

Zachary M. C. Baum, MSc, BComp

PhD Student - EPSRC i4health Center for Doctoral Training

Department of Biomedical Engineering and Medical Physics, University College London

EDUCATION

University College London (UCL) London, United Kingdom
Doctor of Philosophy **Sep. 2019 -**

Thesis Topic: "Machine learning for ultrasound-guided interventions"

Queen's University Kingston, Ontario, Canada
Master of Science (Computing) **Sep. 2017 - May 2019**

Thesis Title: "Augmented reality training platform for placement of neurosurgical burr holes"

Cumulative GPA: 4.30 / 4.30

Queen's University Kingston, Ontario, Canada
Bachelor of Computing (Honours) - Biomedical Computing **Sep. 2013 - May 2017**

Honours Thesis Title: "Mobile augmented reality display system for surgical navigation"

Dean's Honour List with Distinction Standing: 2016 – 2017

Dean's Honour List Standing: 2013 – 2016

Cumulative GPA: 3.99 / 4.30 (4th in class)

HONOURS & AWARDS

School of Computing, Queen's University **Apr. 2019**
Ian A. Macleod Award

This award is granted to the graduate student who made the greatest contribution to the intellectual and social spirit of the School of Computing during the preceding academic year.

Queen's University **Feb. 2019**
Agnes Benidickson Tricolour Award

Admissions to the Tricolour Society through the Agnes Benidickson Tricolour Award is the highest honour given to a Queen's student for non-academic, non-athletic activities. This award is named after Dr. Agnes Benidickson who was Chancellor of Queen's University from 1980 until 1996. With all recipients chosen by their fellow students, this honour is bestowed in recognition of the valuable and distinguished service of outstanding individuals to the University.

Hamlyn Centre for Surgical Robotics, Imperial College London **Dec. 2018**
Hamlyn Winter School Best Project Award, Runner-Up

Queen's University Athletics and Recreation **Nov. 2018**
Nixon Academic Leadership Award

Awarded to the male and female varsity student-athletes who have exemplified achievement in academics, community service and fair play in their sport.

School of Computing, Queen's University **May 2017**
Award for Outstanding Contribution to School Life

Recognizes outstanding contributions by a student to the Queen's School of Computing with distinguished service, while maintaining excellent academic performance and research contributions throughout their undergraduate career.

Computing Students' Association (COMPSA), Queen's University **Mar. 2017**
Gradum Dominus Machinarium Award

Presented to a graduating undergraduate student who has, throughout their time at Queen's has contributed to the betterment of the University experience and demonstrated spirit and enthusiasm for everything COMPSA.

Sunnybrook Research Institute

The Sunnybrook Research Prize, National Finalist

Jan. 2017

Recognized as one of six national finalists for excellence in undergraduate biomedical sciences research.

GRANTS, FELLOWSHIPS & SCHOLARSHIPS

University College London

Graduate Research Scholarship & Overseas Research Scholarship - £175,000 Sep. 2019 - Aug. 2023

"Machine learning for ultrasound-guided interventions"

The Graduate Research Scholarship and Overseas Research Scholarship Programs are awarded on the basis of academic excellence and research potential to attract high-quality students to University College London to undertake postgraduate research programs.

Natural Sciences and Engineering Research Council of Canada (NSERC)

Postgraduate Scholarship-Doctoral - \$63,000 CAD

Sep. 2019 - Aug. 2022

"Intelligent simulated environments for augmented reality surgical training"

The Postgraduate Scholarships-Doctoral Program provides financial support to high-calibre scholars who are engaged in a doctoral program in the natural sciences or engineering.

Hamlyn Centre for Surgical Robotics, Imperial College London

Hamlyn Winter School Travel Scholarship - £500

Dec. 2018

Government of Ontario – Ministry of Advanced Education and Skills Development

Ontario Graduate Scholarship - \$15,000 CAD

Sep. 2018 - Aug. 2019

"Holographic visualization for neurosurgical planning and training"

The Ontario Graduate Scholarship program provides merit-based scholarships to Ontario's best graduate students in all disciplines and encourages excellence in graduate studies at publicly-assisted universities in Ontario.

