

PROFILE

- Developing *ab initio* and atomistic simulation methods to model the physics of modern semiconductor devices
- Experience with quantum transport, Monte Carlo, and graph-based atomistic modelling methods
- Wrote/contributed to high-performance physics simulation codes written in C++, Python, MATLAB, and Julia
- Interested in computational design of emerging memory technologies and neuromorphic computing architectures

EDUCATION

ETH Zurich

Candidate for PhD, Information Technology and Electrical Engineering

Zurich, Switzerland

September 2021–present

University of Waterloo

Master of Applied Science (MSc), Electrical and Computer Engineering

Waterloo, ON, Canada

September 2019–May 2021

University of Waterloo

Bachelor of Applied Science (BSc), Nanotechnology Engineering.

Waterloo, ON, Canada

September 2014–May 2019

Turner Fenton Secondary School

International Baccalaureate (IB) Diploma

GTA, ON, Canada

September 2012–May 2014

EXPERIENCE

Scientific Assistant (PhD Candidate) - ETH Zürich

Advisor: Dr. Mathieu Luisier, Professor

Zürich, Switzerland

September 1st 2021 - 2026

- Developing multi-scale atomistic models for resistive switching in emerging Non-Volatile Memories (NVM), using electronic structure calculations, *ab initio* quantum transport, and Kinetic Monte Carlo. Working with experimental partners at ETH and IBM Zurich to realize new device structures and investigate their operating mechanisms.

Device/Process Modelling Engineer (Intern) - Samsung Semiconductor

Supervisor: Dr. Byounghak Lee, Principle Engineer

San Jose, CA, USA

May 15th 2023 - August 4th 2023

- Developed a symmetry-aware topological classification algorithm, and implemented it in an advanced Kinetic Monte Carlo code to be used for large-scale semiconductor device and process simulations. Graduate internship.

Research Assistant (MSc Student) - University of Waterloo

Advisor: Dr. Youngki Yoon, Associate Professor

Waterloo, ON, Canada

September 1st 2019 - September 1st 2021

- Used Density Functional Theory and Non-Equilibrium Green's Function-based transport codes to design and simulate devices made from 2D materials. Investigated defect and strain-engineering in FET and TFET structures. Collaborated with an experimental group at Sungkyunkwan University, South Korea, to fabricate and test devices.

Internship - Waterloo Institute for Nanotechnology (WIN)

Supervisor: Dr. Dayan Ban, Professor

Waterloo, ON, Canada

January 1st 2018 - September 1st 2018

- Wrote a MATLAB+c-mex code to simulate the operation of Resonant-Phonon Quantum Cascade Lasers, based on self-consistently solved wavefunctions and charge distributions. Implemented Markov-Chain Monte-Carlo global optimization methods to search for designs with higher-temperature lasing potential. Assisted in optical characterization of fabricated devices.

Formulations Engineering Intern - Adaptive Surface Technologies (AST)

Supervisor: Dr. Tehila Nahum, Principle Formulations Engineer

Cambridge, MA, USA

September 1st 2016 - April 30th 2017

- AST develops slippery coatings on the principle of infusing a nanoporous surface with a lubricant. Worked in a team of three engineers to formulate food-safe container coatings for a customer in the consumer packaging industry.

Internship - National Institute of Materials Science (NIMS)

Supervisor: Dr. Genki Yoshikawa, Associate Professor and Group Leader

Tsukuba, Ibaraki, Japan

January 1st 2016 - April 1st 2016

- Optimized the coating of drop-casted polymer films on a membrane-type sensor which measures mechanical deflection upon gas absorption to perform ‘olfactory’ sensing. Designed and 3D printed parts to customize dispensing equipment. Used COMSOL multiphysics modelling for sensor performance.

Internship - Canadian Nuclear Laboratories (CNL)

Supervisor: Dr. Syed Bukhari, Research Associate, Neutron Scattering Branch

Chalk River, Ontario, Canada

May 2015 - August 2015

- Optimized sputtering parameters to minimize the interfacial roughness between stacked metal-alloy thin films

TEACHING & SUPERVISION

Teaching Assistant Positions

- **Quantum Transport in Nanostructures, ETH Zurich** February 2023 - May 2023
Taught one third of the tutorials.
- **Quantum Transport in Nanostructures, ETH Zurich** February 2022 - May 2022
Taught one third of the tutorials.
- **Linear Circuits (NE140), University of Waterloo** January 2021 - April 2021
Prepared and taught all remote (synchronous) tutorials.
- **Nanoelectronics (NE471), University of Waterloo** September 2020 - December 2020
Held office hours for student questions, prepared assignments, and marked exams.
- **Electronic Circuits (NE344), University of Waterloo** May 2020 - August 2020
Prepared and taught all remote (synchronous) tutorials.
- **Linear Circuits (NE140), University of Waterloo** January 2020 - April 2020
Prepared and taught all tutorials.

