Christopher Edwin Mower

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Education

University of Edinburgh — **Edinburgh, UK**
PhD Informatics — *September 2021*
Thesis: An Optimization-based Formalism for Shared Autonomy in Dynamic Environments
Supervised by Professor Sethu Vijayakumar FRSE. Affiliated with the Edinburgh Centre for Robotics.

Imperial College London — **London, UK**
MSc Computing (Visual Information Processing) — *August 2016*
Dissertation: Objective Assessment of Surgical Dexterity
Supervised by Dr Benny Lo.

University of Manchester — **Manchester, UK**
MSc Applied Mathematics with Numerical Analysis — *August 2015*
Dissertation: Shrinking For Restoring Definiteness
Supervised by Professor Nicholas J. Higham FRS, and Dr Craig Lucas (NAG).

University of Sheffield — **Sheffield, UK**
BSc Mathematics — *August 2012*

Experience

King's College London — **London, UK**
Research Associate — *May 2022—*
- Work in the RViM Lab with Christos Bergeles, and CAI4CAI group with Tom Vercauteren.
- Robotic surgery, human-robot interaction, imitation learning, and shared autonomy.
- Collaborating on the European Union Horizon 2020 project FAROS.
- Attended surgical summer school and other workshops/training sessions, and observed live surgery.

University of Edinburgh — **Edinburgh, UK**
Research Associate — *September 2021—May 2022*
- Worked in the SLMC Group with Sethu Vijayakumar.
- Shared control for sequencing hybrid multi-contact, dual-arm interactions.
- Developed and implemented ROS-PyBullet interface.
- Collaborated on the European Union Horizon 2020 project HARMONY and ORCA Hub.
- Contributed to the Smart Factory projects in collaboration with the Kawada Group, Japan.
- Affiliated with The Alan Turing Institute.
- Several contributions to the EXOTica library.

University of Edinburgh — **Edinburgh, UK**
Lab demonstrator — *January 2019—June 2020*
- Supervisory role for the course System Design Project on HRI and UX. Marking assignments, group assessments, etc.

The Numerical Algorithms Group (NAG) — **Manchester, UK**
Numerical software developer intern — *June 2014—October 2014*
- Analyzed and implemented the routine `G02ANF` in FORTRAN that computes a correlation matrix, subject to preserving a leading principle submatrix by applying the smallest uniform perturbation of the remainder of the approximate input matrix.
- Authored documentation and example routines for `G02ANF`, and collaborated with NAG personnel on the development of several unit and functional tests.
- Routine included in the Mark 25 NAG C and FORTRAN Libraries, and NAG Toolbox *for MATLAB*.
- Acknowledged as a code contributor to the NAG Library.

University of Manchester — **Manchester, UK**
Research intern — *May 2014—October 2014*
- Implemented a method in Python that computes a unit triangular matrix with prescribed singular values, unit/functional tests, and reviewed related code developed by PhD students at University of Manchester. Used Git/Github for source control.
- Project supervised by Professor Nicholas J. Higham FRS.

Scholarships and Awards

- **First prize for best poster** on *Non-prehensile Dual Arm Manipulation* at the 5th IEEE UK & Ireland RAS Conference 2022.
- **First prize** for "*Greatest Potential For Positive Impact*", Robots for Resilient Infrastructure International Challenge, UK, 2017.
- **iCASE Studentship Award**, University of Edinburgh, The Costain Group, and UKRI-EPSRC, 2016.
- **Industrial Bursary Award**, University of Manchester, Numerical Algorithms Group (NAG), 2015.
- Travel grant from London Mathematical Society for *Prospects in Mathematics*, University of Oxford, 2014.

