François Charih

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Research Interests

Computational biochemistry	High performance computing	Motor neuron diseases
Applied machine learning	Protein biochemistry	Cancer

Education

Ph.D. Electrical and Computer Engineering (Computational Biochemistry) 2019 -
Carleton University Ottawa, ON
Advisors: James R. Green (Engineering) and Kyle K. Biggar (Biochemistry)
Thesis: *Computational methods to uncover and modulate the methyllysine proteome*

M.A.Sc. Electrical and Computer Engineering (Data Science) 2016 - 2018
Carleton University Ottawa, ON
Advisor: James R. Green
Thesis: *Machine Learning in Audiology: Applications and Implications*

B.Sc.(Hons.) Biochemistry 2010 - 2016
University of Ottawa Ottawa, ON
Advisor: Jean-François Couture
Thesis: *Structural Insights into the DNA-Binding Activity of Metalloregulator Fur in C. jejuni*

B.A.Sc. Chemical Engineering 2010 - 2016
University of Ottawa Ottawa, ON
Thesis: *Design, Simulation and Optimization of a High Production Volume Toluene Plant*

Recent Employment

Lead Researcher (Contractual position) Summer 2020
Carleton University Ottawa, ON

- Collaboration initiated by the WSIB of Ontario upon reading my master's thesis
- Managed a team composed of myself, one M.Eng. student, and one undergraduate student
- Responsible for developing a semi-automated audiogram digitization/interpretation solution using machine learning and computer vision to support the claim adjudication process at WSIB

Contract Researcher 2018 - 2019
The Ottawa Hospital Rehabilitation Centre Ottawa, ON

- Responsible for the implementation of a tablet-based software for the annotation of stress levels of PTSD/TBI patients undergoing VR therapy (collaboration with Rehabilitation Virtual Reality Lab at The Ottawa Hospital).

Contract Researcher 2017 - 2018
Natural Resources Canada Ottawa, ON

- Co-authored a technical report detailing how deep learning strategies can be deployed for passive monitoring of critical electrical infrastructure
- Responsible for the annotation of thousands of images for the development of deep learning-based segmentation models

Teaching Assistant 2017 -
Carleton University Ottawa, ON

- SYSC2002 - Data Structures and Algorithms (Spring 2020)
- SYSC2006 - Foundations of Imperative Programming (Fall 2017, Winter 2019)

Undergraduate Research Assistant 2014 - 2016
Ottawa Institute of Systems Biology Ottawa, ON

- Successfully crystallized and contributed to the resolution of the crystal structure of the protein under study
- Performed and optimized a variety of biochemistry techniques, including protein overexpression, mutational studies, structural characterization and protein-DNA interaction studies
- Used tools including high-throughput crystallization robots, x-ray diffractometer, FPLC/HPLC, protein modelling software, isothermal titration calorimetry on a regular basis in addition to applying other common techniques

Publications

Peer-Reviewed Journal Articles

[J7] G.M. Rurak, S. Simard, **F. Charih**, A. Van Geel, J. Stead, B. Woodside, J.R. Green, G. Coppola, N. Salmaso. Translatomic database of cortical astroglia across male and female mouse development reveals two distinct developmental phenotypes (2020). *Cell Reports*. (Submitted)

[J6] **F. Charih**, J. R. Green, K. K. Biggar. Machine Learning-Driven Identification of Novel Lysine Methylation Sites with MethylSight (2020). *Star Protocols*.

[J5] K. K. Biggar*, **F. Charih***, H. Liu, Y. B. Ruiz-Blanco, L. Stalker, A. Chopra, J. Connolly, K. Frensemier, M. Galka, Q. Fang, C. Wynder, W. L. Standford, J. R. Green, and S. S-C. Li. Proteome-wide Prediction of Lysine Methylation Reveals Novel Histone Marks and Outlines the Methyllysine Proteome (2020). *Cell Reports* 32(107896). (*Co-first authors)

[J4] **F. Charih**, M. Bromwich, A. E. Mark, R. Lefrançois, and J. R. Green. Data-Driven Audiogram Classification for Mobile Audiometry (2020). *Scientific Reports* 10(3962).