School of Graduate Studies, Queen's University

Tri-Agency Recipient Recognition Award - \$5,000 CAD

Sep. 2017 - Aug. 2018

Natural Sciences and Engineering Research Council of Canada (NSERC)

Alexander Graham Bell Canada Graduate Scholarship - \$17,500 CAD

Sep. 2017 - Aug. 2018

"Mobile augmented reality display system for musculoskeletal injections"

The Canada Graduate Scholarship Program provides financial support to high-calibre scholars who are engaged in eligible master's programs in Canada.

Queen's School of Computing

Undergraduate Research Fellowship - \$6,500 CAD

May 2017 - Aug. 2017

"Image overlay surgical navigation in musculoskeletal procedures"

The Queen's School of Computing Undergraduate Research Fellowship is an undergraduate research award that supports summer undergraduate research for Computing undergraduate students who have demonstrated academic excellence.

Natural Sciences and Engineering Research Council of Canada (NSERC)

Undergraduate Student Research Award - \$6,000 CAD

May 2016 - Aug. 2016

"Image overlay guidance for medical interventions"

RESEARCH EXPERIENCE

Laboratory for Percutaneous Surgery, School of Computing, Queen's University

Research Assistant

May 2015 - May 2019

Develops open-source medical engineering solutions for image-guided therapy and surgical navigation. Contributes to the open-source platforms 3DSlicer and SlicerIGT through implementation and development of software for ultrasound-based scoliosis monitoring and augmented reality display devices. Conducts clinical trials and feasibility studies for augmented reality and holographic technologies in neurosurgical planning and emergency medicine. Provides mentorship and supervision to high-school and undergraduate students; recent supervised projects include assessment of tracked ultrasound calibration reproducibility and development of low-cost needle guides for spine interventions, among others.

ACADEMIC & TEACHING EXPERIENCE

Teaching Assistance

School of Computing, Queen's University

To Prof. G. Fichtinger: CISC 472 - Medical Informatics

Winter 2019

To R. Linley & W. Powley: CISC 121 - Introduction to Computing Science I

Winter 2019

To Dr. M. S. Rakha: CISC 432 - Advanced Data Management Systems

Fall 2018

To Prof. G. Fichtinger: CISC 472 - Medical Informatics

Winter 2018

To R. Linley: CISC P81 - Computers: Applications and Implications

Winter 2017

To Prof. R. Dawes: CISC 365 - Algorithms

Fall 2016

To R. Linley: CISC P81 - Computers: Applications and Implications

Fall 2015

Faculty of Engineering and Applied Science, Queen's University

To Prof. D. Skillicorn: CMPE 365 - Algorithms

Fall 2017

PROFESSIONAL EXPERIENCE

Verdure Imaging Inc.

Senior Medical Systems Software Engineer

Jul. 2016 -

Develops ultrasound-based diagnostic software for monitoring and assessing scoliosis. Works to implement well-designed and user-friendly software and develop documentation which is compliant with FDA and other regulatory bodies.

Smith School of Business, Queen's University

Project Assistant

May 2019 – Aug. 2019

Advises students in the Master of Management in Artificial Intelligence program on implementation strategies and technology solutions for their Capstone projects. Guides student model development and validation efforts, while aiding students in selecting and reviewing appropriate reporting and visualization tools.

Office of Undergraduate Admission and Recruitment, Queen's University

Automation Developer

Jan. 2019 - May 2019

Developed software and macros to automate the reporting and collection of various test scores and other application-specific information for Admission Coordinators to simplify daily workflows and remove the need for manual searches through internal datastores by any staff members.

COMMUNITY INVOLVEMENT

Sail Canada / Voile Canada

Director at Large, Board of Directors

Oct 2018 -

Provides the governance and strategic direction for the Association. Brings an array of skills, expertise, and sailing experience to fulfill my responsibilities and duties on the board with respect to setting the vision and mission of the Association. Provides input and monitors performance of

all branches of the Association by overseeing core financial information and updating policies to reflect international best practices in sailing.

