

# David Black

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## Education

### PhD in Electrical and Computer Engineering

University of British Columbia, Vancouver (May 2021 — Present)

Studying medical robotics, teleoperation, and control, focusing on human-computer interaction through augmented reality and haptics to create a novel “human teleoperation” system. Working with the First Nations Health Authority to improve healthcare access for rural and Indigenous communities.

### B.A.Sc. in Engineering Physics

University of British Columbia, Vancouver (September 2016 — April 2021)

Engineering Physics is the combination of mechatronics engineering with the equivalent of an honors degree in physics. I won awards for academic achievement and published multiple papers.

### High School

St. George’s School, Vancouver (September 2011 — June 2016)

I won gold at the Canadian national championships in rowing, co-led the school outdoors club, finished 3<sup>rd</sup> in Canada in the National Latin Sight-Translation contest, and won several other awards.

## Experience

### Cofounder / Lead Engineer of Snowspines Inc.

Vancouver, BC (March 2021 – April 2022)

Took the company from concept to production-ready product. Developing a novel stride-assist exoskeleton mechanism for ski touring, like an e-bike for skis.

### Haptic Mixed Reality Tele-Ultrasound (Engineering Physics Capstone Project II)

Robotics and Control Laboratory, UBC, Vancouver (July 2020 – April 2021)

Developing an ultrasound teleguidance system with a Microsoft HoloLens 2 and haptic feedback. Involves mixed reality, teleoperation, haptics, and real-time communication networks.

### Robotics Engineer (Co-op)

A&K Robotics, Vancouver (May – August 2020)

Worked as a member of the 3-person hardware team in a robotics start-up specializing in autonomous, mobile robots. We designed and built two separate robots, and made major changes on two more.

### Robotic PET Phantom (Engineering Physics Capstone Project I)

BC Cancer Research Centre / UBC Vancouver (September – April 2020)

Designed and built a robotically actuated anthropomorphic phantom for use in PET motion correction studies. Received 2020 UBC Engineering Design and Innovation Day Faculty Award for this work.

### Surgical Robotics Research Engineer (Co-op)

Robotics and Control Laboratory, UBC, Vancouver (April – December 2019)

Instrumented the master of a da Vinci surgical robot with force sensing. Also wrote control software and firmware for a novel, 6-axis optical force/torque sensor, and helped design an MRI elastography device.

## Advanced Development Intern (Co-op)

Carl Zeiss Meditec AG, Oberkochen

(January 2018 — April 2019)

Worked on a novel technology in quantitative fluorescence microscopy-based neurosurgery. After the 4-month internship, I was hired to continue working on the project remotely (40 hrs per month).

## UBC Engineering Physics Robot Course

UBC Vancouver

(June — August 2018)

In this intensive course we were given 6 weeks to build an autonomous robot that performs a variety of challenging tasks. In competition our robot was the only one of 20 to complete all the tasks. Please see my team's website for more information: <https://scooter2018enph.wordpress.com/>

## Vehicle Dynamics Team Lead

UBC Solar Team

(September 2016 — January 2018)

UBC Solar Car is a student engineering design team dedicated to creating a fully solar powered car. I lead the vehicle dynamics team for the chassis, suspension, steering, and braking, and aided in the aerodynamic design of the aeroshell.

## Publications

### Patents

- **D. Black**, Y. Oloumi, A.H. Hadi Hosseinabadi, S. Salcudean. "Mixed Reality Human Teleoperation," US Patent Office Provisional Patent 63/224,646. July 2021. Patent Pending July 2022.
- **D. Black**, J. Voldeng, A. Fraser. "Electronic Stride Assist Mechanism for Ski Touring," US Patent Office Provisional Patent. July 2021.

