

**1. Personal Details****2019- Professor of Robotics & AI**

2016-19 Senior Lecturer (2016) then Reader (2017) in Robotics

2014-16 Lecturer in Robotics, Dept of Engineering Maths, University of Bristol

2010-14 Research Associate in Robotics, Dept. of Psychology, University of Sheffield

2005-09 Research Associate in Neuroscience, Dept. of Psychology, University of Sheffield

**2000-05 Gap in academic career** Employed full-time in Educational Publishing

1996-00 Junior Research Fellow in Physics, Cambridge University &amp; Imperial College London

1996 PhD in Theoretical Physics Cambridge University

1993 MMath (Part III) Mathematics Distinction Cambridge University

1992 BA in Mathematics First Cambridge University

**Notable Awards**

2019 British Medical Association book awards, First prize in basic and clinical science

<https://www.bma.org.uk/library/medical-book-awards/winners>

2017 Silver award winner for 'Robots (Findout!)' from 'MadeForMums' children's book awards.

2016 First prize for Contributions in Soft Robotics Research (from 80 teams)

Annual Harvard Soft Robotics Competition <https://softroboticstoolkit.com/competitions>

2016 Leverhulme Research Leadership Award

1996 Elected to Junior Research Fellowship at King's College, Cambridge University

Date	Funder	Title	Funding
2021-2025	EPSRC - ISCF Made Smarter	Smart Collaborative Industrial Robotics EP/V062158/1	Col: £4.8M Bristol £800k
2020/2021	University of Bristol	Robotic Arms for Robot Education	PI: £120k Bristol
2020	EPSRC Core Equipment	University of Bristol Core Equipment Award EP/V036440/1	Col: £800k Bristol
2020-2021	EPSRC Impact Acceleration	New Markets in Virtual Haptic Texture Industrial partner: Ultraleap	PI: £50k Bristol
2018-2022	Ultraleap CASE conversion	Tactile Validation of Mid-air Haptic Displays Industrial partner: Ultraleap	PI: £25k Bristol
2018-2023	Google DeepMind CASE conversion	Deep Reinforcement Learning for Robot Touch Industrial partner: Google DeepMind	PI: £25k Bristol
2017-2018	EPSRC Impact Acceleration	Tactile Smart Grasping System Industrial partner: Shadow Robotics	PI: £50k Bristol
2017-2022	Leverhulme Trust Leadership Award	A Biomimetic Forebrain for Robot Touch RL-2016-039	PI: £1M Bristol
2016-2017	EPSRC Impact Acceleration	Neuromorphic Tactile Fingertip Industrial partner: iniVation	PI: £20k Bristol
2015-2017	EPSRC First Grant	Tactile Super-resolution Sensing EP/M02993X/1	PI: £100k Bristol
2013	EPSRC Capital Award	Human-Machine Co-operation in Robotics EP/J013714/1	Col: £1M Sheffield
2010-2013	EU FP7	Convergent Science Network FP7-ICT-2009-8.9 agreement 248986	Col: €600k Sheffield €110k

**2. Contribution to New Ideas, Hypotheses, Tools or Knowledge**

After appointment in 2014 as a lecturer at the University of Bristol, I transformed robotics education by directing the Robotics MSc (2014-17) from an unsustainable <10 students to a UK-leading robotics program with now 100+ students per year. The program is joint with the University of the West of England as partners in the Bristol Robotics Laboratory, and my handling led to the program being deemed "A model educational partnership" in the University of Bristol's Good Practice Directory.

In 2015, I founded the Tactile Robotics Lab that now comprises myself, 3 newly-appointed lecturers, 4 postdocs and 12 PhD students, equipped with a diverse array of robot arms, fabrication machinery and computing infrastructure. My lab and I are known internationally for our biomimetic tactile sensor: the TacTip (reviewed in Lepora, IEEE Sensors 2021; Ward-Cherrier et al, Soft Robotics 2018, 165 citations), recognized by 1st place in the Harvard Soft Robotics competition and a display in the Science Museum. I have led my lab to integrate this tactile fingertip into many robots including several dexterous robot hands, such as the open-source 3d-printed 3-fingered hand from Yale that previously won the DARPA ARM challenge. My lab and I have recently made key contributions in applying deep learning to the tactile control of robots, resulting in a step-change in dexterous interactions reported in a large body of publications from mid-2019 onwards (see technical CfS).

