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1. Scientific and professional profile and career

My academic career has been developed in Computer Science, at the intersection of Software Engineering, Formal Methods, and Human–Computer Interaction. I am currently an Associate Professor with Habilitation at the University of Minho and a Research Coordinator at INESC TEC's High Assurance Software Laboratory, where I lead research on the engineering of safe, reliable interactive systems.

My research centres on the design, analysis, and verification of interactive systems, with particular emphasis on safety and usability in critical domains such as aerospace and medical device software. A defining aspect of this work has been the integration of formal, model-based approaches with real-world application, resulting in contributions to the modelling, verification, and testing of interactive systems. These contributions are grounded in the development of tools such as the IVY workbench, which supports the formal analysis of user interface behaviour in safety-critical settings.

Over time, this agenda has evolved to address the tension between rigorous system analysis and user-centred design. I have explored the use of prototypes as a means of grounding formal models in concrete, user-accessible representations, facilitating the validation of design assumptions. More recently, I have been investigating how AI can support the analysis of safety-critical systems, in particular, how large language models can help interpret and communicate formal verification results, such as counterexamples, making these techniques more accessible to practitioners without deep formal methods expertise.

My publication record spans international journals and conferences in both Software Engineering and Human–Computer Interaction, including IEEE Transactions on Software Engineering, ACM Transactions on Computer-Human Interaction, IEEE Transactions on Human-Machine Systems, and leading venues such as EICS and INTERACT. This is complemented by editorial roles, sustained involvement in program

2. Contributions to science and society

2.a. Contributions to the generation of new ideas, tools, methodologies or knowledge

My research sits at the intersection of Software Engineering and Human-Computer Interaction, focusing on how formal, model-based approaches can be effectively applied to interactive systems, domains where usability and user-centred concerns are as central as correctness and safety. A recurring theme has been ensuring that the rigour these approaches bring does not come at the cost of practical applicability.

A central methodological contribution has been the development of frameworks that combine model-based development, formal verification, and user-centred evaluation. These frameworks enable the systematic analysis of interactive behaviour, supporting the identification of usability and safety issues early in the design process. A key insight underlying this work is that formal models of user interfaces need not be confined to verification specialists. With appropriate tooling and representations, they can serve as shared artefacts bridging developers, designers, and safety engineers.

One concrete realisation of this vision is the IVY workbench, a tool environment supporting the formal specification and verification of user interface behaviour. IVY enables the expression of interaction properties as verifiable requirements and provides automated analysis capabilities targeted at safety-critical contexts. Its application to real systems, including space system interfaces and infusion pump interfaces, has demonstrated both the feasibility and the practical value of formal UI verification in industrial settings.

A further methodological contribution has been the development of template-based approaches to formal verification of interactive systems. Verification templates provide reusable, domain-specific abstractions that encapsulate common safety and usability properties, making formal reasoning more accessible to engineers without deep expertise in formal methods. This approach lowers the barrier to adoption while preserving the rigour of the underlying analysis.

Complementary work has explored the role of prototyping in formal development processes. Rather than treating prototypes and formal models as separate artefacts, I have investigated how prototypes can serve as executable representations of formal models, enabling system behaviour and design assumptions to be explored and validated in a more concrete, user-accessible way. This line of work has contributed to bridging the gap between specification and validation in interactive system development.

More recently, I have been investigating the role of artificial intelligence , in particular, large language models, in making formal verification more accessible. Counterexamples produced by model checkers are often difficult to interpret, limiting their usefulness to non-specialist engineers. My current work explores how LLMs can be used to automatically generate natural language explanations of counterexamples, supporting their interpretation in the context of specific application domains such as medical devices, and thereby making formal analysis results more actionable in practice.

2.b. Contributions to the training and career development of researchers and/or research teams

My contribution to the development of individuals and research teams spans postgraduate supervision, collaborative research, and active engagement in international research communities.

In terms of supervision, I have (co-)supervised 6 PhD degrees, on topics at the intersection of formal methods, software engineering, and human-computer interaction, including reverse engineering of graphical user interfaces, agile prototyping of ambient intelligence systems, and, more recently, the use of generative AI to support the interpretation of model checking results. A further PhD student is currently under supervision. At Master's level, I have supervised or co-supervised 53 dissertations since 2005, primarily in the MSc in Informatics Engineering at the University of Minho, with 5 currently ongoing. These supervisions have resulted in co-authored publications in international venues and in the professional placement of students in industry and research institutions.

My contributions to research team development have been shaped by long-standing international collaborations, most notably with Michael D. Harrison (Emeritus Professor, Newcastle University), with whom I have co-supervised PhD students and co-authored numerous publications over many years. More recently, I have been developing a collaboration with the Interactive Critical Systems group at IRIT (Université de Toulouse), where I am currently a visiting researcher, and with whom I have co-authored publications in the area of safety-critical interactive systems.

Within INESC TEC's High Assurance Software Laboratory, I have contributed to the coordination of research activities, the mentoring of junior researchers, and the development of collaborative projects.