Faculty of Arts and Science, Queen's University

Graduate Studies Mentor & Recruitment Advisor

Aug. 2018 - May 2019

Took part in discussions with current undergraduate students through online and in-person events to address concerns and questions of prospective students on programs, supervisors, funding applications and graduate student life.

Graduate Computing Society (GCS), Queen's University

MSc SGPS Liaison Officer

May 2018 - May 2019

Attended meetings of the Society of Graduate and Professional Students (SGPS) and their Council to act as a liaison for the concerns of School of Computing graduate students with the SGPS.

Graduate Computing Society (GCS), Queen's University

President

May 2018 - May 2019

Was responsible for the day-to-day operations of the society. Planned monthly social events for students and sits on various committees as the voice and representative for computing graduate students. Revamped the Society's orientation activities to better engage with students and provide them with a grasp of the resources and supports available in the department and at Queen's. Created a 'Computing Graduate Student Handbook' for students to provide information on the department, resources, courses, and life in Kingston.

Office of Undergraduate Admission and Recruitment, Queen's University

Senior Campus Tour Guide

Mar. 2018 - May 2019

Led prospective students and families throughout campus, giving a first impression and information on Queen's University. Provides day-to-day oversight of the program and additional logistical support during large recruitment events.

School of Computing, Queen's University

Computing Student Research Conference, Founder & Conference Chair

Jan. 2018 - Oct. 2018

Was responsible for the planning and execution of the inaugural Computing Student Research Conference. Oversaw the management of six additional chairs and their respective committees to create and facilitate a conference which promotes and encourages Canadian students to engage in undergraduate and graduate research.

Graduate Computing Society (GCS), Queen's University

COMPSA Liaison Officer

Sep. 2017 - May 2019

Attended meetings of the Computing Students' Association (COMPSA) and their Council to act as a liaison for the School of Computing's graduate students with COMPSA. Provided assistance with interpretation of policy and external perspectives as an ex-officio member of the association.

Graduate Computing Society (GCS), Queen's University

MSc Graduate Committee Officer

Sep. 2017 - May 2019

Attended the School of Computing Graduate Committee's meetings to represent the opinions and interests of master's students in the School of Computing, and to actively strive to improve the MSc program for students.

School of Computing, Queen's University

School of Computing Council, Graduate Student Member

Sep. 2017 - May 2019

Voiced graduate student concerns and discusses changes to programs, courses and other aspects of the School of Computing with members of Administration, Faculty and Staff.

Graduate Computing Society (GCS), Queen's University

Vice President Operations

Sep. 2017 - May 2018

Primarily responsible for the day-to-day operations of the Society. Was responsible for the Society's finances, event budgeting and acted as a coordinator for all officers of the Society.

Queen's Varsity Sailing Team, Queen's University

President & Captain

Jan. 2017 - Dec. 2019

Acted as chairperson of the executive committee and as the team's spokesperson and representative to Queen's University and other external stakeholders. Managed finances and operations for the team of over 60 athletes and its coaching staff. Created the 'Try Varsity Sailing' program to bring high school sailors to Queen's to experience life as a student-athlete. Established partnerships with Able Sail Kingston to aid with their fundraising and promotional efforts.

Canadian Intercollegiate Sailing Association (CICSA)

Team Development Officer

Jan. 2017 - Dec. 2017

Created and promoted opportunities for new post-secondary institutions to develop competitive sailing programs through outreach and mentorship. Organized sailing clinics and implemented a team ranking system across the league to reinforce existing best practices in college sailing. Represented the Association to external sports associations such as Sail Canada.

Queen's Native Student Association (QNSA)

Director of Web Development

Sep. 2016 - Aug. 2017

Oversaw the design, development, and maintenance of the QNSA webpage, and worked to rebrand the organization's national online presence.

