

# Fernando Macías

Computer Scientist, Post-doctoral Researcher, Ph.D.

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Fernando Macías is a post-doctoral researcher in the areas of Software Engineering and Computer Science. His work includes creative thinking, study of technical publications, tool prototyping and dissemination of research.

In recent years, Fernando has earned a PhD after extensive research, including the development of the open-source tool **MultEcore** and the publication of a PhD dissertation. More recently, he is involved in transferring research results regarding formal verification to both the aerospace industry and blockchain ecosystems.

Fernando holds a PhD in Informatics from the University of Oslo, Norway, and an MSc, Major and BSc from the University of Extremadura, Spain. He has lived in three countries and speaks English, Spanish and Norwegian.

## Experience

- Post-doc Researcher**, IMDEA Software Institute, Madrid, Spain 2019–  
Research on the state of the art and state of the practice of software reliability for embedded systems, with special focus on test generation, code analysis, model-based testing and symbolic execution.
- Part-time Lecturer**, Dep. of Information Systems Eng., University of Extremadura, Spain 2019  
Teaching of the Bachelor course Concurrent and Distributed Programming (see **Teaching** below).
- R&D Engineer**, Homeria Open Solutions, Spain 2019
- Guest Researcher**, Dep. of Computer Science, Universidad Autónoma de Madrid, Spain 2017  
Research on multi-level modelling.
- PhD Research Fellow**, Dep. of Software Engineering and Computing, Western Norway 2015–2019  
University of Applied Sciences, Norway  
75% research on formal aspects of model-driven engineering. Development of **MultEcore**, a framework for multi-level modelling and multilevel model transformation founded on graph theory and category theory. 25% teaching, carrying out lab sessions and evaluating in courses at the Master level.
- Lecturer**, EITIE Plan for Innovation and Entrepreneurship, University of Extremadura, Spain 2013  
Teaching of the seminar Cloud-based Services for Software Development (see **Teaching** below).
- Research Fellow**, Quercus Software Engineering Group, University of Extremadura, Spain 2013–2015  
Research on model-based reverse engineering of legacy web applications and its modernisation into rich internet applications using model-to-model transformation and code generation, and on model transformation verification using statistical methods.

## Projects

- Offchain Tezos RV**, verification of high-level temporal properties on the Tezos blockchain 2022–  
Funded by Nomadic Labs.  
Researcher.
- MFoC**, techniques to improve the testing and verification of new-generation satellite systems 2019–2022  
Co-funded project by Comunidad de Madrid and European Regional Development Fund (ERDF).  
Main Researcher.
- MultEcore**, a tool for multilevel modelling and multilevel model transformation in EMF 2015–2019  
Funded by the Western Norway University of Applied Sciences.  
PhD Research Fellow.
- MLM Rearchitecting**, a tool for automatic rearchitecting of models into multilevel models 2017–2018
- RV+MM**, an approach to integrate runtime verification techniques into modelling processes 2016–2019
- DATASHELTER**, a system for microblog information retrieval with topic & sentiment analysis 2014–2015  
Agreement with the company Nubalia Cloud Computing, S.L. Researcher.
- MoTES**, a model transformation testing approach based in contracts 2013–2021
- MIGRARIA**, a model-driven reverse engineering & modernisation process of legacy web apps 2013–2015  
Co-funded by TIN2011-27340, GR-10129 and European Regional Development Fund (ERDF).  
Researcher.

## Management

**Web Editor**, MFoC Project and MFoC Workshop, IMDEA Software Institute, Spain 2019–  
**Student Union Member**, Polytechnic School, University of Extremadura, Spain 2013–2014

## Organisation

Organising Committee Member: MFoC Workshop 2019, NIKT 2016, European Researcher's Night 2013

Program Committee Member: MULTI 2022, MULTI 2021, MULTI 2020, MULTI 2019

Reviewer: SoSyM, EMISAJ, IEEE Access, MULTI 2022, MULTI 2021, MULTI 2020, MULTI 2019, MULTI 2018, NIKT 2016, The 13th Overture Workshop (2015)

## Education

**Philosophiae Doctor (PhD)**, Department of Informatics, University of Oslo, Norway 2019  
Subject of the dissertation: Multilevel Modelling and Domain Specific Languages.  
Supervisors: Adrian Rutle and Volker Stolz. Opponents: Thomas Kühne and Reiko Heckel.

