



Christopher Edwin Mower

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Education

University of Edinburgh

PhD Informatics [iCASE Studentship funded by The Costain Group]

Thesis: An Optimization-based Formalism for Shared Autonomy in Dynamic Environments

Supervised by Professor Sethu Vijayakumar FRSE.

Affiliated with the Edinburgh Centre for Robotics.

Edinburgh, UK

September 2021

Imperial College London

MSc Computing (Visual Information Processing)

Dissertation: Objective Assessment of Surgical Dexterity

Supervised by Dr Benny Lo.

London, UK

August 2016

University of Manchester

MSc Applied Mathematics with Numerical Analysis [bursary for dissertation funded by NAG]

Dissertation: Shrinking For Restoring Definiteness

Supervised by Professor Nicholas J. Higham FRS, and Dr Craig Lucas (NAG).

Manchester, UK

August 2015

University of Sheffield

BSc Mathematics

Sheffield, UK

August 2012

Experience

Kings College London

Research Associate

- Work in the RViM Lab with Christos Bergeles, and CAI4CAI group with Tom Vercauteren.
- Robotic surgery, human-robot interaction, imitation learning, shared autonomy.
- Collaborating on the European Union Horizon 2020 project FAROS.

London, UK

May 2022 —

University of Edinburgh

Research Associate

- Worked in the SLMC Group with Sethu Vijayakumar.
- Shared control for sequencing hybrid multi-contact, dual-arm interactions.
- Developed and implemented ROS-PyBullet interface, see Projects section below.
- 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.

Edinburgh, UK

September 2021 — May 2022

University of Edinburgh

Lab demonstrator

- Provided expertise in a supervisory role, for the course System Design Project (SDP), on human-robot interaction, usability testing, and interfaces. Marking assignments responsibilities, group assessments, etc.

Edinburgh, UK

January 2019 — June 2020

The Numerical Algorithms Group (NAG)

Numerical software developer intern

- 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.

Manchester, UK

June 2014 — October 2014

University of Manchester

Research intern

- 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.

Manchester, UK

May 2014 — October 2014

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.
- Travel grant from London Mathematical Society for *Prospects in Mathematics*, University of Oxford, 2014.

Publications

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 MATLAB, FORTRAN, and C++. Some experience with Lisp, and Lua.
- **Hardware**: Experience developing/implementing demonstrations and experiments using the 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: human interfaces (i.e. joystick, space mouse), sensors (i.e. ASUS Xtion RGBD-camera, and Bumblebee2 FireWire stereo vision camera), and motion tracking (i.e. Vicon).
- **Operating systems**: Most experienced using Ubuntu and Mac OS. Some experience using Windows.
- **Libraries, packages, and frameworks**: CasADi, Eigen, Git, Gurobi, IPOPT, KNITRO, LAPACK, LCM, Matplotlib, NAG Library, Numpy, OpenAI Gym, OpenCV, Pandas, PyBullet, PyGame, ROS/ROS2, SNOPT, Scikit-learn, Scipy, and V-REP.
- **Document preparation and code editing**: L^AT_EX, 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

- **ROS-PyBullet Interface** (*currently private, release planned in next several months*): a framework that provides an interface between the Robot Operating System (ROS) with a reliable impact/contact simulator Pybullet. The package can be easily used alongside physical systems, and is intended to enable easy development/prototyping of control and machine learning algorithms in contact-rich scenarios.
 - Written in Python within a ROS package.
 - I am the lead developer alongside other core contributors from the SLMC Group, University of Edinburgh. In addition, I regularly submit pull-requests and review others code.
- **EXOTica**: an extensible tool-set for inverse kinematics, trajectory optimization, and optimal control with a design advocating modularity, extensibility, and integration with ROS.
 - Written in C++ with bindings for Python.
 - Summary of my contributions: several task maps (maps joint states to some task space), modifications/additions/bug-fixes to EXOTica core functionality, and Python bindings; a facility that allows a user to interactively tune a cost function; unit/functional tests for each contribution; code reviews on others pull-requests.
 - Source control for EXOTica is done using Git/Github and leverages continuous integration.

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.

Additional

- Professional qualifications: First aid at work (St. Johns Ambulance, UK), National Pool Lifeguard Qualification (Royal Life Saving Society, UK).
- Personal interests: Badminton (competed at county and university level, coaching experience), Guitar.

References

Available upon request.