Arts and Sciences Undergraduate Society (ASUS), Queen's University

The Data Journal, Founder & Editor-in-Chief

May 2016 - Apr. 2017

Coordinated with the Editorial Board and Panel of Referees, tracks submissions to the Journal, hires management, and provides general supervision and oversight of the Journal's inaugural volume.

Office of Undergraduate Admission and Recruitment, Queen's University

Campus Tour Guide

Mar. 2016 - Mar. 2018

Led prospective students and families throughout campus, giving a first impression and information on Queen's University.

Information Technology Services (ITS), Queen's University

Information Services and Technology Student Advisory Committee Member

May 2015 - Apr. 2016

Provided concerns and commented on student priorities about information technology at Queen's University. Discussed current and future information technology initiatives while developing reports for ITS management.

School of Computing, Queen's University

School of Computing Council, Undergraduate Student Member

May 2015 - Apr. 2016

Voiced undergraduate student concerns and discussed changes to programs, courses and other aspects of the School of Computing with members of Administration, Faculty and Staff.

Computing Students' Association (COMPSA), Queen's University

Vice President Operations

May 2015 - Apr. 2016

Oversaw day-to-day operations and finances of the Association, worked with commissioners to assist with execution of their events and initiatives throughout the year. Renewed relations with the Arts and Science Undergraduate Society and worked collaboratively with them to found new programs such as The Data Journal - Queen's first undergraduate computer science research journal.

School of Computing, Queen's University

Orientation Chair

Oct. 2014 - Sep. 2015

Planned, coordinated and successfully delivered the 2015 Computing Orientation Week. Recruited and trained Orientation Leaders and Executives. Reinforced positive relations with external bodies and stakeholders, including students, staff, faculty and administrators ranging from the School of

Computing, to the Office of the Principal. Developed new events with other faculties to promote interfaculty relations and restructured several core events of the week. As a result, saw higher turn-out and retention rates than any previous computing orientation weeks.

School of Computing, Queen's University Open House Volunteer

Oct. 2013 - May 2019

Engages with students at various recruitment events, such as Fall Preview, March Break Open House, Majors Night, the Ontario University Fair and Summer Orientation to Academic Resources (SOAR). Helps to promote the Queen's School of Computing, the Faculty of Arts and Science, and the School of Graduate Studies to prospective students and parents through discussion of the programs offered at Queen's, and by demoing various graduate and undergraduate research projects at these events.

