Simon Hadfield

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Research Summary

I am an Associate Professor (Reader) leading my own research team, and currently involved in the supervision of around 10 PhD candidates. My interests focus on Robotics, Computer Vision and Machine Learning, with a particular emphasis on the effective exploitation of novel visual sensors. To date, my team's work has focussed on taking computer vision techniques "out of the lab" and making them practically applicable in the real world. I proposed a new paradigm for efficient dynamic reconstruction, with a computational overhead several orders of magnitude lower than previous techniques. This was an important step towards using these techniques in real-time robotics applications, and was published in both the top journal [1] and the top international conference [10] in the field, generating more than 100 citations to date. My research has also placed second and third in the last two years of the ChaLearn continuous gesture recognition challenge.
Since receiving my PhD (without corrections) in 2013, I have managed a number of research projects and been involved in supervising 13 PhD students (with 3 more starting shortly). This includes the winners of the Sullivan Thesis Prize (for the best UK computer vision PhD) in 2016, 2018 and 2021. I have also published an average of two top tier journal articles and 3 high impact conference articles per year, accruing over 1500 citations in 4 years (H-index of 15).

Research grants and/or scholarly funding

2023 (upcoming) **(PI) Secure federated learning via data proxies**, *£124,000*, Industrial/Internal, 4 year studentship, 25% industrially funded by Saab and 25% industrially funded by MBDA Ltd, looking at generative AI techniques as a proxy to enable federated learning between businesses without data leakage.

2023 (upcoming) **(PI) AI for future space missions**, *£124,000*, Industrial/Internal, 4 year studentship, 50% industrially funded by Surrey Satellite Technology Ltd looking at novel visual sensors for space situational awareness and debris avoidance.

2023 (upcoming) **(PI) Eye-in-the-sky: Satellite supported autonomous vehicles**, *£86,874*, Internal, 3.5 year studentship looking at satellite assistance for autonomous vehicles as part of the "Autonomous Vehicles and Robots" Proto-CDT hub.

2022 **(PI) Proto-CDT in Autonomous Robots and Vehicles**, *£414,015*, Internal (Faculty Proto-CDT), Lead on a successful hub, resulting in five full-cost, 3.5 year PhD studentships on autonomous systems.

2022 **(PI) Robotic co-working using novel sensing modalities**, *£75,303*, Industrial/Internal, 3.5 year studentship, 50% industrially funded by IS-Instruments and I3D-robotics, looking at equipping teleoperated nuclear robots with Raman spectrometers for anomaly detection and navigation.

2022 **(PI) Learning to walk: Reinforcement Learning for robotic locomotion**, *£85,803*, Internal, 3.5 year studentship, on learned locomotion for multi-legged agents over variable terrain types.

2022 **(PI) Privacy preservation in recommender systems**, *£85,803*, Internal, 3.5 year studentship, exploring AI fairness and hierarchical privacy preservation in online media and consumer recommendation systems.

2022 **(CI) A visual GPS**, *£62,131*, Internal, 3.5 year studentship, using AI to geo-locate autonomous vehicles and systems.

2021 **(CI) Flexible & Intelligent Payload Chain**, *£139,394 (funder contrib.)*, External (European Space Agency), 18 month ESA InCubed project, looking at exploiting machine learning and task aware compression methods to satellite downlink data.

2021 **(CI) The Million Parameter Problem**, *£28,825 (funder contrib.)*, Internal (EPSRC IAA), 6 month impact accelerator project, bridging developments in bayesian deep-learning to domains such as robotic control.

2019 **(PI) Reflexive Robotics**, *£376,661 (funder contrib.)*, External (EPSRC), 3 Year EPSRC New Investigator Award, developing a new approach to robotic autonomy with a concurrent conscious/subconscious systems driven by advances in asynchronous visual sensing.

2019 **(PI) AI media production**, *£228,266*, External (EPSRC/Industrial), Two full-cost, 4 year, EPSRC Industrial CASE vouchers allocated to the British Broadcasting Corporation (BBC), looking at the use of generative deep-learning in various aspects of automated media production.

