Juan M. Parrilla

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Research interests

3D-printing, digital manufacturing and rapid prototyping; robotics and autonomous systems; artificial intelligence and machine learning; computer and robot vision; robot integration with life sciences.

Professional experience

Glasgow Caledonian University **Glasgow, UK**
Lecturer in Mechanical Engineering *2022–present*
Started my own research group. Our research focuses on: (1) Combining digital manufacturing, robotics and artificial intelligence to create autonomous manufacturing machines. (2) Building modular robots inspired by how life emerged during the Origin of Life.

University of Glasgow **Glasgow, UK**
Lord Kelvin Adam Smith Research Fellow *2019–2022*
Developing as independent researcher. My research focused on using Generative AI to: (1) Model scientific experiments, and integration of these models with exploratory tools such as Reinforcement Learning. (2) Finding new ways of representing molecules, and generating novel ones based on user-defined applications.

University of Glasgow **Glasgow, UK**
Research associate *2016–2019*
Supervisor: Prof. Leroy Cronin. Developing autonomous robots for the characterisation of chemical experiments, such as real-time analysis of crystallization processes, tracking and manipulation of droplet experiments, and designing a chemical computer using oscillating reactions. Developing CAD software for the design of 3D-printable reaction vessels. Helping with the administration of the Robotics team: mentorship of students and publications, recruiting new members and defining new projects. Assisting with grant applications, their deliverables, and the collaboration with other universities and industry partners. The Chemical Computer project was awarded a £1m DARPA grant.

Spain, Denmark and Scotland
Organized several DIY workshops *2012–present*
With Kliment Yanev (Future Bits OpenTech UG) I have organized several workshops that involved building 3D-printers based on the RepRap project, as well as building bespoke robotic platforms for laboratory automation

Syddansk Universitet **Odense, Denmark**
System Administrator *2009–2010*
At MMMI for Prof. John Hallam. Writing server applications in Perl and PHP.

Meristation **Spain**
Article writer *2008-2010*
Wrote videogame articles for the most popular videogame website in Spain.

UPC **Barcelona, Spain**
System Administrator *2008*
Set-up a Wikipedia using MediaWiki for the "Networks" course.

Education

University of Glasgow **Glasgow, UK**
PhD in Robotics and Chemistry *2012–2016*

Specialized in robot design integrated with chemistry, 3D-printing, Computer Vision, and AI.
Supervisor: Prof. Leroy Cronin. Thesis title: Investigating automated chemical evolution of oil-in-water droplets. During the PhD two different automated platforms were designed: a custom 3D-printed liquid handling robot, and a custom 3D-printed device with in-built mixer and droplet generator. Both projects required to interface with chemistry and produce platforms that could generate thousands of experiments to be analysed in real-time using computer vision and machine learning. *Other experiences:* Set-up a hardware workshop and managed the 3D-printing facilities. Worked on a daily basis with researchers from life sciences in multidisciplinary teams. Presented to several visitors and stakeholders, including a EPRSC committees. A follow-up of the PhD project was awarded a £1.5m EPSRC grant.

Syddanks Universitet   **Odense, Denmark**
Project student   *2012*
Supervisor: Danish Shaikh and Prof. John Hallam. Project title: Sound localization with Arduino based on the lizard peripherical auditory system.

Syddansk Universitet   **Odense, Denmark**
MSc in Robot Systems Engineering   *2010–2012*
Specialized in AI and computer vision.
Thesis title: Automatic liquid handling for artificial life research. Supervisors: Dr. Martin Hanczyc and Dr. Kasper Stoy. A robot was built that generated droplets into an aqueous phase. The robot was also able to track the droplets, and add or remove content from them. The work developed during this project kickstarted the Evobliss EU project.

Syddanks Universitet   **Odense, Denmark**
Erasmus semester   *2009*
Followed courses on game design and bioinformatics.

Universitat Politècnica de Catalunya   **Barcelona, Spain**
Informatics Engineering (five-year degree)   *2003–2009*
Equivalent to BSc plus MSc in Computer Engineering. Specialized in Software Design and AI.
Thesis title: Using support vector machines and similarity functions to work with heterogeneous data and classifying documents. Supervisors: Dr Romero from UPC (Spain) and Prof. John Hallam from SDU(Denmark).