Student Project Supervisions

- **Masters’ Thesis of Jente Clarysse, ETH Zurich** April 2023 - October 2023
Simulating thermally-activated switching phenomena in oxide-based resistive memory.
- **Masters’ semester project of Jente Clarysse, ETH Zurich** September 2022 - January 2023
Developing a Markovian model of non-equilibrium current flow through atomistic structures modelled as resistive networks.
- **Masters’ semester project of Zhouyang Yu, ETH Zurich** September 2022 - January 2023
Performing quantum transport simulations on Interband Cascade Lasers (ICLs) using an in-house NEGF solver. Co-supervised with Prof. Matheiu Luisier.
- **Bachelor Thesis of Patrik Gjini, ETH Zurich** February 2022 - May 2022
Implemented a Fast Multipole Method algorithm to accelerate the solution of Poisson’s equation in across amorphous structures, written in Python. Co-supervised with Dr. Marko Mladenovic.
- **Masters’ semester project of Patrick Bütler, ETH Zurich** February 2022 - May 2022
Investigating phase transition-induced resistive switching in monolayer MoTe₂ towards non-volatile memory applications, using *ab-initio* Molecular Dynamics. Co-supervised with Jonathan Backmann.
- **Research projects of Patrick Kim and Raymond Chong, Deep River Science Academy** May 2015 - Aug 2015
Minimizing the interfacial roughness of sputtered metal alloy thin films to investigate nano-scale corrosion mechanisms, using X-Ray Reflectometry and X-Ray Diffraction. Counted towards the students’ high-school course credit.

OTHER ACTIVITIES

Team Lead - UW Nano Robotics Group (UWNRG)

Waterloo, ON, Canada

January 2015 - July 2019

- UWNRG designs microbotic actuation systems to compete at the annual IEEE ICRA Microbotics Challenges.
- Led the development of a microbot called SAM (Solenoid Actuated Microbot). Managed funding applications for lab expenses, equipment, cleanroom usage, and conference travel costs.
- Competition Record: 3rd place (at ICRA 2015), 1st place (at ICRA 2016), 2nd place (at ICRA 2018).

PROJECT FUNDING

- “Flexible Photovoltaics with 2D Material Heterostructures” (NSERC PGSD Doctoral Award) - 63,000 CAD 2021
- “Simulations of semiconductor quantum structures” (NSERC Undergraduate Student Research Award) - 4,000 CAD 2018
- “Modeling of quantum cascade lasers” (NSERC Undergraduate Student Research Award) - 4,000 CAD 2017

SCHOLARSHIPS & AWARDS

- Top 10% (out of 715) Poster Commendation at the Psi-K Conference 2022
- Waterloo Faculty of Engineering Awards (x2) 2020
- Sanford Fleming Foundation (SFF) Teaching Assistant Excellence Award 2021
- Waterloo Graduate Research Studentship (with MASc offer) 2019–2021
- Waterloo Dean’s Entrance Award (Graduate) 2019
- Presentation Award, Waterloo Nanotechnology Symposium 2019
- Waterloo Undergraduate Research Assistantship Awards (x2) 2017–2018
- Waterloo Undergraduate Research Internship Awards (x2) 2017–2018
- Waterloo International Internship Award 2016
- NIMS (Japan) Internship Program Fellowship 2016
- Waterloo President’s (Entrance) Scholarship 2014

JOURNAL ARTICLES & CONFERENCE PAPERS (* = EQUAL CONTRIBUTION)