2019 **(PI) Multi-agent Reinforcement Learning for Robot Empathy**, *£114,029*, Internal ($\approx 5\%$ acceptance rate), 3 Year Vice-chancellors studentship award, at full overseas rate.

2019 **(PI) Capability building in Next-Gen Machine Perception**, *£10,000*, Internal, Part of the university of Surrey's Industrial Strategy Funding.

2019 **(PI) Indoor Scene Localization and Mapping based on Semantic information & asynchronous vision**, *£153,229*, External (Chinese Scholarship council), 4 Year overseas studentship looking at the use of semantic information and event cameras for visual odometry & robot localization.

2019 **(PI) Robotic avatars for chemical plants**, *£109,200*, Internal (cross department), A 3 year studentship funded in collaboration with the Department of Chemical Process Engineering, looking at novel robotic technology for chemical plant automation.

2019 **(PI) Equal-opportunity AI for sign language**, *£2,400*, Internal, Supervisor for a 8 week EPSRC Vacation Internship project, exploring adversarial learning for AI fairness in sign language production.

2018 **(PI) NIMROD**, *£113,644*, Internal/Industrial, 4 year EPSRC Industrial CASE project, looking at signal processing for novel visual sensors.

2018 **(CI) ROSSINI: Reconstructing 3D structure from single images: a perceptual reconstruction approach**, *£436,153 (funder contrib.)*, External (EPSRC), 3 year EPSRC project, looking at 3D reconstruction techniques which maximize human perceptual quality.

2018 **(CI) PROTEIN: PeRsOnalized nutriTion for hEalthy livINg**, *£311,315 (funder contrib.)*, External (EU H2020), Sole machine learning and computer vision expert looking at non-contact estimation of eating rate in a successful EU Horizon2020 project on eating behaviours.

2018 **(PI) Deep learning for driver assistance and behaviour modelling**, *£81,935*, Internal/Industrial, 4 year EPSRC Industrial CASE project, looking at deep learning for assisting high speed racing drivers and owners of luxury vehicles.

2016 **(CI) SMILE: Scalable Multimodal sign language technology for Sign language Learning and Assessment**, *£261,312 (funder contrib.)*, External (Swiss National Science Foundation), 3 year project on an assessment system for Swiss sign language.

Awards

2018 **Early Career Teacher of the year**, Winner for the Faculty of Engineering and Physical Sciences (one third of the University of Surrey).

2017 **Top bracket**, In the international academic challenge on continuous gesture recognition (ChaLearn 2017).

2017 **Supervisor of the year**, one of the few nominees chosen out of the 250 academics in the Faculty.

2017 **Tony Jeans inspirational teaching award**, one of the 4 nominees out of 50 academics in the department.

2016 **Departmental prize for Research Excellence finalist**, One of 3 nominees out of more than 600 researchers from the department.

2016 **Second place**, In the international academic challenge on continuous gesture recognition (ChaLearn 2016).

2013 **Top bracket tracker**, 3rd of 30 & 5th of 27 on the CVPR 2013 "Visual Tracking Benchmark" and ICCV 2013 "Visual Object Tracking" challenges respectively. Lead to publications [2, 11, 12] and 62 total cites.

2013 **PhD thesis (no corrections)**, In the previous 8 years, only 5 candidates had obtained their Computer Vision doctorate without corrections at CVSSP (out of 98).

2009 **DTI MEng Prize**, for best all round performance of the entire graduating year, awarded by Department of Trade and Industry.

University Education

2014–2015 **Graduate Certificate in Teaching and Learning**, *University of Surrey*, A 2 year course taken by new lecturers. I requested to enrol on it to aid my academic career development, and completed it in 2015.

2009–2013 **EPSRC funded PhD in Computer Vision**, *University of Surrey (Second in UK for Elec. Eng. research - Guardian and Complete University Guide 2013)*, Thesis: "The estimation and use of 3D information, for natural human action recognition".
Supervised by Prof. Richard Bowden

2004–2009 **MEng (Distinction) in Electronic and Computer Engineering**, *University of Surrey*, Top student in the graduating year, awarded DTI MEng prize.
Average mark 75.1%. Dissertation on the estimation and synthesis of 3D spatial audio

Employment

2017–Present **Associate Professor (Reader) in Robot Vision and Autonomous Systems**, *University of Surrey*, Developing a research team focussed on next-gen visual perception for autonomous systems. In particular, the integration of deep learning with asynchronous visual sensors. .