In 2017, I initiated a partnership with Swiss company IniVation to develop a neuromorphic tactile sensor that encodes information analogously to neural systems. With former PhD student Ben Ward-Cherrier, we patented the invention and now he is leading this work with a focus on integration into prosthetics as a Royal Academy of Engineering Research Fellow and University of Bristol Lecturer.

I have also initiated partnerships with: DeepMind with an EPSRC CASE award for Alex Church, who is currently an intern within the company; Ultraleap with an EPSRC CASE award for Noor Alakhawand and an Impact Acceleration Award on rendering haptic texture; Shadow Robotics with an Impact Acceleration Award for integrating tactile sensors in their commercial robotic hands; and Ocado Technology as a Co-Investigator on an ISCF Made Smarter Research Centre, where they are a project partner and the primary industrial collaborator for the University of Bristol.

### **3. Leadership and Development of Others**

#### **Examples of Leadership**

2021- Theme Lead, Robot Dexterity

My research group has changed recently because there are now three lecturers/PIs who I mentor (Dr Ben Ward-Cherrier, Dr Dandan Zhang, Dr Efi Psomopoulou). I have created a broader Robot Dexterity theme across Bristol Robotics Laboratory with other PIs in teleoperation and haptics.

2020 Acting Co-Director, Bristol Robotics Laboratory

Acted as University of Bristol Co-Director of BRL while the Director was on 8-month paternity leave. Contributions: led UoB COVID planning to reopen BRL; led successful internal capital bid (£250k); UoB representative on high-level discussions on BRL operations and UWE-UoB partnership.

2014-17 Program Director, MSc in Robotics,

Extensive program changes to improve course quality; was deemed “A model educational partnership” in the University of Bristol’s Good Practice Directory (Academic Quality and Policy Office).

Achieved rapid growth from an unsustainable 9 cohort (2013-14) to largest in UK at 100+ cohort (2018-).

2015- Group Lead, Tactile Robotics

Founded the Tactile Robotics research group. Sole PI for group until 2020; approx. 15 members.

#### **Development of Others**

I have a strong track record in successfully supporting and mentoring others in their career aspirations.

Dr Uriel Martinez-Hernandez (PhD supervisor 2011-15). Lecturer in Robotics, University of Bath.

I led the research aspects of Uriel’s PhD, as recognized by last authorship on his publications. He now leads the Inte-R-action lab that researches cyber-physical systems.

Dr Benjamin Ward-Cherrier (PhD supervisor 2015-19). Lecturer in Robotics, University of Bristol.

I was sole supervisor for Ben over his PhD, then mentored him for a University Research Fellowship, Lectureship and Royal Academy of Engineering Research Fellowship on neuromorphic prosthetics.

Dr Maria Elena Giannaccini (PI 2016-17). Lecturer in Robotics, University of Aberdeen.

Maria Elena was a postdoc on my EPSRC first grant (14 months), after which she changed direction to the Soft Robotics group in Bristol Robotics Laboratory, then was hired as a University Lecturer.

Dr Efi Psomopoulou (PI 2019-21). Lecturer in Data Science, University of Bristol.

Efi was a Senior Research Associate on my Leverhulme Leadership Award. She has recently been appointed as a Lecturer in Data Science and I continue to mentored her, mainly on her research.

Dr Luke Cramphorn (PhD supervisor 2016-2020). Advanced Robotics Engineer, Dyson

Dr Jasper James (PhD supervisor 2017-2021). Data Analyst, HM Government

Dr Kirsty Aquilina (PhD supervisor 2017-2021). Robotics Engineer.

Sophie Anne Baker (PhD supervisor 2017-). Part-time Teaching Fellow (50%), University of Bristol

Alex Church (PhD supervisor 2018-). Currently employed on a 6-month internship with DeepMind.

### **Assistance to Others**

I have assisted many researchers at other institutions across a wide range of research topics.