**Master of Science (MSc)**, D. of Information Systems Eng., University of Extremadura, Spain 2014  
Advanced curriculum in computer science and software engineering. Final mark 8,467/10. Master's research thesis distinction. Subject of the dissertation: Verification of Model-to-Model Transformations using Metrics.  
Supervisor: Roberto Rodríguez Echeverría.

**Science Major**, Dep. of Information Systems Engineering, University of Extremadura, Spain 2013  
Advanced curriculum in computer science and software engineering. Final mark 8,066/10. Ten-month Erasmus scholarship in the Otto-Friedrich-Universität Bamberg, Germany. Senior research thesis distinction. Subject of the dissertation: Generating a RIA Client from a Legacy Web Application. Supervisor: Roberto Rodríguez Echeverría.

**Bachelor of Science (BSc)**, D. of Information Systems Eng., University of Extremadura, Spain 2011  
General curriculum in computer science and software engineering.

## Awards

**Distinguished Student Award** May 2015  
Polytechnic School, University of Extremadura, Spain

**Best Academic Record Award** Software Engineering Master's Degree Feb 2015  
Professional Association of Software Engineers of Extremadura, Spain

**Best Academic Record Award** Software Engineering Master's Degree Jan 2015  
University of Extremadura, Spain

**1st Prize in the category Health and Wellbeing at All Ages** H4SB Hackaton Sep 2013  
Campus Party Europe, London, United Kingdom

**Best Non-verbal Communication** Debate Team of the Polytechnic School Apr 2010  
University of Extremadura, Spain

**Educational Excellence Award** Best academic record in Extremadura to matriculate for Nov 2008  
Software Engineering  
Savings Bank of Extremadura, Spain

## Courses

**ArVi Summer School on Runtime Verification**, ArVi COST Action, Madrid, Spain Sep 2016

**Erasmus+ Training Assignment**, University of Lübeck, Lübeck, Germany May 2016

**Communicating Scientific Research**, Simula School of Research & Innovation, Oslo, Norway 2016

**Developing Android Apps**, Udacity, Online 2014

**Introduction to Model-Driven Software Development**, University of Extremadura, Spain 2013

## Teaching

**Lecturer and Lab Instructor**, Concurrent and Distributed Programming (English and Spanish) Spring 2019  
Bachelor course 501284, University of Extremadura

**Lecturer and Lab Instructor**, Advanced Software Technologies (English) Fall 2018  
Master course DAT250, Western Norway University of Applied Sciences

<b>Lecturer</b> , Modern Software Development Methods (English) Master course DAT251, Western Norway University of Applied Sciences	Spring 2018
<b>Lecturer and Lab Instructor</b> , Advanced Software Technologies (English) Master course DAT250, Western Norway University of Applied Sciences	Fall 2017
<b>Lecturer and Lab Instructor</b> , Advanced Software Technologies (English) Master course DAT250 (former MOD250), Western Norway University of Applied Sciences	Fall 2016
<b>Lecturer</b> , Modern Software Development Methods (English) Master course DAT251 (former MOD251), Western Norway University of Applied Sciences	Spring 2016
<b>Lecturer</b> , Advanced Software Technologies (English) Master course DAT250 (former MOD250), Western Norway University of Applied Sciences	Fall 2015
<b>Lecturer</b> , Cloud-based tools for Software Developers (Spanish) EITIE training courses for entrepreneurship, University of Extremadura	Fall 2013

## Supervision

Juan Francisco García Casado, Research Intern at IMDEA Software Institute.	2020–
Leif Arne R. Johnsen, Master student in Software Engineering at Western Norway University of Applied Sciences. Master's thesis at Western Norway University of Applied Sciences. Subject of the dissertation: Towards a multilevel model transformation engine.	2017
Gabor Stajer, Bachelor student in Computer Systems Networking and Telecommunications, Budapest University of Technology and Economics. IAESTE exchange student at Western Norway University of Applied Sciences.	2016
Rodrigo Vilaça, Bachelor student in Computer Engineering, University of Brasilia. IAESTE exchange student at Western Norway University of Applied Sciences.	2016

## Computer skills

Software engineering: EMF, Eclipse, Java, C/C++, Go, Bash, SQL, HTML, CSS, JavaScript, XML, JSON

