

# IVAN PEREZ

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## WORK EXPERIENCE

### Senior Research Scientist / NASA Contractor

KBR Wyle, Mountain View, CA, USA

August 2022 - Present

- Contractor for NASA Ames Research Center, member of the NASA Formal Methods group.
- Technical lead of open-source runtime monitoring frameworks for flight systems Copilot (Class D / 7150.2C) and NASA Ogma (Class E).
- Research on runtime monitoring, requirements elicitation.
- Technical event organization, and review of scientific papers submitted for publication in journals and conferences.

### Senior Research Scientist / NASA Contractor

National Institute of Aerospace, Hampton, VA, USA

January 2018 - July 2022

- Contractor for NASA Langley Research Center, member of the NASA Formal Methods group.
- Technical lead of open-source runtime monitoring framework for flight systems Copilot, contributing to the certification as NASA Class D (7150.2C).
- Technical lead of open-source runtime monitoring framework for flight systems Ogma, NASA Class E (7150.2C).
- Research focused on swarms of distributed vehicles, autonomous aerial vehicles, and runtime monitoring.
- Research and evaluation of fault tolerance for collision detection and avoidance systems for satellites in Low-Earth Orbit (with NASA LaRC and the Air Force Research Lab).
- Co-PI of one-year DARPA-funded project to investigate the use of formal methods and category theory in combination with modeling languages for systems engineering.
- Technical event organization, and review of scientific papers submitted for publication in journals and conferences.
- Promoted 3 times during tenure.

### Founder / Software Architect / Director

Keera Studios Ltd, London, UK / Remote

July 2013 - December 2017

- Lead developer of Haskell applications and games for mobile, desktop and web.
- Created the first ever commercial Haskell game for Android (2015) and iOS (2017).
- Created Andronaut and CuriOSity, toolchains to compile/package/distribute Haskell mobile apps.
- Created Haskell Titan, a testing/debugging system specific for mobile games based on temporal logic that records and reproduces game runs exactly by taking advantage of purity and strong types in Haskell.

### Researcher / Doctoral Candidate

University of Twente, Enschede, NL

May 2013 - October 2013

- Investigated limits of purely functional abstraction used by the Computer Architecture for Embedded Systems group to model and verify hybrid and cyber-physical systems (e.g. phased array antennas).

### Research Assistant

High Performance Computing Center (HLRS), Stuttgart, DE

May 2012 - August 2012

- Developed a complete Haskell Graphical User Interface for SoOSim, a simulator of supercomputer operating systems, as part of the S(o)OS project funded by the European Commission.
- Continued participating in meetings in 2013 to assist project members with their presentation.

### Consultant / Software Developer

Self-employed, Coventry, UK

July 2011 - July 2013

- Developed compilers, debuggers, rule-based systems, formal reasoning frameworks, game engines, game IDEs and mobile apps, using, mainly, Haskell, Prolog, Idris, Scala, Java and C.

## Researcher

IMDEA Software Institute, Madrid, ES

October 2007 - December 2009

- Formalised component-based mash-ups using Description Logics; implemented in web framework.
- Extended Description Logics with ontology parameters; implemented plug-ins for reasoning tools.
- Participated in elaborating project proposals successfully funded by the Ministry of Industry.

## Research Associate

BABEL Research Group - UPM, Madrid, ES

April 2003 - March 2010

- Developed MTP, a parser/scanner/AST generator written in Java targeting Java and Haskell.
- Developed compiler frontend for SLAM-SL, an object-oriented specification language, written in Haskell. Learned to use the B-method to specify and prove machine properties.

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## ACADEMIC EXPERIENCE

### Teaching Assistant

University of Nottingham, Nottingham, UK

February 2014 - November 2016

- Duties include marking, lab assistance and preparing material. I participated in Introduction to Functional Programming (2014-2015), Programming (2014-2016), and Compilers (2014, Head T.A.).