Teaching and supervision

Teaching and Learning recognitions
Achieved an "Associate Fellowship of Recognizing Excellence in Teaching" certificate on completion of the "Developing as teacher of Higher Education" course offered by the University of Glasgow.

Glasgow Caledonian University   **2022–present**
(1)Module leader for "Manufacturing Management" and "Robotics and AI in Sustainable Engineering" (Both MSc level). (2) Tutor in "Sustainable Materials and Manufacturing Processes" (MSc), "Design, Process and Manufacturing" (BA), "Simulation for Design and Manufacture" (BA). (3) Supervised over 15 Project students at undergraduate and postgraduate level.

University of Glasgow   **2022–present**
(1) Presented tutorials within the School of Chemistry about programming, machine learning, 3D-printing, computer vision and robotics. (2) Mentored PhD students, providing help with their publications; and mentored and designed projects for undergraduate project students. (3) Organized an on-line Python course for beginners during Covid-19 lockdown. This course was offered to students and researchers from the School of Chemistry at the University of Glasgow.

Grants and fellowships

Royal Society Research Grant   **2022-2023**
Valued in £20,000.
Used to fund the research project "ZombieML: Reanimating inanimate objects with machine learning".

Lord Kelvin Adam Smith Fellowship   **2019-2024**
Valued in £600,000, and offered by the University of Glasgow.
Used to become an independent research and start my own research group.

Valued in £3,3000. Offered by the EPSRC and the University of Glasgow.
Awarded through an internal competition. Used to fund a research student during 10 weeks.

Scientific collaborations

- Currently writing a UKRI Cross-disciplinary research grant with collaborator from The University of Edinburgh and King's College London.
- Core member of the *Glasgow University* team in the EU "*Evobliss*" project where we collaborated with different european research teams with the objective of combining robotics, chemistry and microbiology. As a member of this project I have given regular research updates to the other members, and helped with the reports.
- Collaborated with Kliment Yanev from *Future Bits OpenTech UG* using 3D-printers to build robots that could automate laboratory actions.
- Collaborated with Unilever, as part of the Cronin group, testing how different formulations of detergent would clean stained cloths using one of our robots.

Public engagement and media coverage

- Published an opinion piece in the journal *Nature*: "Support letters: mostly ghost-written, always glowing. What's the point?" September 2021 (doi: 10.1038/d41586-021-02374-0).
- Published an opinion piece in the journal *Nature*: "Dear grant agencies: tell me where I went wrong" February 2021 (doi: 10.1038/d41586-021-00444-x).
- Organised an on-line GameDev symposium with 2 speakers and over 35 viewers (2021).
- Participated in "Science Slam 2015" organized by the University of Glasgow (College of Science and Engineering). It was hosted in a pub and the audience was mostly composed of members the public.
- Participated in "7 Minutes of Science 2020", organized by the University of Glasgow (School of Physics and Astronomy). The audience was mostly composed of undergraduate students.
- Participated in RSC Twitter Poster Conference 2018 and 2020 (2020 Engineering winner).
- The first robot built during the PhD featured in the episode "Are we here for a reason?" of the TV program *Through the Wormhole*, presented by Morgan Freeman.
- The publication "Evolution of oil droplets in a chemorobotic" (*Nature Comm, 2014*) had feature articles in the *Daily Mail*, *Wired* and *Popular Science*.
- The publication "A Crystallization Robot for Generating True Random Numbers" (*Matter, 2020*) had feature articles in *Vice Magazine*, *Chemistry World* and *Phys.org*.

Technical skills

-Able to conceive, design and build autonomous robots, from start to end. This includes the use of 3D-printers, actuators and DIY electronics, in conjunction with embedded and "high-level" software, computer vision and artificial intelligence.
-Knowledge of general programming languages, such as C, C++, Python, Java Perl, PHP and HTML+JS. Production tools like Matlab, Labview, Eclipse, Tex or VIM. Version control system software like Git.
-Familiar with many libraries for scientific and robot related work such as: Tensorflow, NumPy, SciPy, Matplotlib, Scikit-learn, OpenCV. Familiar with Arduino and Raspberry Pi. Familiar with database management software such as MySQL or NoSQL.
-Knowledge of 3D design tools like OpenSCAD and Rhinoceros, and video editing like Blender.