System administration: GNU/Linux, Android, macOS, MySQL, Subversion, Git

Collaborative tools: Slack, Mattermost, Trello, GDocs, Overleaf

Desktop publishing: L<sup>A</sup>T<sub>E</sub>X, Beamer, TikZ, BibTeX, Biber, Emacs, Microsoft Office, LibreOffice, Inkscape, GIMP

## Languages

Mother tongue	<b>Spanish</b>									
Other languages <sup>1</sup>	<b>Understanding</b>				<b>Speaking</b>				<b>Writing</b>	
	Listening		Reading		Interaction		Production			
<b>English</b> <sup>2</sup>	C2	Fluent	C2	Fluent	C2	Fluent	C2	Fluent	C2	Fluent
<b>Norwegian (Bokmål)</b> <sup>3</sup>	A2	Basic	A2	Basic	A2	Basic	A2	Basic	A2	Basic

<sup>1</sup> Common European Framework of Reference for Languages (CEFR)

<sup>2</sup> Completed all courses at Official School of Languages in Badajoz, Spain

<sup>3</sup> Tok A1 og A2 kurs på Folkeuniversitetet i Bergen

## Publications

### Peer-reviewed journals

- [1] Multi-Level Modelling with MultEcore: A Contribution to the Multi-Level Process Challenge  
Alejandro Rodríguez, Fernando Macías  
*Enterprise Modelling and Information Systems Architectures* 17 (2022) pp. 1–40. 2022. doi: [10.18417/emisa.17.8](https://doi.org/10.18417/emisa.17.8)
- [2] Suggesting model transformation repairs for rule-based languages using a contract-based testing approach  
Roberto Rodríguez-Echeverría, Fernando Macías, Adrian Rutle, José M Conejero  
*Software and Systems Modeling* 21 (2021) pp. 81–112. Springer, 2021. doi: [10.1007/s10270-021-00891-0](https://doi.org/10.1007/s10270-021-00891-0)
- [3] Multilevel Coupled Model Transformations for Precise and Reusable Definition of Model Behaviour  
Fernando Macías, Uwe Wolter, Adrian Rutle, Francisco Durán, Roberto Rodríguez-Echeverría

*Journal of Logical and Algebraic Methods in Programming* 106 (Aug. 2019) pp. 167–195. Elsevier, 2019. doi: [10.1016/j.jlamp.2018.12.005](https://doi.org/10.1016/j.jlamp.2018.12.005)

- [4] An Approach to Flexible Multilevel Modelling  
Fernando Macías, Adrian Rutle, Volker Stolz, Roberto Rodríguez-Echeverría, Uwe Wolter  
*Enterprise Modelling and Information Systems Architectures* 13 (2018) 10:1–10:35. 2018. doi: [10.18417/emisa.13.10](https://doi.org/10.18417/emisa.13.10)
- [5] Legacy Web Application Modernization by Generating a REST Service Layer  
Roberto Rodríguez-Echeverría, Fernando Macías, Victor M. Pavón, José M. Conejero, Fernando Sánchez-Figueroa  
*IEEE Latin America Transactions* 13 (July 2015) pp. 2379–2383. 2015. doi: [10.1109/TLA.2015.7273801](https://doi.org/10.1109/TLA.2015.7273801)