PUBLICATIONS & PRESENTATIONS

Conference Presentations with Proceedings

1. **Z Baum**, B Church, A Lasso, T Ungi, C Schlenger, D Borscheck, P Mousavi, G Fichtinger. "Step-wise identification of ultrasound-visible anatomical landmarks for 3D visualization of scoliotic spine," SPIE Medical Imaging - Image-Guided Procedures, Robotic Interventions, and Modeling. International Society for Optics and Photonics, Vol. 10951, p. 1095129 (2019). (Poster) [\[DOI\]](#)
2. H Lia, **Z Baum**, T Vaughan, T Ungi, T McGregor, G Fichtinger. "Electromagnetically tracked partial nephrectomy navigation: demonstration of concept," SPIE Medical Imaging - Image-Guided Procedures, Robotic Interventions, and Modeling. International Society for Optics and Photonics, Vol. 10951, p. 109512W (2019). (Poster) [\[DOI\]](#)
3. S Perrin, **Z Baum**, M Asselin, G Underwood, S Choueib, H Lia, T Ungi, A Lasso, G Fichtinger. "Reproducibility of freehand calibrations for ultrasound-guided needle navigation," SPIE Medical Imaging - Image-Guided Procedures, Robotic Interventions, and Modeling. International Society for Optics and Photonics, Vol. 10951, p. 109512B (2019). (Poster) [\[DOI\]](#)
4. J Wiercigoch, **Z Baum**, T Ungi, J Fritz, G Fichtinger. "Validation of a low-cost adjustable handheld needle guide for spine interventions," SPIE Medical Imaging - Image-Guided Procedures, Robotic Interventions, and Modeling. International Society for Optics and Photonics, Vol. 10951, p. 109510L (2019). (Oral) [\[DOI\]](#)
5. **Z Baum**, T Ungi, A Lasso, B Church, C Schlenger, G Fichtinger. "Visual aid for identifying vertebral landmarks in ultrasound," SPIE Medical Imaging - Image-Guided Procedures, Robotic Interventions, and Modeling. International Society for Optics and Photonics, Vol. 10576, p. 105760Z (2018). (Oral) [\[DOI\]](#)
6. R Hisey, T Ungi, M Holden, **Z Baum**, Z Keri, G Fichtinger. "Real-time workflow detection using webcam video for providing real-time feedback in central venous catheterization training," SPIE Medical Imaging - Image-Guided Procedures, Robotic Interventions, and Modeling. International Society for Optics and Photonics, Vol. 10576, p. 1057620 (2018). (Poster – Honourable Mention Award) [\[DOI\]](#)
7. C Pinter, B Travers, **Z Baum**, S Kamali, T Ungi, A Lasso, B Church, G Fichtinger. "Real-time transverse process detection in ultrasound" SPIE Medical Imaging - Image-Guided Procedures, Robotic Interventions, and Modeling. International Society for Optics and Photonics, Vol. 10576, p. 105760Y (2018). (Oral) [\[DOI\]](#)
8. **Z Baum**, T Ungi, A Lasso, G Fichtinger. "Usability of a real-time tracked augmented reality display system in musculoskeletal injections," SPIE Medical Imaging - Image-Guided Procedures, Robotic Interventions, and Modeling. International Society for Optics and Photonics, Vol. 10135, p. 101352T (2017). (Poster) [\[DOI\]](#)
9. A Ilina, A Lasso, M Jolley, B Wohler, A Nguyen, A Scanlan, **Z Baum**, F McGowan, G Fichtinger. "Patient-specific pediatric silicone heart valve models based on ultrasound," SPIE Medical Imaging - Image-Guided Procedures, Robotic Interventions, and Modeling. International Society for Optics and Photonics, Vol. 10135, p. 1013516 (2017). (Oral) [\[DOI\]](#)
10. G Underwood, T Ungi, **Z Baum**, A Lasso, G Kronreif, G Fichtinger. "Skull registration for prone patient position using tracked ultrasound," SPIE Medical Imaging - Image-Guided Procedures, Robotic Interventions, and Modeling. International Society for Optics and Photonics, Vol. 10135, p. 1013522 (2017). (Poster) [\[DOI\]](#)
11. R House, V Harish, A Lasso, **Z Baum**, G Fichtinger. "Evaluation of the Intel RealSense SR300 camera for image-guided interventions and application in vertebral level localization," SPIE Medical Imaging - Image-Guided Procedures, Robotic Interventions, and Modeling. International Society for Optics and Photonics, Vol. 10135, p. 101352Z (2017). (Poster) [\[DOI\]](#)

12. V Harish, E Bibic, A Lasso, M S Holden, T Vaughan, **Z Baum**, T Ungi, G Fichtinger. "Monitoring electromagnetic tracking error using redundant sensors," SPIE Medical Imaging - Image-Guided Procedures, Robotic Interventions, and Modeling. International Society for Optics and Photonics, Vol. 10135, p. 101352R (2017). (Poster) [\[DOI\]](#)
13. **Z Baum**, A Lasso, T Ungi, G Fichtinger. "Real-time self-calibration of a tracked augmented reality display," SPIE Medical Imaging - Image-Guided Procedures, Robotic Interventions, and Modeling, Vol. 9786, p. 97860F (2016). (Oral) [\[DOI\]](#)
14. V Harish, A Baksh, T Ungi, A Lasso, **Z Baum**, G Gauvin, CJ Engel, J Rudan, G Fichtinger. "Measurement of electromagnetic tracking error in a navigated breast surgery setup," SPIE Medical Imaging - Image Guided Procedures, Robotic Interventions, and Modeling, Vol. 9786, p. 97862K (2016). (Poster) [\[DOI\]](#)