[J3] S. Sarvan, A. Yeung, **F. Charih**, A. Stintzi, and J.-F. Couture. Crystal structure of Campylobacter jejuni peroxide regulator (2018). *BioMetals* 32(3) 491-500.

[J2] S. Sarvan, **F. Charih**, J. Butcher, J. S. Brunzelle, A. Stintzi, and J.-F. Couture. Crystal structure of Campylobacter jejuni peroxide regulator (2018). *FEBS Letters* 592(13) 2351-2360.

[J1] S. Sarvan, **F. Charih**, M. Askoura, J. Butcher, J. S. Brunzelle, A. Stintzi, and J.-F. Couture. Functional insights into the interplay between DNA interaction and metal coordination in ferric uptake regulators (2018). *Scientific Reports* 8(1) 1-14.

Conference Proceedings

[C5] K. Dick, **F. Charih**, J. Woo, J. R. Green. Gas Prices of America: The Machine-Augmented Crowd-Sourcing Era. *17th Conference on Computer and Robot Vision*, Ottawa, Canada, May 2020.

[C4] R. Selzler, A. Smith, **F. Charih**, A. Boyle, J. Holly, C. Bridgewater, M. Besemann, D. Curran, A. D. C. Chan, and J. R. Green. Exploratory Analysis of Ultra-Short-Term Heart Rate Variability Features in Virtual Rehabilitation Sessions. *2020 IEEE International Symposium on Medical Measurements and Applications (MeMeA)*, Bari, Italy, June 2020.

[C3] **F. Charih**, A. Steeves, M. Bromwich, A. E. Mark, R. Lefrançois, and J. R. Green. Applications of Machine Learning Methods in Retrospective Studies on Hearing. *Proceedings of the 2018 IEEE Life Sciences Conference*, Montréal, Canada, October 2018.

[C2] **F. Charih**, M. Bromwich, R. Lefrançois, A. E. Mark, and J. R. Green. Mining Audiograms to Improve the Interpretability of Automated Audiometry Measurements. *Proceedings of the 2018 IEEE International Symposium on Medical Measurements and Applications (MeMeA)*, Rome, Italy, June 2018.

[C1] K. Dick, **F. Charih**, Y. Souley Dosso, L. Russell, and J. R. Green. Systematic Street View Sampling: High Quality Annotation of Power Infrastructure in Rural Ontario. *Proceedings of the 2018 15th Conference on Computer and Robot Vision (CRV)*, Toronto, Canada, May 2018.

Other Manuscripts (e.g. pre-prints, theses, etc.)

[O2] **F. Charih**. Machine Learning in Audiology: Applications and Implications. *Master's thesis*, Carleton University, Ottawa, ON, December 2018, (170 pages). (Defended without revisions, and was awarded the Carleton University Senate medal)

[O1] K. Dick, **F. Charih**, Y. Souley Dosso, L. Russell, and J. R. Green. Towards Energy Infrastructure Image Seg-mentation Using Deep Learning. *Technical Report prepared for Natural Resources Canada*, Carleton University, Ottawa, ON, April 2018, (88 pages).

Presentations and Workshops

[PW6] **AI in biology and biomedical engineering (guest lecture)** — December 2nd, 2019
ECOR1055 — Ottawa, ON

[PW5] **X-ray crystallography and computational biochemistry (guest lecture)** — November 22nd, 2019
BIOC3202 — Ottawa, ON

[PW4] **Introductory Data Analysis with Pandas** — October 16th, 2019
Lecture Series (IEEE EMBS Carleton) — Ottawa, ON

[PW3] **Building interactive visualizations in the browser with D3.js** — February 6th, 2019
Lecture Series (IEEE EMBS Carleton) — Ottawa, ON