2.c. Contributions to the scientific community

My contributions to the research community span editorial activities, scientific event organisation, peer review, evaluation panels, and involvement in international scientific bodies.

On the editorial side, I have been a member of the EICS Track Editorial Board of the ACM Proceedings on Human-Computer Interaction since 2017, serving as Track Chair between 2022 and 2024. I have also served as guest editor for special issues in journals including Interacting with Computers and Computers and Graphics, and am currently co-editing a special issue of Software Tools for Technology Transfer.

In terms of scientific event organisation, I have served in leadership roles in over 20 conferences and workshops, including as General co-chair of the ACM SIGCHI Symposium on Engineering Interactive Computing Systems (EICS) in 2012 and 2017, and of the International Conference on Graphics and Interaction (ICGI) in 2024 and 2025. I have also chaired the EICS Steering Committee and participated in over 130 editions of programme committees of international conferences in Software Engineering and Human-Computer Interaction.

My peer review activity covers more than 120 manuscripts for 38 international journals, including IEEE Transactions on Software Engineering, ACM Transactions on Human-Computer Interaction, and the International Journal of Human-Computer Studies.

As a member of evaluation panels, I have assessed research proposals and researchers for funding agencies in several countries, including the FCT (Portugal), MBIE (New Zealand, 15 proposals over 8 years), ANVUR (Italy), NSERC (Canada), FWO (Belgium), and EPSRC (United Kingdom).

Through my involvement in IFIP TC13 and its working groups, in particular as Chair of WG 2.7/13.4 on User Interface Engineering, I have contributed to the coordination of an international research community and to the organisation of events and initiatives that shape the research agenda in HCI Engineering.

2.d. Contributions to society

My research is driven by a societal concern: the technology people rely on in critical situations, such as medical devices or aircraft cockpits, should be safe to use and not just functionally correct. Much of my work has gone into showing that rigorous analysis can find use-related hazards before systems reach users. Examples include the formal analysis of software components of a new dialysis machine, developed by a clinical team at the Royal Victoria Infirmary (Newcastle) who were seeking regulatory certification, and the analysis of infusion pump and avionics interfaces. My current work on using large language models to explain verification results in plain language aims to put these techniques in the hands of practitioners and safety engineers, not only formal methods specialists.

I also try to make the results of this research openly available. The IVY workbench is freely available to the community, and the HCIspecs repository (hcispecs.di.uminho.pt) provides open access to models of interactive systems, tools and related artefacts. Both can be used for teaching, replication and further development.

In higher education, as Course Director of the Licentiate in Informatics Engineering at the University of Minho, I contribute to training the engineers who will build tomorrow's software. The researchers and engineers I have supervised now take that expertise to both industry and academia: the six PhD graduates I have supervised have gone on to positions in both sectors, and over 50 of my MSc graduates have gone on to careers in industry and research.

3. Scientific production and/or selected activities

These five outputs illustrate the central dimensions of my research: the development and application of formal methods for the analysis of interactive systems, their validation in safety-critical contexts, and sustained engagement in shaping the international research community.

1. "Verification templates for the analysis of user interface software design". Harrison, Masci, and Campos. IEEE Transactions on Software Engineering, 2019.

This paper introduced a template-based approach to formal verification of user interfaces, encoding recurring user-centred safety requirements as reusable property specification templates that can be instantiated to specific devices and verified using the PVS theorem prover, reducing the effort required to apply formal verification to new interface design problems.

2. "Supporting the analysis of safety critical user interfaces: an exploration of three formal tools". Campos et al. ACM Transactions on Computer-Human Interaction, 2020.

This paper provided a systematic comparative analysis of three formal tools (CIRCUS, PVSio-web, and IVY) applied to the same safety-critical case study, a subsystem of the Airbus A380 Flight Control Unit, offering an evidence-based account of the relative strengths and limitations of each approach for the model-based analysis of critical user interfaces.

3. "Formal techniques in the safety analysis of software components of a new dialysis machine". Harrison et al. Science of Computer Programming, 2019.

This paper demonstrates the application of formal verification to a device developed by a clinical team at the Royal Victoria Infirmary (Newcastle) who were seeking regulatory certification to bring it to market. This contributes to the evidence base for the viability of formal methods in the development of safety-critical medical systems.

4. "A 'more intelligent' test case generation approach through task models manipulation". Campos et al. Proceedings of the ACM on Human-Computer Interaction (EICS track), 2017.

This paper introduces an approach to automating the generation and execution of test cases for interactive systems from task models. Mutations of the task model are used to represent deviations from prescribed procedures, targeting behaviours most likely to arise from use errors.

5. Chairing the Steering Committee of the ACM SIGCHI Symposium on Engineering Interactive Computing Systems (EICS).

As chair, I have contributed to the governance and strategic direction of the leading international venue in HCI Engineering, including overseeing the transition of its proceedings to the ACM Proceedings on Human-Computer Interaction.