Conference Presentations

1. **Z Baum**, S Ryan, E Rae, A Lasso, T Ungi, R Levy, G Fichtinger. "Assessment of intraoperative neurosurgical planning with the Microsoft HoloLens," 17th Annual Imaging Network of Ontario Symposium (2019). (Oral)
2. H Lia, **Z Baum**, T Vaughan, T Ungi, T McGregor, G Fichtinger. "Usability and accuracy of an electromagnetically tracked partial nephrectomy navigation system," 17th Annual Imaging Network of Ontario Symposium (2019). (Poster)
3. **Z Baum**, T Ungi, A Lasso, B Church, C Schlenger, G Fichtinger. "Ultrasound-based vertebral landmark localization using deformable spine models," 16th Annual Imaging Network of Ontario Symposium (2018). (Poster)
4. R Hisey, T Ungi, M Holden, **Z Baum**, Z Keri, C McCallum, D Howes, G Fichtinger. "Assessment of the use of webcam-based workflow detection for providing real-time feedback in central venous catheterization training," 16th Annual Imaging Network of Ontario Symposium (2018). (Poster)
5. C Pinter, B Travers, **Z Baum**, T Ungi, A Lasso, B Church, G Fichtinger. "Real-time transverse process delineation in tracked ultrasound for scoliosis measurement," 16th Annual Imaging Network of Ontario Symposium (2018). (Poster)
6. **Z Baum**, T Ungi, A Lasso, G Fichtinger. "Real-time, tracked, mobile augmented reality display for surgical navigation: usability study on simulated patients," 9th National Image-Guided Therapy Workshop (2017). (Poster)
7. **Z Baum**, T Ungi, A Lasso, G Fichtinger. "Evaluation of a mobile, real-time, tracked augmented reality display for surgical navigation," 15th Annual Imaging Network of Ontario Symposium (2017). (Oral)
8. A Ilina, A Lasso, M Jolley, B Wohler, A Nguyen, A Scanlan, **Z Baum**, F McGowan, G Fichtinger. "Creating patient-specific anatomical models from highly elastic materials using 3D-printed molds," 15th Annual Imaging Network of Ontario Symposium (2017). (Poster)
9. E Bibic, **Z Baum**, V Harish, T Ungi, A Lasso, G Fichtinger. "PLUS Model Catalog: A library of 3D-printed medical tools," 15th Annual Imaging Network of Ontario Symposium (2017). (Poster)
10. G Underwood, T Ungi, **Z Baum**, A Lasso, G Kronreif, G Fichtinger. "Registration of preoperative images for navigated brain surgery using ultrasound-accessible skull regions," 15th Annual Imaging Network of Ontario Symposium (2017). (Oral)
11. V Harish, E Bibic, A Lasso, M Holden, T Vaughan, **Z Baum**, T Ungi, G Fichtinger. "An application of redundant sensors for intraoperative electromagnetic tracking error monitoring," 15th Annual Imaging Network of Ontario Symposium (2017). (Oral)
12. **Z Baum**, A Lasso, T Ungi, G Fichtinger. "Usability of augmented reality displays for musculoskeletal surgical navigation," Canadian Undergraduate Conference on Healthcare (2016). (Poster)
13. **Z Baum**, A Lasso, T Ungi, G Fichtinger. "Real-time self-calibration of a handheld augmented reality overlay system," 14th Annual Imaging Network Ontario Symposium (2016). (Poster)
14. V Harish, A Baksh, T Ungi, A Lasso, **Z Baum**, G Gauvin, C Engel, J Rudan, G Fichtinger. "Monitoring electromagnetic tracking error in computer-navigated breast cancer surgery," 14th Annual Imaging Network Ontario Symposium (2016). (Oral)
15. **Z Baum**, A Lasso, T Ungi, G Fichtinger. "Augmented reality overlay system for computer-guided needle insertion procedures," 10th Annual Inquiry @ Queen's Undergraduate Research Conference. Queen's University (2016). (Oral)