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## EDUCATION

### PhD in Computer Science

University of Nottingham, Nottingham, UK

November 2017

- Dissertation Topic: "Extensible and Robust Functional Reactive Programming"
- Supervisors: Henrik Nilsson, Graham Hutton

### MSc., European Master in Computational Logic

Technical University of Madrid

September 2009

- Dissertation Topic: "Gadget composition and automatic discovery in EzWeb"
- Supervisors: Susana Munoz Hernandez

### Engineer in Computer Science

Technical University of Madrid

September 2008

- Dissertation Topic: "A formalization of parametric context-free grammars"
- Supervisors: Angel Herranz Nieva

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## SELECTED PUBLICATIONS

- Ivan Perez, Anastasia Mavridou, Thomas Pressburger, Alwyn Goodloe, Dimitra Giannakopoulou. *Automated Translation of Natural Language Requirements to Runtime Monitors*. 28th International Conference on Tools and Algorithms for the Construction and Analysis of Systems. April 2022.
- Ivan Perez, Anastasia Mavridou, Thomas Pressburger, Alwyn Goodloe, Dimitra Giannakopoulou. *Integrating FRET with Copilot: Automated Translation of Natural Language Requirements to Runtime Monitors*. NASA Technical Manual - NASA/TM-2022-0000049. February 2022.
- Aaron Dutle, Cesar Munoz, Esther Conrad, Alwyn Goodloe, Laura Titolo, Ivan Perez, Swee Balachandran, Dimitra Giannakopoulou, Anastasia Mavridou, Thomas Pressburger. *From Requirements to Autonomous Flight: An Overview of the Monitoring ICAROUS Project*. In Proceedings Second Workshop on Formal Methods for Autonomous Systems, EPTCS 329. December 2020.
- Ivan Perez, Henrik Nilsson. *Runtime Verification and Validation of Functional Reactive Systems*. Journal of Functional Programming. August 2020.
- Ivan Perez, Alwyn Goodloe. *Fault-Tolerant Functional Reactive Programming (Extended Version)*. Journal of Functional Programming. May 2020.

- Ivan Perez, Frank Dedden, Alwyn Goodloe. *Copilot 3*. NASA Technical Manual - NASA/TM-2020-220587. April 2020.
- Christina Zeller, Ivan Perez. *Mobile Game Programming in Haskell*. FARM 2019, co-located with ICFP 2019. August 2019.
- Ivan Perez, Alwyn Goodloe, William Edmonson. *Fault-Tolerant Swarms*. IEEE International Conference on Space Mission Challenges for Information Technology. Pasadena, CA. July 2019.
- Kerianne L. Hobbs, Ivan Perez, Aaron W. Fifarek, Eric M. Feron. *Formal Verification of Decision Logic for Automatic Maneuvering of Spacecraft*. AIAA Scitech 2019 Forum. San Diego, California. January 2019.
- Manuel Baerenz, Ivan Perez. *Rhine - FRP with Type-level Clocks*. Haskell Symposium 2018, co-located with ICFP 2018. September 2018.
- Ivan Perez. *Fault Tolerant Functional Reactive Programming*. ICFP 2018. September 2018.
- Ivan Perez. *GALE: A Functional Graphic Adventure Library and Engine*. FARM 2017, co-located with ICFP 2017. September 2017.
- Ivan Perez. *Back to the Future: Time Travel in FRP*. Haskell Symposium 2017, co-located with ICFP 2017. September 2017.
- Ivan Perez, Henrik Nilsson. *Testing and Debugging Functional Reactive Programming*. ICFP 2017. September 2017.
- Ivan Perez, Manuel Baerenz, Henrik Nilsson. *Functional Reactive Programming, refactored*. Haskell Symposium 2016, co-located with ICFP 2016. September 2016.
- Ivan Perez, Henrik Nilsson. *Bridging the GUI gap with Reactive Values and Relations*. Haskell Symposium 2015, co-located with ICFP 2015. September 2015.
- Henrik Nilsson, Ivan Perez. *Declarative Game Programming*. 16th International Symposium on Principles and Practice of Declarative Programming (PPDP 2014). September 2014.
- Ivan Perez, Oscar Corcho. *Pattern Definitions and Semantically Annotated Instances*. Workshop on Ontology Patterns, co-located with 8th International Semantic Web Conference. October 2009.
- Oscar Corcho, Catherine Roussey, Luis Vilches, Ivan Perez. *Pattern-based OWL Ontology Debugging Guidelines*. In Workshop on Ontology Patterns (WOP 2009), collocated with the 8th International Semantic Web Conference (ISWC-2009), CEUR Workshop proceedings, pages 68-82. October 2009.
- Jesus Martinez, Ivan Perez, Susana Munoz, and Daniel Lancho. *Thin client technology in the academic environment*. In IV Congreso Universidad y Cooperacion al Desarrollo, Barcelona, Spain. November 2008.
- Ivan Perez, Angel Herranz, Susana Munoz, Juan Jose Moreno-Navarro. *Modelling mash-up resources*. 13th Conference on Software Engineering and Databases (JISBD 08). October 2008.
- Ivan Perez. *Method for automatic secure retrieval of Trusted Public Keys*. First Spanish Conference on Informatics (CEDI), Information Security Symposium. September 2005. (In Spanish.)