2017 **Research Fellow level 2 (RA2)**, *University of Surrey*, Principal research assistant and Researcher Co-Investigator on the Swiss National Science Foundation project "SMILE: Scalable Multimodal sign language technology for sign language Learning and assessment". The project focused on the new field of automating assessment for sign language learners. This post also included significant teaching responsibilities.

2013–2016 **Research Fellow**, *University of Surrey*, Principal research assistant on the EPSRC project "Learning to Recognise Dynamic Visual Content from Broadcast Footage" (EP/I011811/1) focusing on reconstruction and recognition of information from weakly supervised data.

Teaching experience

2018–pres **Teaching EEE3043 "Robotics"**, *Assisted development of the new module, which was delivered in spring 2019. Lecturer MEQ was **4.7 out of 5***.

2018–pres **Teaching EEE2047 "C++ and Object Oriented Design"**, *Most recent MEQ by students was **4.6 out of 5***, including a newly developed type of digital lab-based programming assessment.

2015–2016 **Teaching EEE3032 "Computer Vision and Pattern Recognition"**, *MEQ of **4.8 out of 5** and nominations for "Tony Jeans Inspirational Teaching" and "Early Career Teacher" awards*, Included 45 hours of contact time and a practical computer vision programming assignment.

2017–pres **UG personal tutor**, for approximately 25 students across all levels, including regularly timetabled meetings.

2013–pres **Supervision of UG/MSc dissertation projects**, including weekly review meetings. Approx 4-5 per year.

Supervision, Management & Leadership

2013–pres **PhD supervision**, Involved in supervising 10 successfully completed PhDs, including the winner of the 2016, 2018 and 2021 Sullivan thesis prizes for the best UK computer vision thesis.
Completed thesis titles:
- Multi-Task Autonomy For Robotics (viva complete, undergoing corrections 2023)
- Active Sampling for Computer Vision (viva complete, undergoing corrections 2023)
- Using Reinforcement Learning to Design and Control Free-Flying Space Robots (2022)
- Learning Generic Deep Feature Representations (2022)
- Optimal Use of Machine Learning for Planetary Terrain Navigation (2021)
- Machine Learning for Robotic Grasping (2021)
- Neural Sign Language Recognition and Translation (2020)
- Learning to Recognise Visual Content from Textual Annotation (2018)
- Collaborative Strategies for Autonomous Localisation, 3D Reconstruction and Pathplanning (2017)
- 2D and 3D Tracking and Modelling (2016)

2017–pres **Module organiser**, Solely responsible for the new EEE2047 module including an entirely new assessment pattern for teaching programming.

2015–pres **Undergraduate/MSc dissertation project administrator**, *Developed and maintained an electronic system for proposing, bidding, allocating and examining more than 100 final year dissertations annually across the department*.

2014 **Organiser and General Chair**, British Machine Vision Association (BMVA) Student Symposium, where 20 UK PhD students presented and discussed their current computer vision research.

2013–2015 **Lead RA on EPSRC project**, responsible for presenting the groups research to collaborators, organising the project outreach page (`cvssp.org/projects/dynavis/overview`) and arranging transfer of research materials between partners.

2013–2018 **Organising and chairing reading groups**, each month. Students found these invaluable for improving critical reading skills.

Outreach, invited talks & Other evidence of standing

2022 **Associate Editor**, International Conference on Robotics and Automation (ICRA).

2021 **Session chair**, International Conference on Robotics and Automation (ICRA).

2019–pres **Area chair**, British Machine Vision Conference (BMVC).

2018–pres **Internal examiner**, for numerous PhD awards.

2018 **Program Committee member**, IEEE Conference on Computer Vision and Pattern Recognition (CVPR).

2017 **Presented the centre's robotics research**, at the "Festival of Wonder" (3000 attendees).

2017 **Technical Program Committee member**, International Conference on Internet of Things and Machine Learning (IML).