Presentations

2021 Designing a chemical computer and modelling its behaviour using RNNs and Transformers. Invited talk at the "Machine Learning in Science" symposium organized by the University of Glasgow.
2020 Using AI to model chemistry. Invited talk at the "Computer-aided Chemistry" on-line symposium organized by the University of Nottingham.
2020 Building robots based on how life happened on Earth. 7 Minutes of Science. Glasgow, UK.
2015 Programming droplet behaviours. Invited talk at the *SynNatSys* workshop during the ECAL'15 conference. York, UK.
2015 Embodied evolution of artificial cells in a robotic platform. During the "In Vitro" main track of the ECAL'15 conference. York, UK.
2015 Oil droplets and the origin of life. Science Slam 15. Glasgow, UK.
2014 Assisted evolution of protocell droplets in a chemo-robotic platform. Invited talk at the Evobliss workshop during the ALife'14 conference. New York, USA.

Publications

Peer reviewed journals and conference proceedings

P10. Predicting real-time scientific experiments using transformer models and reinforcement learning. *IEEE ICMLA'21*. 2021. JM. Parrilla Gutierrez.
P9. Automatic generation of 3D-printed reactionware for chemical synthesis digitization using Chem-SCAD. *ACS Central Science*. 2021. W. Hou, A. Bubliauskas, PJ. Kitson, JP. Francoia, H. Powell-Davies, JM. Parrilla Gutierrez, P. Frei, JS. Manzano, and L. Cronin.
P8. A programmable chemical computer with memory and pattern recognition. *Nature Communications*. 2020. 1442. JM. Parrilla Gutierrez, S. Tsuda, A. Sharma, G. Cooper, G. Aragon-Camarasa and L. Cronin.
P7. A crystallization robot for generating true random numbers based on stochastic chemical processes. *Matter*. 2020, 2. EC. Lee, JM. Parrilla Gutierrez, A. Henson, EK. Brenchin and L. Cronin.
P6. Adaptive artificial evolution of droplet protocells in a 3D-printed fluidic chemorobotic platform with configurable environments. *Nature Communications*. 2017, 8, 1144. JM. Parrilla Gutierrez, S. Tsuda, J. Grizou, JW. Taylor, A. Henson and L. Cronin.
P5. The evolution of active droplets in chemorobotic platforms. *Proceedings on the European Conference of Artificial Life 2017.* 14, 356-357. LJ. Points, J. Grizou, JM. Parrilla Gutierrez, JW. Taylor and L. Cronin.
P4. Creating and maintaining chemical artificial life by robotic symbiosis. *Artificial Life.* 2015, 21, 47-54. MM. Hanczyc, JM. Parrilla Gutierrez, A. Nicholson, K. Yanev and K. Stoy.
P3. Embodied evolution of artificial cells in a hybrid wet/hard-ware platform. *Proceedings on the European Conference of Artificial Life 2015*. 12, 215. JM. Parrilla Gutierrez, L. Cronin.
P2. Towards heterotic computing with droplets in a fully automated droplet-maker platform. *Philosophical Transactions A*. 2015, 373, 20140221. A. Henson, JM. Parrilla Gutierrez, S. Tsuda and L. Cronin.
P1. Evolution of oil droplets in a chemorobotic platform. *Nature Communications*. 2014, 5, 5571. JM. Parrilla Gutierrez, T. Hinkley, JW. Taylor, K. Yanev and L. Cronin.

Preprints

PP2. Computation in a synchronous chemical-oscillator driven information processor. *Manuscript submitted to a peer-reviewed journal.* A. Sharma, TK. Ng, JM. Parrilla Gutierrez, Y. Jiang and L. Cronin.
PP1. Hardware and software manual for evolution of oil droplets in a chemo-robotic platform. *Arxiv.org*. 2014. 1411.1953. JM. Parrilla Gutierrez, T. Hinkley, JW. Taylor and L. Cronin.