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## SELECTED PRESENTATIONS

- *Invited Talk: Runtime Verification with Copilot 3 and Ogma*. Iowa State University. July 2022.
- *Copilot: A tutorial*. Virginia Commonwealth University (VCU). June 2022. With Alwyn Goodloe (NASA).
- *Runtime Verification with Copilot 3 and Ogma*. NASA Jet Propulsion Laboratory. May 2022.
- *Invited Talk: Runtime Verification with Copilot 3 and Ogma*. University of Southern California. May 2022.
- *Invited Lecture: Functional Reactive Programming in the Real World*. Haskell in Industry Session - Concepts of Higher Programming Languages. University FH Voralberg, Austria. January 2022.
- *Invited Lecture: Practice Requirements, Requirements in Practice*. Requirements Engineering. University FH Voralberg, Austria. June 2021.
- *Invited Lecture*. CS141-15 Functional Programming. University of Warwick, UK. February 2021.
- *Invited Lecture: Functional Reactive Programming in the Real World*. Haskell in Industry Session - Concepts of Higher Programming Languages. University FH Voralberg, Austria. January 2021.

- *Invited talk: Runtime Verification with Copilot 3*. Second Workshop on Formal Methods for Autonomous Systems. Virtual. December 2020.
- *Testing and Extending Functional Reactive Systems*. Galois, Inc. Arlington, VA. January 2020.
- *Keynote: Streams, Reactivity and FRP: where we are, where to go*. Workshop on Reactive and Event-based Languages and Systems (REBLS 2019). Athens, Greece. October 2019.
- *Introduction to Functional Programming*. Netflix. Los Gatos, CA. December 2018.
- *Functional Abstractions for Robust and Fault Tolerant Reactive Systems*. National Institute of Aerospace. Hampton, VA. May 2018.
- *Reactive Programming with Monadic Stream Functions*. NASA Langley Research Center - Formal Methods Group - Informal Friday Lunch Talk series. May 2018.
- *Keynote: Extensible Functional Reactive Programming Applied to iOS and Android Game Programming*. Haskell in Leipzig. October 2017.
- *Lightning talk: Our Tools for Mobile Haskell Games and Apps*. Haskell eXchange. October 2017.
- *Haskell Games and Apps for iOS and Android*. Commercial Users of Functional Programming - Co-located with ICFP 2017. September 2017.
- *Game programming in Haskell*. Functional Programming Meetup Group, Kyiv, Ukraine. April 2016.
- *Game programming in Haskell: baby steps*. University of Bamberg. February 2016.
- *Haskells ultimate challenge: game programming for fun and profit*. Haskell eXchange. October 2015.
- *Haskell Game Development from Zurich to London*. Haskell Meetup Group, London. June 2015.
- *Game Programming in Haskell*. Technical University of Madrid. April 2015.
- *Lightning Talk: Keera Studios - Game Programming in Haskell with FRP*. FP Days, London. November 2014.
- *Functional Games, Reactivity and UIs*. Haskell Meetup Group, London. June 2014.
- *Lightning Talk: Game Programming in Haskell*. Midlands Graduate School. Nottingham, UK. April 2014.
- *An exploration of Functional Reactive Programming*. University of Twente. September 2013.
- *Reactive Programming with Reactive Values*. University of Twente. March 2013.
- *Reactive Programming in Haskell*. Technical University of Madrid. December 2011.