2016 **Presented the centre's robotics research**, to 300 members of the general public, alongside numerous industrial and academic presentations at the "Evening on Space Robotics" event. The presentation received excellent feedback and was referred to as "the star of the show".

2016–pres **Health and Safety forum**, *member, reporting (quarterly) on H&S issues pertaining to robotics research*, across the research centre and undergraduate teaching.

2016–pres **UG/PG dissertations**, maintaining the automated submission, allocation and feedback system for the Electronic Engineering department.

2015 **Organised invited talks**, by researcher from Carnegie Mellon University, Edinburgh University and Microsoft Research Cambridge.

2014 **Efutures network**, application accepted to participate in funding sandpit. Lead to first successfully funded proposal, and a collaborative journal publication.

2013–pres **Conference speaker**, *research invited for oral presentation at numerous internationally renowned conferences, including IEEE CVPR, IEEE ICRA, BMVC, TAROS and others*, (see publications list for details).

2013–pres **Invited speaker**, *research invited for oral presentation at numerous one day technical meetings sponsored by the BMVA*, These meetings include: " Robotics meets Semantics: Enabling Human-Level Understanding in Robots", "Geometry and Deep Learning", "BMVA Student Symposium", "Reconstructing a Dynamic World".

2012–pres **Reviewer**, *for numerous internationally renowned conferences and journals, including IEEE TPAMI, IEEE TIP, Springer IJCV and Springer JMLC*, (total of 7 different journals with impact factor up to 17.7).

Membership of Societies

2022–pres **Surrey AI Fellow**, at the Institute for People Centred AI.

2016–pres **Fellow of the higher education academy**.

2016–pres **Member of InnovateUK Knowledge Transfer Network**, (Robotics and Autonomous Systems).

2012–pres **Member of Institute of Engineering and Technology (IET)**, currently applying for CEng status.

2012–pres **Member of British Machine Vision Association (BMVA)**.

2010–pres **Member of Institute for Electrical and Electronics Engineers (IEEE)**.

Publications

Publications are sorted in reverse chronological order (most recent first). The total number of indexed citations is currently around **1500** and is growing rapidly each year, leading to a current H-Index of **15**.

Refereed journal articles

Journal [1] **Simon Hadfield**, Karel Lebeda and Richard Bowden. HARD-PnP: PnP Optimization Using a Hybrid Approximate Representation. In IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI), 2018

Journal [2] Karel Lebeda, **Simon Hadfield**, and Richard Bowden. TMAGIC: A Model-free 3D Tracker. In IEEE Transactions on Image Processing (TIP), 2017. 1 citation

Journal [3] **Simon Hadfield**, Karel Lebeda and Richard Bowden. Hollywood 3D - 3D Action recognition in the wild. In Springer International Journal of Computer Vision (IJCV), 2016. 7 citations

Journal [4] Karel Lebeda, **Simon Hadfield**, and Richard Bowden. Texture-independent long-term tracking. IEEE Transactions on Image Processing (TIP), 25(1):359–371, 2016. 10 citations

Journal [5] **Simon Hadfield**, and Richard Bowden. Stereo reconstruction using top-down cues from urban environment. In Elsevier journal of Computer Vision and Image Understanding (CVIU), 2016. 2 citations

Journal [6] Miguel Lopez-Benitez, Tim Drysdale, **Simon Hadfield**, and Mohamed Ismaeel Maricar. Prototype for Multidisciplinary Research in the context of the Internet of Things. In Elsevier Journal of Network and Computer Applications, 2016. 3 citations

Journal [7] **Simon Hadfield** and Richard Bowden. Scene particles: Unregularized particle based scene flow estimation. IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI), 36(3):564–576, March 2014. 40 citations

Refereed conference articles

Conference [8] Jaime Spencer, Richard Bowden, **Simon Hadfield**. Scale-adaptive Neural Dense Features: Learning via hierarchical context aggregation. conference on Computer Vision and Pattern Recognition (CVPR), 2019

Conference [9] Celyn Walters, Oscar Mendez, **Simon Hadfield**, Richard Bowden. A Robust Extrinsic Calibration Framework for Vehicles with Unscaled Sensors. International conference on Intelligent Robots and Systems (IROS), 2019