Publications

Christopher E. Mower, Theodoros Stouraitis, João Moura, Christian Rauch, Lei Yan, Nazanin Zamani Behabadi, Michael Gienger, Tom Vercauteren, Christos Bergeles, Sethu Vijayakumar, "*ROS-PyBullet Interface: A Framework for Reliable Contact Simulation and Human-Robot Interaction*", [to appear] Conference on Robot Learning (CoRL), 2022. [Links: submission, submission video, code]
Christopher E. Mower, João Moura, Theodoros Stouraitis, Sethu Vijayakumar, "*Shared Autonomy for Enhancing Trajectory Optimization*", Proc. of the IEEE ICRA Workshop on Shared Autonomy in Physical Human-Robot Interaction: Adaptability and Trust, 2022. [Links: paper, talk, poster, workshop]
Christopher E. Mower, João Moura, Sethu Vijayakumar, "*Skill-based Shared Control*", Robotics: Science and Systems (R:SS), 2021. [Links: paper, video, presentation, poster]
Christopher E. Mower, João Moura, Sethu Vijayakumar, "*Modulating Human Input for Shared Autonomy in Dynamic Environments*", IEEE RO-MAN, 2019. [Links: paper, pdf]
Christopher E. Mower, Wolfgang Merkt, Sethu Vijayakumar, "*Comparing Alternate Modes of Teleoperation for Constrained Tasks*", IEEE CASE, 2019. [Links: paper, pdf, preprint, video]
Wolfgang Merkt, Yiming Yang, Theodoros Stouraitis, **Christopher E. Mower**, Maurice Fallon, Sethu Vijayakumar, "*Robust shared autonomy for mobile manipulation with continuous scene monitoring*", IEEE CASE, 2017. [Links: paper, pdf, video, outreach demo, press (BBC), press (Made In Leeds TV)] [**First prize for "*Greatest potential for Positive Impact*", see below**]

Skills

- **Programming**: Most fluent in Python, then C++, MATLAB, and FORTRAN. Some experience with Lisp, and Lua.
- **Hardware**: Experience developing/implementing demonstrations and experiments using the KUKA LBR Med Arm, KUKA LWR Arm, Kawada Nextage humanoid, Clearpath Husky UGV, Universal Robot 5 (UR5) Arm, and Robotiq 3-finger adaptive gripper. Additionally, experience setting up and integrating several sub-systems: (i) human interfaces such as the Haption Virtuose 6D and Touch X haptic devices, several joysticks, and 3DConnexion SpaceMouse, (ii) perception sensors such as the ASUS Xtion RGBD-camera, and Bumblebee2 FireWire stereo vision camera, and (iii) motion tracking systems such as Vicon and AprilTags.
- **Operating systems**: Most experienced using Ubuntu and Mac OS. Some experience using Windows.
- **Libraries, packages, and frameworks**: CasADi, CVXOPT, Eigen, Git, Gurobi, Ipopt, Knitro, LAPACK, LCM, Matplotlib, MoveIt, NAG Library, Numpy, OSQP, Gym Library, OpenCV, Pandas, PyBullet, PyGame, PyTorch, ROS/ROS2, SNOPT, Scikit-learn, Scipy, and CoppeliaSim (V-REP).
- **Document preparation and code editing**: LaTeX, Emacs, and Vim. Some experience using Visual Studio Code.
- **Time management**: Org-mode (for Emacs).
- **Soft skills**: mentoring, public speaking, self-motivated, and open to feedback and idea exchange.

Projects

- **OPTAS** (lead): an optimization-based task specification library for trajectory optimization and model predictive control.
- **ROS-PyBullet Interface** (lead): a framework for reliable contact simulation and human-robot interaction (*accepted at the Conference on Robot Learning (CoRL) 2022*).
- **EXOTica** (contributor): an extensible optimization toolset for prototyping and benchmarking motion planning and control.

Responsibilities

- Reviewer: ICRA, CASE.
- Vice President for SIAM Student Chapter, University of Manchester, Sept 2014 — Sept 2015.
- Session chair, SIAM Student Chapter Conference, 2014, 2015.
- Program Representative for MSc Group, University of Manchester, Sept 2014 — Sept 2015.
- School of Mathematics Board Member, University of Manchester, Sept 2014 — Sept 2015.
- Team Captain for University of Sheffield Badminton Club, University of Sheffield, Sept 2010 — Sept 2012.

Training

- Surgical and Interventional Engineering Summer School 2022 at Guy's and St. Thomas' Hospital, King's College London.
- King's NeuroLab Teaching Sessions: Posterior lumbar spine approaches, June 2022.
- First aid at work, St. Johns Ambulance.
- National Pool Lifeguard Qualification, Royal Life Saving Society.

Additional

- Personal interests: Badminton (competed at county and university level, coaching experience), Guitar.