## Peer-reviewed conferences and workshops

- [1] An application of KLEE to aerospace industrial software  
Juan Francisco García, Daniel Jurjo, Fernando Macías, Jose F. Morales, Alessandra Gorla  
*XX Jornadas de Programación y Lenguajes (PROLE 2021)*, 2021
- [2] Multilevel Typed Graph Transformations  
Uwe Wolter, Fernando Macías, Adrian Rutle  
*Graph Transformation*, 2020. doi: [10.1007/978-3-030-51372-6\\_10](https://doi.org/10.1007/978-3-030-51372-6_10)
- [3] Composition of multilevel modelling hierarchies  
Alejandro Rodríguez, Adrian Rutle, Francisco Durán, Lars Michael Kristensen, Fernando Macías, Uwe Wolter  
*Nordic Workshop on Programming Theory (NWPT)*, 2019. doi: [10.23658/taltech.nwpt/2019](https://doi.org/10.23658/taltech.nwpt/2019)
- [4] Multilevel Modelling with MultEcore: A Contribution to the MULTI Process Challenge  
Alejandro Rodríguez, Fernando Macías  
*6th International Workshop on Multi-Level Modelling (MULTI 2019)*, 2019. doi: [10.1109/MODELS-C.2019.00026](https://doi.org/10.1109/MODELS-C.2019.00026)
- [5] Empowering Multilevel DSMLs with Integrated Runtime Verification  
Fernando Macías, Adrian Rutle, Volker Stolz, Torben Scheffel, Malte Schmitz  
*Proceedings of the 3rd International Workshop on Verification of Objects at Runtime Execution (VORTEX 2019)*, 2019
- [6] Fuentes de Sobrecarga en Pruebas de Transformaciones de Modelos  
Roberto Rodríguez-Echeverría, Fernando Macías, José M. Conejero, Juan C. Preciado, Alvaro E. Prieto, Adrian Rutle  
*Jornadas de Ingeniería del Software y Bases de Datos (JISBD)*, 2018
- [7] Multilevel modelling of coloured Petri nets  
Alejandro Rodríguez, Adrian Rutle, Francisco Durán, Lars Michael, Fernando Macías  
*5th International Workshop on Multi-Level Modelling (MULTI 2018)*, 2018
- [8] A Tool for the Convergence of Multilevel Modelling Approaches  
Fernando Macías, Adrian Rutle, Volker Stolz  
*5th International Workshop on Multi-Level Modelling (MULTI 2018)*, 2018
- [9] Towards Domain-Specific CPN Modelling Languages  
Alejandro Rodríguez, Fernando Macías, Lars Michael Kristensen, Adrian Rutle  
*Nordic Workshop on Programming Theory (NWPT)*, 2017. ISBN: 978-952-12-3608-2
- [10] Towards an Autonomous Robot Architecture Combining Complex Event Processing and Multilevel Modelling  
Juan Boubeta-Puig, Fernando Macías, Adrian Rutle  
*Nordic Workshop on Programming Theory (NWPT)*, 2017. ISBN: 978-952-12-3608-2
- [11] Coordination and Amalgamation of Multilevel Coupled Model Transformations  
Fernando Macías, Adrian Rutle, Volker Stolz  
*Nordic Workshop on Programming Theory (NWPT)*, 2017. ISBN: 978-952-12-3608-2
- [12] Multilevel Modelling with MultEcore: A Contribution to the MULTI 2017 Challenge  
Fernando Macías, Adrian Rutle, Volker Stolz  
*4th International Workshop on Multi-Level Modelling (MULTI 2017)*, 2017
- [13] Towards rearchitecting meta-models into multi-level models  
Fernando Macías, Esther Guerra, Juan Lara  
*International Conference on Conceptual Modeling*, 2017. doi: [10.1007/978-3-319-69904-2\\_5](https://doi.org/10.1007/978-3-319-69904-2_5)
- [14] Describing Behaviour Models through Reusable, Multilevel, Coupled Model Transformations  
Adrian Rutle, Fernando Macías, Francisco Durán, Roberto Rodríguez-Echeverría, Uwe Wolter  
*Nordic Workshop on Programming Theory (NWPT)*, 2016