Stephen Redmond (University College Dublin) Partner on his President of Ireland Future Research Leaders Fellowship 'Tactile sensors for robotic and prosthetic grippers inspired by human touch' (2019)

Robyn Grant (Manchester Metropolitan) Partner on her Royal Society APEX Public Engagement Award (2021) and Royal Society APEX Award on the 'Morphology, Mechanics and Movement of Mammalian Whiskers' (2021), and her award with the EPSRC Friction Innovation Fund (2019)

Mehmet Dogar (University of Leeds) Partner on his EPSRC Early Career Fellowship 'Robotic Picking and Packing with Physical Reasoning' (2021)

Nicolas Rojas (Imperial College) Partner on his EPSRC First Grant 'Trustable dexterous manipulation'

Alyx Milne (Manchester Metropolitan) Support for her BBSRC Early Career Fellowship 'Super Seal Sense: Whisker movement strategies in Pinnipeds' and Royal Society (Dorothy Hodgkin) Fellowship 'Behavioural, biomechanical and robotic investigations of Pinniped whiskers' (2021)

Ned Barker (University College London) Support for his Leverhulme Trust Early Career Fellowship 'Biohybrid bodies: a sociological framework for living with Living Machines' (2021)

I have also donated tactile sensing hardware to over 20 UK and EU academics and companies, many of which have led to novel demonstrations or ongoing collaborations.

## **4. Contributions to Research Community**

### **Indications of external recognition**

2021 Turing Fellow

2020 Acting for University of Bristol on the UK-RAS Network; member of UK Soft Robotics Network

2018 EPSRC full College membership

2017 Co-editor (with T. Prescott, P. Verschure) for 50 chapter (1008 page) book on *Living Machines: Handbook of Research in Biomimetic and Biohybrid Systems* (OUP)

2016 EPSRC Associate College of peer reviewers

2012/13/16 Editor, *Biomimetic & Biohybrid Systems (Living Machines)* in LNAI, Springer.

Regular reviewer for the main conferences and journals in robotics and neuroscience, and high-impact interdisciplinary journal such as Science and Nature Communications. Editorial roles at the principal robotics conferences (ICRA/IROS) and on multiple special issues.

Regular reviewer of grant proposals for EPSRC, BBSRC, Leverhulme Trust and the Royal Society.

### **Organization of conferences and workshops**

2022 (planned) Lead organizer UK Manipulation Workshop, Bristol (150 participants, estimated)

2019/20/21 Co-organizer on 3 ICRA Workshops 'ViTac: Vision and Touch' (400 participants)

2019 Co-organizer UK Manipulation Workshop, Leeds (150 participants)

2018 Lead organizer ICRA 2018 Workshop on 'Active touch' (100 participants)

2012/13/14/16/17/18 Living Machines; international conference (200 participants/year)

Program chair 2012/13/16; communications chair 2014/17/18

2016 Co-organizer IROS 2016 Workshop on 'Active touch sensing' (100 participants)

### **Selected participation in academic outreach**

**The Turing Presents: AI UK (23-24 March 2021):** Invited to a panel on "Safe and ethical priorities for AI", with Joanna Bryson, Tabitha Goldstaub and Adrian Weller.

**Science Museum, 2017:** I provided our 3d-printed tactile sensors and a tactile robotic hand for display in the Science Museum, London, then a travelling exhibition. Viewed by over 1M people.

**Winner of soft robotics competition, 2016:** My team won first prize in the Harvard Soft Robotics Competition from 80 teams internationally. Our entry was on an open source 3d-printed tactile fingertip. <https://www.seas.harvard.edu/news/2017/01/4-projects-selected-winners-soft-robotics-competition>

## 5. Exploitation of Research

**Industrial collaboration, DeepMind:** I collaborate with the Director of Robotics, Dr Raia Hadsell.

- BBC article featuring our views of Robotics & AI [www.bbc.co.uk/news/business-55770190](http://www.bbc.co.uk/news/business-55770190)
- Ongoing CASE PhD award for Alex Church. Co-authored papers on Deep Reinforcement Learning for robots. Alex is currently employed as an intern with DeepMind in a break from his PhD.

