computational Synthetic Biology (hosted at INESC-TEC & University of Aveiro), 2018 - 2021. Industrial partnership with *Silicolife*, a Portuguese company specialised in industrial biotechnology.
5. Dalí – Dynamic logics for cyber-physical systems: towards contract based design (hosted at INESC-TEC & University of Aveiro) 2016 - 2020.
6. Trust – Trustworthy Software Design with Alloy (hosted at INESC-TEC) 2016 - 2020.
7. PT-FLAD Chair in Smart Cities & Smart Governance (hosted at University of Minho), 2016 - 2018. *PT* is one of the main telecommunication companies working in Portugal.
8. Nasoni – Heterogeneous software coordination: Foundations, methods and tools (hosted at INESC-TEC & University of Aveiro), 2013 - 2016.
9. Mondrian – Foundations for architectural design: Service certification, dynamic reconfiguration and self-adaptability (hosted at INESC-TEC & University of Aveiro), 2010 - 2013.

5 Teaching Activities

Courses taught

I taught different courses at all levels of higher education:

1. **Quantum computing**, MAP-i programme (**coordinator**, PhD) – 2020/2021
2. **Cyber-Physical computation**, MAP-i programme (**coordinator**, PhD) – 2019/2020
3. **Architecture and Calculi**, University of Minho (**coordinator**, MSc) – 2019/2020, 2020/2021.
4. **Quantum Logic**, University of Minho (MSc) – 2019/2020, 2020/2021
5. **Program calculus**, University of Minho (BSc) – 2014/2015, 2016/2017, 2018/2019, 2019/2020
6. **Laboratórios de Informática 1**, University of Minho (BSc) – 2014/2015, 2019/2020 ²
7. **Introduction to Programming**, Singesco Instruction Center (equivalent to High school) – 2010/2011
8. **Introduction to Databases**, Singesco Instruction Center (equivalent to High school) – 2010/2011

²The address <https://haslab.github.io/Teaching/LI1/> presents a selection of the student's projects.

Course proposals and restructuring of master degrees

In 2019 I designed and proposed a course on ‘Cyber-Physical Computation’ in the context of the MAP-i doctoral programme with a teaching team including members of the University of Minho and University of Aveiro. The proposal was accepted for that academic year and was attended by students with different backgrounds (Physics and Informatics).

Due to my growing interest in quantum computing, in 2020 I also proposed a course precisely on ‘Quantum Computing’ in the context of the MAP-i doctoral programme with a team comprised of specialists on quantum-error correction codes, quantum λ -calculus, computability & complexity, and logic. The team also included members of University of Minho and University of Aveiro (the MAP-i doctoral programme expects the lecturing team to be inter-university). The proposal was accepted for the academic year of 2020/2021; the course is currently running.

In 2019 I was invited by the pedagogical committee to participate in the restructuring of the degree “Mestrado Integrado em Engenharia Física” (Masters in Physics Engineering) at University of Minho. Specifically, I participated in the coordination of the courses in the degree that intersect programming languages, quantum, and cyber-physical computing. On top of that, I designed a new course (‘Cyber-physical computation’) for the degree.

(Co)supervisions

1. (PostDoc) Pedro Nora, October 2019
Topic: Theoretical aspects of Quantitative semantics and its relation to Coalgebra.
2. (PhD) Liu Ai, May 2020
Topic: Quantum-based transition systems & component-based programming.
3. (PhD) Vítor Fernandes, in progress
Topic: Timing Constraints in Quantum Programming Languages (in collaboration with Benoît Valiron).
4. (MSc) Eduardo Barbosa, in progress
Topic: Component-based programming: implementation of a component-based λ -calculus in Agda.
5. (MSc) Paulo Ribeiro, in progress
Topic: Implementation of a Kleene-like theorem for hybrid automata.
6. (MSc) Vítor Fernandes, December 2019
Topic: Typing systems and timing constraints for quantum processes.
7. (MSc) Tiago Loureiro, February 2017.
Topic: A framework for architectural design and simulation of hybrid systems.
8. (Visiting researcher) Liu Ai, December 2018.
Topic: Literature revision on quantum automata and coalgebras for quantum systems.
9. (BSc. research grant) Rita Vale, March 2018.
Topic: Implementation of a basic hybrid programming language.

6 Grants Awarded

1. Research grant, Minho University, February 2018 - July 2018.
Project: PT-FLAD University of Minho Chair.
2. Accomodation grant to attend Topdrim School on Topology, Camerino, Italy, July 2015.
3. PhD grant awarded by the Portuguese Science and Tech. Foundation based on past curricular and scientific achievements, January 2014 - December 2017.
4. Research grant, Minho University & INESC TEC, August 2013 - December 2013.
Project: Heterogenous software coordination: Foundations, methods, tools.
NASONI (FCT), contract FCOMP-01-0124-FEDER-028923.
5. Research grant, Aveiro University & CIDMA, September 2012 - May 2013.
Project: Tool support for the hybridisation method.
MONDRIAN (FCT), contract PTDC/EIA-CCO/108302/2008.
6. Research grant, Minho University- INESC TEC, January 2012 - July 2012.
Project : Proof support for hybrid logics
MONDRIAN (FCT), contract PTDC/EIA-CCO/108302/2008.