### Journal Papers

- **D. Black**, Y. Oloumi, A.H. Hadi Hosseinabadi, S. Salcudean. "Human Teleoperation - a Haptically-Enabled Mixed Reality System for Teleultrasound," Human Computer Interaction. 2022.
- S.E. Salcudean, H. Moradi, **D. Black**, N. Navab. "Robot-assisted Medical Imaging: a Review," in Proceedings of the IEEE. 110(7). July, 2022.
- E. Suero Molina, **D. Black**, S. Kaneko, M. Muether, W. Stummer. "Double dose of 5-ALA and its effect on PPIX expression in Low-Grade Glioma," in Journal of Neurosurgery. 137(4). Feb., 2022.
- W. Stummer, S. Kaneko, **D. Black**, E. Suero Molina. "5-ALA induced porphyrin contents in various brain tumors - Implications regarding imaging device design and their validation," in Neurosurgery. 89(6). December, 2021.
- **D. Black**, S. Kaneko, A. Walke, S. Koenig, W. Stummer, E. Suero Molina. "Characterization of Autofluorescence and Quantitative Protoporphyrin IX Biomarkers for Optical Spectroscopy-Guided Glioma Surgery," in Nature: Scientific Reports 11(1). Oct., 2021.
- **D. Black**, Y. Oloumi, J. Wong, R. Fedrigo, C. Uribe, D. Kadrmas, A. Rahmim, I. Klyuzhin. "Design of an Anthropomorphic Respiratory Phantom for PET Imaging," in Medical Physics 48(8). May 2021.
- S. Kaneko, P. Sporns, S. Schipmann, **D. Black**, W. Stummer. "Fluorescence Real-Time Kinetics of Protoporphyrin IX after 5-ALA Administration in Low-Grade Glioma," in Journal of Neurosurgery. Oct. 2020.
- A. H. Hadi Hosseinabadi, **D. Black** and S. Salcudean, "Ultra Low-Noise FPGA-Based 6-Axis Optical Force-Torque Sensor: Hardware and Software," in IEEE Transactions on Industrial Electronics 68(10). Oct. 2021.
- **D. Black**, A. H. Hadi Hosseinabadi and S. E. Salcudean, "6-DOF Force Sensing for the Master Tool Manipulator of the da Vinci Surgical System," in IEEE Robotics and Automation Letters 5(2). April 2020.
  - Also presented at the International Conference on Robotics and Automation 2020

- A. Walke, **D. Black**, S. Koenig, W. Stummer, P.A. Valdes, E. Suero Molina. "Hyperspectral imaging in malignant glioma: Challenges in, and recommendations for, ex vivo biopsy measurements". Nature Methods. Submitted Oct. 2022 (NMETH-A50719).
- **D. Black**, S. Salcudean, "Evaluation of communication and human response latency for (human) teleoperation", IEEE Transactions on Medical Robotics and Bionics. Submitted Oct. 2022.
- **D. Black**, H. Moradi, S. Salcudean, "Human-as-a-Robot Performance in Augmented Reality Teleultrasound". Information Processing in Computer Aided Interventions (IPCAI) conference and International Journal of Computer Aided Radiology and Surgery (IJCARS). Submitted Oct. 2022.

## Conference Presentations

- **D. Black**, S. Salcudean. "A Mixed Reality System for Human Teleoperation in Tele-Ultrasound," in the Hamlyn Symposium for Medical Robotics, June 26-29, 2022, London, UK. Presentation.
  - *Won Best Paper Award*
- **D. Black**, Y. Oloumi, J. Wong, R. Fedrigo, C. Uribe, D. Kadrmas, A. Rahmim, I. Klyuzhin. "Design and Manufacture of Anatomically Realistic, Actuated, Elastic Lung Inserts for PET/CT Phantom Studies with Respiratory Motion," in the American Association of Physicists in Medicine / Canadian Organization of Medical Physicists joint conference 2020. AAPM e-Poster library Poster Number: BReP-SNAP-I-15.
  - *Accepted as Blue Ribbon ePoster for very high reviewer scores*
- **D. Black**, S. Kaneko, A. Walke, S. Koenig, W. Stummer, E. Suero Molina. "Characterisation of autofluorescence and quantitative protoporphyrin IX biomarkers for optical spectroscopy-guided glioma surgery," in the German Neurosurgery Society (DGNC) Annual Conference. Köln, Germany. May 29-June 1, 2022. Abstract Presentation.
- E. Suero Molina, S. Kaneko, P. B. Sporns, S. Schipmann-Miletic, **D. Black**, W. Stummer. "Fluorescence real-time kinetics of protoporphyrin-IX after 5-ALA administration in low grade glioma," in the American Association of Neurosurgeons Conference. 2020. Presentation
- E. Suero Molina, S. Kaneko, P. B. Sporns, S. Schipmann-Miletic, **D. Black**, W. Stummer. "Fluorescence real-time kinetics of protoporphyrin-IX after 5-ALA administration and factors predicting fluorescence in low-grade glioma," in the Joint Conference of the German Neurosurgery Society (DGNC) and Japanese Neurosurgery Society. 2020.