- [15] Integration of Runtime Verification into Metamodeling  
Fernando Macías, Torben Scheffel, Malte Schmitz, Rui Wang, Martin Leucker, Adrian Rutle, Volker Stolz  
*Nordic Workshop on Programming Theory (NWPT)*, 2016
- [16] Multilevel Behavioural Metamodelling  
Fernando Macías, Adrian Rutle, Volker Stolz  
*Nordic Workshop on Programming Theory (NWPT)*, 2016
- [17] On Reducing Model Transformation Testing Overhead  
Roberto Rodríguez-Echeverría, Fernando Macías, Adrian Rutle  
*2nd Joint International Workshop on Patterns in Model Engineering and the 5th International Workshop on the Verification of Model Transformation (PAME-VOLT 2016)*, 2016
- [18] MultEcore: Combining The Best of Fixed-Level and Multilevel Metamodelling  
Fernando Macías, Adrian Rutle, Volker Stolz  
*3rd International Workshop on Multi-Level Modelling (MULTI 2016)*, 2016
- [19] Integration of Runtime Verification into Metamodeling for Simulation and Code Generation (Position Paper)  
Fernando Macías, Torben Scheffel, Malte Schmitz, Rui Wang  
*16th International Conference in Runtime Verification (RV 2016)*, 2016. DOI: [10.1007/978-3-319-46982-9\\_29](https://doi.org/10.1007/978-3-319-46982-9_29)
- [20] A Heuristic Approach for Resolving the Class Responsibility Assignment Case  
Maximiliano Vela, Yngve Lamo, Fazle Rabbi, Fernando Macías  
*9th Transformation Tool Contest (TTC 2016)*, 2016
- [21] A Property Specification Language for Runtime Verification of Executable Models  
Fernando Macías, Adrian Rutle, Volker Stolz  
*Nordic Workshop on Programming Theory (NWPT)*, 2015
- [22] A statistical analysis approach to assist model transformation evolution  
Roberto Rodríguez-Echeverría, Fernando Macías  
*MODELS*, 2015. DOI: [10.1109/MODELS.2015.7338253](https://doi.org/10.1109/MODELS.2015.7338253)
- [23] Formalización de Modelos de Comportamiento  
Fernando Macías  
*Jornadas de Concurrencia y Sistemas Distribuidos (JCSD)*, 2015
- [24] Herramienta de soporte en procesos de modernización, para las fases de ingeniería inversa y reestructuración  
Víctor M. Pavón, Roberto Rodríguez-Echeverría, Fernando Macías, Pedro J. Clemente, Fernando Sánchez-Figueroa  
*Jornadas de Ingeniería del Software y Bases de Datos (JISBD)*, 2014. ISBN: 978-84-697-1152-1
- [25] Proceso de verificación de reglas de transformación basado en métricas  
Fernando Macías, Roberto Rodríguez-Echeverría, Víctor M. Pavón, José M. Conejero, Fernando Sánchez-Figueroa  
*Jornadas de Ingeniería del Software y Bases de Datos (JISBD)*, 2014. ISBN: 978-84-697-1152-1
- [26] IFML-based model-driven front-end modernization  
Roberto Rodríguez-Echeverría, Víctor M. Pavón, Fernando Macías, José M. Conejero, Pedro J. Clemente, Fernando Sánchez-Figueroa  
*Proceedings of the 23rd International Conference on Information Systems Development, (ISD 2014)*, 2014. ISBN: 978-953-6071-43-2
- [27] Generating a REST Service Layer from a Legacy System  
Roberto Rodríguez-Echeverría, Fernando Macías, Víctor M. Pavón, José M. Conejero, Fernando Sánchez-Figueroa  
*Information System Development* (2014) pp. 433–444. Springer International Publishing, 2014. DOI: [10.1007/978-3-319-07215-9\\_35](https://doi.org/10.1007/978-3-319-07215-9_35)
- [28] Generación dirigida por modelos de una API REST para una aplicación Web heredada  
Fernando Macías, Víctor M. Pavón, Roberto Rodríguez-Echeverría, Fernando Sánchez-Figueroa  
*Jornadas de Ingeniería del Software y Bases de Datos (JISBD)*, 2013. ISBN: 978-84-695-8310-4
- [29] Model-driven generation of a REST API from a legacy web application  
Roberto Rodríguez-Echeverría, Fernando Macías, Víctor M. Pavón, José M. Conejero, Fernando Sánchez-Figueroa  
*International Conference on Web Engineering*, 2013. DOI: [10.1007/978-3-319-04244-2\\_13](https://doi.org/10.1007/978-3-319-04244-2_13)
- [30] Generating a Conceptual Representation of a Legacy Web Application  
Roberto Rodríguez-Echeverría, Víctor M. Pavón, Fernando Macías, José M. Conejero, Pedro J. Clemente, Fernando Sánchez-Figueroa  
*International Conference on Web Information Systems Engineering*, 2013. DOI: [10.1007/978-3-642-41154-0\\_17](https://doi.org/10.1007/978-3-642-41154-0_17)

## Project deliverables and technical reports

- [1] Testing Embedded Software – State of the Art and State of the Practise  
Fernando Macías, César Sánchez, Alessandra Gorla, José F. Morales  
MFoC project deliverable, IMDEA Software Institute, 2020
- [2] The Category of Typing Chains as a Foundation of Multilevel Typed Model Transformations  
Uwe Wolter, Fernando Macías, Adrian Rutle  
Tech. rep., University of Bergen, Department of Informatics, 2019