[PW2] **Machine learning in Audiology (guest lecture)** — November 2018, 2019
HLTH2001 and HLTH4102 (Carleton University) — Ottawa, ON

[PW1] **MethylSight: A Computational Approach to the Elucidation of the Methyllysine Proteome** — November 9th, 2018, Montreal, QC
21st Chemistry and Biochemistry Graduate Research Conference

Selected Posters

[P4] **Machine Learning in Audiology: Applications and Implications** — October 2018
Ottawa-AI Alliance Workshop — Ottawa, ON

[P3] **Systematic Street View Sampling for Accurate Urban Population Estimation** — May 2018
Data Day 5.0 — Ottawa, ON

[P2] **Extending the SHOEBOX Audiometry mobile audiometer with an automated audiogram classification system** — May 2018, Ottawa, ON
Life Science Day 2.0, Carleton University

[P1] **Structural insights into the DNA Binding Activity of the Ferric Uptake Regulator in Campylobacter jejuni** — April, 2015, Ottawa, ON
Honours Project Poster Day

Awards and Honours

Douglas Millar Scholarship, Dean of the FGPA (Carleton) (3,200 CAD) — 2020
Awarded yearly to an outstanding graduate student in engineering

Postgraduate Scholarship-Doctoral (PGS-D), NSERC (63,000 CAD) — 2019
Awarded to high potential researchers to pursue doctoral studies

Ontario Graduate Scholarship, Carleton University (15,000 CAD) — 2019
Declined in favour of NSERC PGS-D award

Carleton University Senate Medal, Carleton University — 2019
Awarded for outstanding academic achievement at the graduate level (1 medal/faculty awarded)

Ph.D. Entrance Scholaship, Carleton University (2,000 CAD) — 2018

CREATE-BEST Scholarship, NSERC (5,000 CAD) — 2017

Engage/VIP-I Grant, NSERC, OCE and Clearwater Clinical Ltd. (50,000 CAD) 2017
Co-authored the proposal for the grant awarded to Prof. James R. Green

M.A.Sc. Entrance Scholaship, Carleton University (2,000 CAD) 2017

Protein Modeling Contest, University of Ottawa (100 CAD) 2014

B.Sc. Entrance Scholarship, University of Ottawa (2,000 CAD) 2011

Research Mentoring

I have had the great pleasure to act as a mentor to the following students:

Abhinav Yalamanchili, M.Eng. Student Summer 2020
Machine vision to digitize audiogram images (with WSIB Ontario)

Ahmed Abdelrazik, Undergraduate Student Summer 2020
Development of an ergonomic audiogram digitization tool (with WSIB Ontario)

Pratyush Singh, Undergraduate Student Summer 2018
Machine vision to digitize audiogram images

Ashlynn Steeves, Undergraduate Student Winter 2018
Using kNN to impute values in incomplete audiograms

Other

Judge, Ottawa Regional Science Fair 2019

Communications Officer, Carleton University Engineering in Medicine and Biology Society 2018-2019

Judge, Canada Wide Science Fair 2018

Languages

- French (native)
- English (fluent)
- Arabic (elementary conversational skills)

Relevant skills

High-performance computing

- Development of concurrent software for scientific applications using low level languages (Rust, C, Java) and high level languages (Python)
- Multithreading (OpenMP)
- Distributed computing (MPI)

- General-purpose GPU programming (GPGPU)

Statistical data analysis/visualization:

- Frequentist and bayesian modelling
- Data processing and exploration
- Interactive data visualization with D3.js
- Machine learning (supervised and unsupervised)
- Deep learning

Bioinformatics:

- Application of machine learning techniques to biological datasets
- Sequence alignment
- Protein modelling and analysis
- Protein-ligand docking

Web development:

- Development and maintenance of web infrastructures (web servers, REST APIs, databases, websites) in the cloud (AWS/Google Cloud)
- Creation of clean, maintainable web applications using modern web technologies (React.js, Express.js, Flask, Postgresql, Docker).