Please see Section 4 for information about project grants.

7 Academic Service

I reviewed submissions to the following conferences and journals: FACS 2021, FM 2021, ICTAC 2021, TASE 2021, FORTE 2021, FoSSacS 2020, Formalise 2020, JLAMP 2020, CONCUR 2020, TOCL 2020, FoSSacS 2019, FSCD 2019, MFCS 2019, iFM'19, SEFM 2018, AiML 2018, JLAMP 2018, TASE 2017, SETTA 2015, SBLP 2014, SBLP 2013. I was a PC member of the following conferences/workshops:

1. Eighth International Conference on eDemocracy & eGovernment (ICEDEG), 2021.
2. Third IFIP International Conference on Topics in Theoretical Computer Science (TTCS), 2020.
3. 3rd DaLí Workshop - Dynamic Logic: new trends and applications, 2020.
4. 9th International Workshop on Open Community approaches to Education, Research and Technology, 2019.
5. EAI International Conference on Smart Governance for Sustainable Smart Cities, 2019.
6. Seventh International Conference on eDemocracy & eGovernment, 2019.
7. 2nd DaLí Workshop - Dynamic Logic: new trends and applications, 2019.
8. International Symposium on Molecular Logic and Computational Synthetic Biology, 2018.

In 2020, I was a member of the organisation committee of a Workshop in the UNESCO World Logic Day, which happened in 2021.

In 2019, I was a publicist for the 3rd World Congress on Formal Methods (<http://formalmethods2019.inesctec.pt/>) (\simeq 600 participants). In 2019, I also coorganised a 4-hour seminar on quantum λ -calculus for our research group and students in ‘Quantum logic 2019-2020’. The lecturer was Benoît Valiron, one of the main contributors to quantum λ -calculus.

In 2017, I coorganised an international school on Probabilistic programming (<http://probprogschool2017.di.uminho.pt>) (\simeq 90 participants).

In 2014, I coorganised a ‘MAP-i Spring school on logic of dynamical systems’. The classes were given by a team from Carnegie Mellon University.

8 Schools and Professional Valorisation

Some of the schools and courses I took to improve my professional skills include,

1. IBM-QuantaLab Quantum Computing, October 2018.
2. Summer school on Topology driven methods for complex systems, Camerino, July 2015.
3. Winter school on Logics for Dynamical Systems, Lyon, January 2014.
4. Summer school on Cyber Physical Systems (CPS), Grenoble, July 2013.
5. Midlands graduate school (Mathematical Foundations of Computing Science), Leicester, April 2013.
6. Course on Lecturing, Bee consulting, July 2010, Maximum grade.

9 Invited Talks

Some of my invited talks include,

1. A semantics for hybrid iteration, *Open Problems in Concurrency Theory* (international research seminar), 2019.
2. When differential equations and programming constructs meet each other: a monadic approach (national seminar on topology), 2018.
3. A uniform theory of hybrid automata, *Friedrich-Alexander University* (L. Schröder’s research group), 2018.
4. Compositional Semantics For New Paradigms, *Peking University*, (S. Meng’s research group), 2018.
5. Towards a Coalgebraic Calculus for Hybrid Components. *Coalgebra in the Netherlands seminar* (COIN) 2015, Radboud University Nijmegen.
6. Towards a Coalgebraic Calculus for Hybrid Components, *Tokyo University*, (I. Hasuo’s research group), 2015.
7. Hybridise to specify. Course on *Formal Methods for Software Engineering*, 2014 (a four hour lecture).
8. Logical reasoning of molecular behaviors, *Workshop on Molecular Logic*, 2014.

10 Academic Visits

Some of my academic visits include,

Tarmo Uustalu, Tallinn University. One week (September 2018), and one week (December 2019). Both visits were financed by T. Uustalu.

Sergey Goncharov, Friedrich-Alexander University. One month (November 2018).

Marcello Bonsangue, CWI & Leiden University. Two weeks (May 2015).

Ichiro Hasuo, NII. Two weeks (September 2015).

11 Collaborations

Some of my collaborations include,

Benoît Valiron (Université Paris-Saclay), on integrating timing constraints into quantum programming.

Dirk Hofmann (University of Aveiro), on developing Coalgebra in the setting of topological categories.

Sergey Goncharov (Friedrich-Alexander University), on advancing hybrid semantics.

Fredrik Dahlqvist (University College London), on developing quantitative semantics and corresponding calculi.

Tarmo Uustalu (University of Reykjavik), on providing refined typing systems for hybrid programming.

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