## Presentations

- [1] MFoC End-of-Project Report – Automatic V&V Techniques  
MFoC End-of-Project Meeting, Madrid, Spain, 15 Jun 2022
- [2] MFoC Progress Report – Automatic V&V Techniques  
MFoC Progress Meeting, Madrid, Spain, 18 Nov 2019
- [3] Multilevel Modelling and Domain-Specific Languages  
Software Seminar Series (S3) at IMDEA Software Institute, Madrid, Spain, 29 Oct 2019
- [4] Empowering Multilevel DSMLs with Integrated Runtime Verification  
VORTEX 2019, part of ECOOP 2019, London, United Kingdom, 19 Jul 2019
- [5] Multilevel Modelling and Transformations with MultEcore and Multilevel Rearchitecting  
Southwest University, Chongqing, China, 20 Dec 2018
- [6] A Tool for the Convergence of Multilevel Modelling Approaches  
MULTI 2018, part of MODELS 2018, Copenhagen, Denmark, 16 Oct 2018
- [7] Refactoring meta-models into multi-level models  
UFCG, Campina Grande, Brazil, 22 Nov 2017
- [8] Towards rearchitecting meta-models into multi-level models  
ER 2017, Valencia, Spain, 7 Nov 2017
- [9] Towards an Autonomous Robot Architecture Combining Complex Event Processing and Multilevel Modelling  
NWPT 2017, Turku, Finland, 1 Nov 2017
- [10] Coordination and Amalgamation of Multilevel Coupled Model Transformations  
NWPT 2017, Turku, Finland, 1 Nov 2017
- [11] Changing the way we program robots  
Opening of the Computer Science PhD Programme at the ICT Engineering Department, Bergen, Norway, 3 Oct 2017
- [12] Multilevel Modelling with MultEcore: A Contribution to the MULTI 2017 Challenge  
MULTI 2017, part of MODELS 2017, Austin, Texas, USA, 19 Sep 2017
- [13] Multilevel Modelling with MultEcore  
University of Extremadura, Cáceres, Spain, 8 May 2017
- [14] Why I travelled over 2000 km to do a PhD  
ICT Engineering Department Annual Seminar, Osterøy, Norway, 5 Apr 2017
- [15] Describing Behaviour Models through Reusable, Multilevel, Coupled Model Transformations  
NWPT 2016, North Jutland, Denmark, 1 Nov 2016
- [16] Multilevel Behavioural Metamodelling  
NWPT 2016, North Jutland, Denmark, 1 Nov 2016
- [17] MultEcore: Combining The Best of Fixed-Level and Multilevel Metamodelling  
MULTI 2016, part of MODELS 2016, Saint-Malo, France, 4 Oct 2016
- [18] On Reducing Model Transformation Testing Overhead  
VOLT 2016, part of MODELS 2016, Saint-Malo, France, 2 Oct 2016
- [19] Solving the CRA problem with simulated annealing implemented in Java and ATL  
TTC 2016, part of STAF 2016, Vienna, Austria, 8 Jul 2016
- [20] Runtime Verification of Executable Models  
NWPT 2015, Reykjavík, Iceland, 22 Oct 2015

- [21] Formalización de Modelos de Comportamiento  
JCSD 2015, Málaga, Spain, 11 Jun 2015
- [22] RSL: Revisión Sistemática de Literatura ó Reading Spooky Lots  
University of Extremadura, Cáceres, Spain, 26 Sep 2014
- [23] Proceso de verificación de reglas de transformación basado en métricas  
JISBD 2014, Cádiz, Spain, 17 Sep 2014
- [24] Herramienta de soporte en procesos de modernización, para las fases de ingeniería inversa y reestructuración  
JISBD 2014, Cádiz, Spain, 17 Sep 2014
- [25] Generación dirigida por modelos de una API REST para una aplicación Web heredada  
JISBD 2013, Madrid, Spain, 18 Sep 2013
- [26] Model-Driven Generation of a REST API from a Legacy Web Application  
MDWE 2013, part of ICWE 2013, Aalborg, Denmark, 10 Jul 2013