Conference (oral) [10] Stephanie Stoll, Necati Cihan Camgoz, **Simon Hadfield**, Richard Bowden. Sign Language Production using Neural Machine Translation and Generative Adversarial Networks. British Machine Vision Conference (BMVC), 2018

Conference [11] Necati Cihan Camgoz, **Simon Hadfield**, Oscar Koller, Richard Bowden. Neural Sign Language Translation. IEEE conference on Computer Vision & Pattern Recognition (CVPR), 2018

Conference [12] Oscar Mendez, **Simon Hadfield**, Nicolas Pugeault, Richard Bowden. SeDAR-Semantic Detection and Ranging: Humans can localise without LiDAR, can robots? International Conference on Robotics and Automation (ICRA), 2018

Conference [13] Sarah Ebling, Necati Cihan Camgoz, Penny Boyes Braem, Katja Tissi, Sandra Sidler-Miserez, Stephanie Stoll, **Simon Hadfield**, Tobias Haug, Richard Bowden, Sandrine Tornay and others. SMILE Swiss German Sign Language Dataset. Language Resources and Evaluation Conference (LREC), 2018

Conference (oral) [14] Necati Cihan Camgoz, **Simon Hadfield**, and Richard Bowden. SubUNets: End-to-end Hand Shape and Continuous Sign Language Recognition. IEEE International Conference on Computer Vision (ICCV), 2017. 2 citations

Conference [15] Oscar Mendez, **Simon Hadfield**, Nicolas Pugeault and Richard Bowden. Taking the Scenic Route: Opportunistic, Collaborative Pathplanning for Autonomous Mapping. IEEE International Conference on Computer Vision (ICCV), 2017

Conference [16] Rebecca Allday, **Simon Hadfield**, and Richard Bowden. From Vision to Grasping: Adapting Visual Networks. In Proceedings, Towards Autonomous Robotic Systems Conference (TAROS), 2017

Conference (oral) [17] Oscar Mendez, **Simon Hadfield**, Nicolas Pugeault and Richard Bowden. Next-best stereo: extending next-best view optimisation for collaborative sensors. In Proceedings, British Machine Vision Conference (BMVC), 2016. 1 citation

Conference [18] **Simon Hadfield**, and Richard Bowden. Exploiting high level scene cues in stereo reconstruction. International Conference on Computer Vision (ICCV), 2015. 3 citations

Conference [19] Karel Lebeda, **Simon Hadfield**, and Richard Bowden. Exploring causal relationships in visual object tracking. International Conference on Computer Vision (ICCV), 2015. 4 citations

Conference [20] **Simon Hadfield**, Karel Lebeda, and Richard Bowden. Natural action recognition using invariant 3D motion encoding. In Proceedings of the European Conference on Computer Vision (ECCV), Lecture Notes in Computer Science, 2014. 17 citations

Conference [21] Karel Lebeda, **Simon Hadfield**, and Richard Bowden. 2D or not 2D: Bridging the gap between tracking and structure from motion. In proceedings of Asian Conference on Computer Vision (ACCV), 2014. 11 citations

Conference [22] **Simon Hadfield** and Richard Bowden. Scene flow estimation using intelligent cost functions. In Proceedings of the British Machine Vision Conference (BMVC), 2014. 5 citations

Conference [23] **Simon Hadfield** and Richard Bowden. Hollywood 3D: Recognizing actions in 3D natural scenes. In Proceedings, IEEE conference on Computer Vision and Pattern Recognition (CVPR), pages 3398–3405, 2013. 77 citations

Conference (oral) [24] **Simon Hadfield** and Richard Bowden. Go with the flow: Hand trajectories in 3D via clustered scene flow. In Proceedings, International Conference on Image Analysis and Recognition, volume 7324 of Lecture Notes in Computer Science, pages 285–295, 2012. 5 citations

Conference [25] **Simon Hadfield** and Richard Bowden. Kinecting the dots: Particle based scene flow from depth sensors. In Proceedings, IEEE International Conference on Computer Vision (ICCV), pages 2290–2295, 2011. 74 citations