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## PARTICIPATION IN CONFERENCES AND EVENTS

- *Space Mission Challenges on Information Technology (SMC-IT)*. PC Chair. July 2023. (Upcoming)
- *4th Workshop on Formal Methods for Autonomous Systems*. PC Member. September 2022. (Upcoming)
- *PhD Symposium, 17th International Conference on integrated Formal Methods (iFM)*. PC Member. June 2022.
- *NASA Formal Methods Symposium 2022*. Program Co-Chair. May 2022.
- *27th International Conference on Tools and Algorithms for the Construction and Analysis of Systems*. External Reviewer. March 2022.
- *3rd Workshop on Formal Methods for Autonomous Systems*. PC Member. October 2021.
- *Space Mission Challenges on Information Technology (SMC-IT)*. PC Co-Chair; Organization Committee Member. July 2021.
- *NASA Formal Methods Symposium 2021*. General Co-Chair. May 2021.
- *2nd Workshop on Formal Methods for Autonomous Systems*. PC Member. December 2020.
- *Workshop on Reactive and Event-based Languages and Systems*. General Chair; Program Chair. November 2020.
- *International Conference of Functional Programming 2020*. External Review Committee Member. August 2020.
- *NASA Formal Methods 2020*. External Reviewer. January 2020.

- *Workshop on Reactive and Event-based Languages and Systems*. PC Member. October 2019.
- *International Symposium on Haskell*. PC Member. August 2019.
- *NASA Formal Methods 2019*. Reviewer. May 2019.
- *Innovations in Systems and Software Engineering - A NASA Journal*. Reviewer. August 2019.
- *Programming Languages Mentoring Workshop @ ICFP 2018*. Member of Discussion Panel. September 2018.
- *International Workshop on Functional Arts, Programming, Modeling and Design*. PC Member. September 2018.
- *International Conference of Functional Programming 2018*. Artifact Evaluation Committee Member. September 2018.
- *Tenth NASA Formal Methods Symposium 2018*. Session Chair. April 2018.
- *International Workshop on Functional Art, Music, Modelling and Design*. PC Member; Session Chair. September 2017.
- *Zurihac - Haskell Hackathon*. HSR Hochschule fur Technik Rapperswil, Zurich. June 2017.
- *Women in Technology Nottingham*. University of Nottingham. February 2017.
- *Women in Technology Nottingham*. University of Nottingham. February 2016.
- *Zurihac - Haskell Hackathon*. Google Zurich. June 2015.
- *WarwickHack*. University of Warwick. March 2015.
- *Nottingham FPLab Away Day*. Main chair / event coordinator. 2014.
- *Hacknotts*. University of Nottingham. Hackathon winner, with M. Baerenz. November 2014.
- *Fun at Facebook – Fun in the Afternoon*. Facebook London. March 2014.

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## AWARDS

- *DoD Defense Advanced Research Projects Agency (DARPA) Grant*. Co-Principal Investigator. Grant Number: N660011914037; Grant Award: 193,089 USD; July 2019 - September 2020.
- *SIGPLAN Professional Activities Committee Grant Award, 2019*.
- *SIGPLAN Professional Activities Committee Grant Award, 2018*.
- *SIGPLAN Professional Activities Committee Grant Award, 2017*.
- *SIGPLAN Professional Activities Committee Grant Award, 2016*.
- *SIGPLAN Professional Activities Committee Grant Award, 2015*.
- *Top-10 finalist, prize winner, Tech Start-up Programme, Technical University of Madrid, 2008*.
- *Top-25 finalist, Tech Start-up Programme, Comunidad de Madrid, 2006*.

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## OPEN SOURCE PROJECTS

- *NASA Oigma (creator, technical lead)*: Runtime Verification framework for cFS applications
- *Copilot (technical lead, developer)*: domain-specific language for runtime verification targeting C99
- *Dunai (creator, developer)*: Haskell FRP eDSL using Monadic Stream Functions
- *Yampa (maintainer)*: Haskell eDSL for pure Arrowized Functional Reactive Programming
- *Haskanoid (creator, developer)*: Haskell game for PC, Mac, web, Android, iOS, supporting Kinect/Wiimote
- *Keera Hails (creator, developer, 2011 - 2017)*: reactive Haskell library supporting GTK+, HTML, Android/iOS, sockets, FRP
- *Keera Posture (creator, developer, 2011 - 2017)*: desktop Haskell application that uses the webcam to prevent RSI

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## **VOLUNTEERING**

TEDECO cooperation group

May 2007 - January 2010

- Systems administrator of teaching platform at University of Ngozi. Included stay in Burundi.
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## **LANGUAGES**

English (fluent), Spanish (fluent), Galician (fluent), Portuguese (advanced), Italian (intermediate), Ukrainian (intermediate), French (elementary)

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## **CERTIFICATIONS**

- Open Water Diver
  - Accelerated Freefall Skydiving
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## **WORK PERMITS**

- **USA:** Green Card (LPR) / No restrictions
- **EU/EEA:** Citizen / No restrictions