**Industrial collaboration, Ultraleap:** I have initiated and developed a partnership to work with Bristol-based SME Ultraleap on tactile sensing for ultrasound haptic displays.

- Ongoing PhD CASE award for Noor Alakhawand. Successful demonstration that our tactile technology can quickly and easily map the pressure field from ultrasound haptic displays.
- EPSRC IAA award for Dr Nick Pestell and Noor Alakhawand in application to texture sensing.

**Industrial collaboration, iniVation:** I initiated a partnership with Swiss company IniVation to develop a neuromorphic (event-based) tactile sensor.

- Patent: PCT/GB2019/053483 – Event-based Tactile Sensing.
- Former PhD student Dr Ward-Cherrier is now leading this work with a focus on integration into prosthetics as a Royal Academy of Engineering Research Fellow and University of Bristol Lecturer.

**Industrial collaboration, Shadow Robotics:** I led a collaboration with Shadow Robotics to combine a commercial robotic hand (Shadow Smart Grasping System) with our tactile sensors.

- EPSRC IAA enabled collaboration and initial pilot study.
- Actively being pursued by Dr Efi Psomopoulou to progress to advanced robot manipulation.

**Industrial collaboration, Ocado Technology:** Initiated a new partnership to develop tactile grasping/gripping technology based on soft robotic hands and high-resolution tactile sensing.

- Principal partner on EPSRC ISCF Manufacturing made Smarter Research Centre 'Smart Collaborative Industrial Robotics'.

### Selected News and media coverage

2021 BBC News 'Puppy training a robotic dog points to the future'  
[www.bbc.co.uk/news/business-55770190](http://www.bbc.co.uk/news/business-55770190)

2021 TechXplore 'Teaching AI agents to type on a Braille keyboard'  
[www.techxplore.com/news/2021-01-ai-agents-braille-keyboard.htm](http://www.techxplore.com/news/2021-01-ai-agents-braille-keyboard.htm)

2020 Times Higher 'Touch to transform with tactile robotics'  
[www.timeshighereducation.com/hub/university-bristol/p/touch-transform-tactile-robotics](http://www.timeshighereducation.com/hub/university-bristol/p/touch-transform-tactile-robotics)



2020 BBC News 'Why your new work colleague could be a robot'  
[www.bbc.co.uk/news/business-51442445](http://www.bbc.co.uk/news/business-51442445)

2020 TechXplore 'Using deep learning to give robots a sense of touch'  
[www.techxplore.com/news/2020-05-deep-robotic-fingertips.html](http://www.techxplore.com/news/2020-05-deep-robotic-fingertips.html)

2020 BBC News 'The robot assistant that can guess what you want'  
[www.bbc.co.uk/news/business-52547331](http://www.bbc.co.uk/news/business-52547331)

2020 Times Higher 'Sensing the future with robotic fingertips'  
[www.flipbooks.timeshighereducation.com/19712/25791/index.html?10252](http://www.flipbooks.timeshighereducation.com/19712/25791/index.html?10252)

2020 BBC4 Documentary 'Secrets of skin. Episode 6: Sensing'  
[www.bbc.co.uk/programmes/m000cf26](http://www.bbc.co.uk/programmes/m000cf26)



## 6. Additional Information

I had a 5-year gap in my academic career where I worked as a commissioned author in educational publishing. Since returning to academia, I have continued writing engaging children's books on science and technology.

2022: (planned) DK book on Artificial Intelligence (ages 8-14).

2018: *Robots (Findout!)*, 64 pages, Dorling-Kindersley (Penguin house). Ages 8-14. (4.8 out of a maximum 5 star rating from ~100 reviews on Amazon)

2015: Commissioned author for magazine *Build MIRO*, aimed at teens/adults to build a biomimetic robot. Partners included Sebastian Conran Associates (London-based Designers). Contribution: 10 articles over 20 issues. Eglemoss Publishing.

2010: 4 books on the physics of Theme Parks: *High-Speed Thrills*, *Falling for Fun*, *Twists and Turns*, *Marvellous Machinery*, 32 pages each. TicToc publishing. Ages 8-14.