Refereed workshop articles

Conference [26] Jaime Spencer Martin, Oscar Mendez, Richard Bowden, **Simon Hadfield**. Localisation via Deep Imagination: learn the features not the map. In Proceedings, European conference on Computer Vision (ECCV) workshop on Vision-based Navigation for Autonomous Driving, 2018

Conference [27] Necati Cihan Camgoz, **Simon Hadfield**, Oscar Koller, Richard Bowden. Particle Filter based Forced Alignment for Continuous Gesture Recognition. IEEE International Conference on Computer Vision (ICCV), ChaLearn Workshop, 2017

Conference (oral) [28] Karel Lebeda, **Simon Hadfield**, and Richard Bowden. Direct-from-Video: Unsupervised NRSfM. In Proceedings, European conference on Computer Vision (ECCV) workshop on Recovering 6D Object Pose, 2016. 1 citation

Conference (oral) [29] Necati Cihan Camgoz, **Simon Hadfield**, Oscar Koller, Richard Bowden. Using Convolutional 3D Neural Networks for User-Independent Continuous Gesture Recognition. IEEE International Conference of Pattern Recognition (ICPR), ChaLearn Workshop, 2016. 16 citations

Conference [30] M. Kristan, J. Matas, A. Leonardis, M. Felsberg, L. Čehovin, G. Fernandez, T. Vojiř, G. Hager, G. Nebehay, R. Pflugfelder, A. Gupta, A. Bibi, A. Lukežič, **S. Hadfield** and others. The Visual Object Tracking VOT2016 challenge results. In Proceedings, Workshop on Visual Object Tracking Challenge at the European Conference on Computer Vision (ECCV), 2016. 32 citations

Conference [31] M. Felsberg, M. Kristan, J. Matas, A. Leonardis, R. Pflugfelder, G. Häger, A. Berg, A. Eldesokey, J. Ahlberg, L. Čehovin, **S. Hadfield** and others. The Thermal Infrared Visual Object Tracking VOT-TIR2016 Challenge Results. In Proceedings, Workshop on Visual Object Tracking Challenge at the European Conference on Computer Vision (ECCV), 2016. 24 citations

Conference (oral) [32] Karel Lebeda, **Simon Hadfield**, and Richard Bowden. Dense Rigid Reconstruction from Unstructured Discontinuous Video. IEEE International Conference on Computer Vision (ICCV) workshop on 3D Representation and Recognition, 2015. 4 citations

Conference [33] M. Kristan, J. Matas, A. Leonardis, M. Felsberg, L. Čehovin, G. Fernandez, T. Vojiř, G. Hager, G. Nebehay, R. Pflugfelder, A. Gupta, A. Bibi, A. Lukežič, **S. Hadfield** and others. The Visual Object Tracking VOT2015 challenge results. In Proceedings, Workshop on Visual Object Tracking Challenge at the International Conference on Computer Vision (ICCV), 2015. 208 citations

Conference (oral) [34] Matthew Marter, **Simon Hadfield**, and Richard Bowden. Friendly faces: Weakly supervised character identification. In Face and Facial Expression Recognition from Real World Videos workshop at International Conference for Pattern Recognition (ICPR), Lecture Notes in Computer Science, 2014. 2 citations

Conference [35] Kristan M, Pflugfelder R, Leonardis A, Matas J, Cehovin L, Nebehay G, Vojir T, Fernandez G, Lukezic A, **Hadfield S** and others. The Visual Object Tracking VOT2014 challenge results. In Proceedings, Workshop on Visual Object Tracking Challenge at European Conference for Computer Vision (ECCV), Lecture Notes in Computer Science, 2014. 209 citations

Conference (oral) [36] Karel Lebeda, **Simon Hadfield**, Jiri Matas, and Richard Bowden. Long-term tracking through failure cases. In Proceedings, IEEE workshop on visual object tracking challenge at International Conference on Computer Vision (ICCV), pages 153 – 160, 2013. 32 citations

Conference [37] **Simon Hadfield** and Richard Bowden. Generalised pose estimation using depth. In Proceedings, International Workshop on Sign, Gesture and Activity at European Conference on Computer Vision (ECCV) 2010, volume 6553 of Lecture Notes in Computer Science, pages 312–325, 2010. 12 citations