## Awards and Recognition

- Vanier Canada Graduate Scholarship (May 2022-2025)  
Most prestigious graduate award in Canada
- President's Academic Excellence Initiative PhD Award (September 2022)
- Best Paper Award, Hamlyn Symposium for Medical Robotics, (June 28, 2022)
- President's Academic Excellence PhD Award (May 2022)
- NSERC Canada Graduate Studies - Doctoral (CGS-D) Award (May 2022 – 2025)  
Highest level of the NSERC Post Graduate Studies (PGS-D) awards
- UBC Four Year Fellowship (4YF) for PhD Students (May 2022 – 2026)
- Faculty of Applied Science Graduate Award (November 2021)  
For academic achievement
- J.K. Zee Fellowship in Electrical and Computer Engineering (October 2021)
- Graduate Support Initiative Award (October 2021)
- Biomedical Imaging and AI Research Showcase Winner (October 2021)  
Three-minute thesis competition
- UBC President's Academic Excellence PhD Initiative Award (September 2021)
- NSERC Alexander Graham Bell Canada Graduate Studies - Master's Scholarship (May 2021 – 2022)  
Awarded for academic, research, and leadership performance for 1<sup>st</sup> year of PhD
- Medical Device Design Centre Innovation Award  
Awarded after presenting my mixed reality telemedicine project to a panel of judges
- NSERC Alexander Graham Bell Canada Graduate Studies – Master's Scholarship
- Dorothy and Arthur Holt Scholarship (February 2021)  
Awarded to about 9 students in any faculty or degree program at UBC for academic excellence.
- UBC Engineering Design and Innovation Day 2020 Faculty Award (May 2020)  
Awarded for my work on the robotic PET phantom
- Edith Grace Buchan Scholarship (November 2019)  
Awarded for excellence in engineering, nominated by a member of the Faculty of Applied Science
- UBC Science Coop International Work-term Award (January 2018)  
Awarded for outstanding international work term placement for coop
- Trek Excellence Scholarship for Continuing Studies (September 2017)  
Awarded to students in the top 5% of their faculty and year
- David Overton Memorial Prize (June 2014)  
Awarded to student in grade 10 who has made the greatest contribution to the school in terms of effort, performance and participation.
- Academic Excellence Medal (June 2013, 2014, 2015, 2016)  
Top ten in grade (of 160) academically in grades 9, 10, 11, and 12

## Skills

- Mechanical Design
- Robotics (mechanical design, kinematics, dynamics)
- Control, teleoperation, haptics
- Machine learning, reinforcement learning, computer vision, data analysis
- C++, C#, MATLAB, LaTeX, Python, Linux, ROS, da Vinci Research Kit, Unity, Mixed Reality Toolkit, Oculus, Java (very familiar), C, Julia, Assembly Language, VHDL (proficient)
- CAD (Solidworks, Onshape, AutoCAD Fusion 360), FEA and CFD (ANSYS), Altium
- Prototyping using 3D printer, laser & water-jet cutter, lathe, mill, saw, drill, angle grinder, Dremel
- Communications through RS-485, RS-232, TCP, UDP, UART, I2C, SPI, CAN bus, networks incl. 4G LTE, 5G, and frameworks incl. WebSockets, WebRTC.
- Medical Imaging, nuclear medicine, biophotonics, optics (Physics and Engineering)
- Analog and digital circuit design, prototyping, and debugging, PCB design on Altium
- Microcontrollers/computers including Arduino, STM32, Raspberry Pi
- Stepper motors, servos, motor controllers, rotary encoders, IR sensing, analog signals processing
- Physics, mathematical modeling, optimization
- Research, report, paper, patent, and grant writing, conference posters, presentations

## Miscellaneous

- Avid ski mountaineer, rock climber, ultrarunner, paragliding pilot, road cyclist
- Enjoy tinkering with electronics, fixing and designing mechanical parts, writing programs
- Completely fluent in German and English
- Play cello