1. **M. Kaniselvan**, M. Luisier, and M. Mladenovic, “Atomistic Modelling of Field-Induced Resistive Switching in Valence Change Memory,” *ACS Nano*, April 2023. doi: 10.1021/acsnano.2c12575 (***Journal Cover Article**)
In the media: [Covered by ETH] [Covered by the Werner Siemens Foundation]
2. H. Park*, A. Sen*, **M. Kaniselvan**, A. AlMutairi, A. Bal, L. Lee, Y. Yoon, and S. Kim, “Wafer-scale Nanoporous 2D Active Pixel Image Sensor Matrix with Highly Uniformity, High Sensitivity, and Rapid Switching,” *Advanced Materials*, February 2023. doi: 10.1002/adma.202210715 (***Journal Cover Article**)
3. **M. Kaniselvan**, M. Luisier, and M. Mladenovic, “An Atomistic Modelling Framework for Valence Change Memory Cells,” *Solid State Electronics: LETTERS from the International Conference on Simulation of Semiconductor Processes and Devices 2022*, October 2022 doi: 10.1063/2F5.0053789
4. **M. Kaniselvan**, M. Sritharan, and Y. Yoon, “Mitigating Tunneling Leakage in Ultrascaled HfS₂ pMOS Devices with Uniaxial Strain,” *IEEE Electron Device Letters*, June 2022 doi:10.1109/LED.2022.3179228 (***Editor’s Pick**)
5. **M. Kaniselvan** and Y. Yoon, “Strain-tuning PtSe₂ for high ON-current lateral tunnel field-effect transistors,” *Applied Physics Letters*, vol. 119, no. 7, p. 073102, Aug. 2021. doi:10.1063/2F5.0053789
6. G. Han, **M. Kaniselvan**, and Y. Yoon, “Photoresponse of MoSe₂ Transistors: A Fully Numerical Quantum Transport Simulation Study,” *ACS Applied Electronic Materials*, vol. 2, no. 11, pp. 3765–3772, Nov. 2020. doi:10.1021/acsaelm.0c00795
7. M. Naqi*, **M. Kaniselvan***, S. Choo*, G. Han, S. Kang, J. Kim, Y. Yoon, and S. Kim, “Ultrasensitive Multilayer MoS₂-Based Photodetector with Permanently Grounded Gate Effect,” *Advanced Electronic Materials*, vol. 6, no. 4, p. 1901256, Feb. 2020. doi: 10.1002/aelm.201901256.

Submitted:

8. **M. Kaniselvan**, J. Clayrsse, M. Mladenovic and M. Luisier, “Atomistic insights on analog conductance modulation in HfO₂ memristors,” *Submitted conference paper*

Refereed:

1. Marko Mladenovic, **Manasa Kaniselvan**, Christoph Weilenmann, Alexandros Emboras, and Mathieu Luisier *Termination-Dependence of Resistive Switching in SrTiO₃-based Valence Change Memory*. International Workshop on Computational Nanotechnology (IWCN), Barcelona, Spain, June 2023. Talk.
2. **Manasa Kaniselvan**, Mathieu Luisier and Marko Mladenovic *An Atomistic Modelling Framework for Valence Change Memory Cells*. International Conference on Simulation of Semiconductor Processes and Devices (SISPAD), Granada, Spain, August 2022. Talk.
3. **Manasa Kaniselvan**, Marko Mladenovic, Patrik Gjini, and Mathieu Luisier *Modelling transport in valence change memory cells*. Psi-k Conference, Lausanne, Switzerland, August 2022. Poster.

Non-Refereed:

4. **Manasa Kaniselvan**, Marko Mladenovic, Patrik Gjini, and Mathieu Luisier *Modelling transport in valence change memory cells*. CECAM Workshop on “Quantum transport methods and algorithms: from particles to waves approaches”, ETH Zürich, Switzerland, July 2022. Poster.
5. Marko Mladenovic, **Manasa Kaniselvan**, and Mathieu Luisier *Ab-Initio-Parametrized Kinetic Monte Carlo Model for Vacancy Diffusion in Amorphous Oxides in Valence Change Memory*. First Principles Modelling of Defects in Solids Workshop, ETH Zürich, June 2022. Poster.
6. **Manasa Kaniselvan**. *Engineering the Performance of 2D Transition Metal Dichalcogenide Nanotransistors through Quantum Transport Simulations*. Nanotechnology Seminar delivered at the University of Waterloo, June 2021. Talk.
7. Boyu Wen, Chao Xu, Siyi Wang, Sm Shazzad Rassel, **Manasa Kaniselvan**, Chris Deimert, Zbigniew Wasilewski and Dayan Ban *Novel 4-well THz QCL with hybrid injection/extraction channels*. ITQW2019: Infrared Terahertz Quantum Workshop.
8. Mary Chen*, **Manasa Kaniselvan***, Corin Seeleman*, Danielle Smith*. *A Real-Time Non-Invasive Sensor for Monitoring Laser-Induced Temperature in Medical Applications*. Waterloo Engineering Design Symposium 2019. Waterloo, ON, Canada. Oral presentation & poster.
9. **UW Nano Robotics Group**. *Solenoid Actuated Microbot (SAM)*. 2018 IEEE International Conference on Robotics and Automation (ICRA). Brisbane, Australia. Competition & poster.
10. **UW Nano Robotics Group**. *ElectroMagnetic Micro Actuation (EMMA): Version 2*. 2016 IEEE International Conference on Robotics and Automation (ICRA). Stockholm, Sweden
11. **UW Nano Robotics Group**. *ElectroMagnetic Micro Actuation (EMMA)* 2015 IEEE International Conference on Robotics and Automation (ICRA). Seattle, Washington, USA

PEER REVIEW ACTIVITY

IEEE Transactions on Electronic Devices (x2), Physical Review E (x1)