Nedialko Krouchev

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Applied Engineer-at-heart Expertise You Can Trust

Portfolio Highlights

A comprehensive outline of milestone professional achievements is available as supplementary documents - namely a detailed slides and spreadsheet collection. In the slides, the reader's attention is invited to the original algorithmic contributions as well as the innovative ideas in the field of AI/ML which carry a potential for future progress and accomplishment in that field. Below, just the more recent and most significant milestones are listed.

Year	Project	Notes, Technology	Field(s)	Team
2025	Generative Neural Network Model of Colour Recognition, Registration and Decision Making using Constructive Geometry and the DAN integrative neural architecture	Matlab, Novel **Neural Network Architecture** that practically does not require pre-training	AI/ML, Neural Networks, Complex Neural Dynamics Modeling and Simulation	GRSNC U.Montreal
2025	Automated Confluence Documentation Pages generation and update through scheduled Jenkins ELT pipelines	python, Java, MySQL	Retrieval-augmented Intelligent Big-Data Acquisition and Processing	Plusgrade
2025	AI Agents and LLMs	python, Java, ChatGPT, Gemini, Amazon-Q, Hugging Face (Certificate)	Retrieval-augmented Intelligent Big-Data Acquisition and Processing	Plusgrade
2021	The Russian-Dolls Ideas Package toward more practical and more observable DNN model creation and exploitation	python, ONNX, neuron	AI/ML, DNNs, Complex Multidimensional Data Modeling	Zetane
2021	Complex Multidimensional AI/ML Model Data Unpacking and Visualization - Colour Rendering of Model	python, C/C++, ONNX, neuron, Keras/Tensorflow, CUDA	AI/ML, DNNs, Complex Multidimensional Data Visualization	Zetane

	Tensors, complete with a multi-dimensions explorer UI			
2020	Airbus A3xx flight simulators Corporate Big Data Post-processing	python, Perl	Retrieval-augmented Intelligent Big-Data Acquisition and Processing	CAE Airbus A3xx Sim Products
2018	Advanced Functional QA Object-Oriented Test API to the Aurora Airport Traffic Simulator	C/C++	Dynamic Systems Simulation	Adacel ATM and ATC products, (contract)
2017	Processing histology slice-stacks toward 3D anatomical Localisation and Reconstruction of electrode path and recording sites in rodent S1 Brain cortices (primary somatosensory)	python, Matlab, Original **Image Registration Data Pipelines** - based on sets of landmark points and contour identification	Retrieval-augmented Image Registration Computer Vision and Object Recognition	McGill University the Neuro
2017	Object Recognition, 3D Spatial Localization, Registration and Motion Tracking in 2D video streaming using Checkerboard-based Calibration, Parametric Systems Identification and Optimization (Maximum-cliques)	python, C/C++, Matlab, OpenCV	Retrieval-augmented Image Registration Computer Vision and Object Recognition	MTL.AI
2017	Business Prediction - based on Generative Modeling of Banking customers behaviour and its motivation	python, Matlab	Retrieval-augmented Intelligent Big-Data Acquisition and Processing	Brainergy.AI
2016	Art Style Transfer	python, Keras/Tensorflow	AI/ML, Neural Networks, Modeling and Simulation	the Neuro, McGill University
2015	Doctorate (PhD) in Biomedical Engineering	Computational Neuroscience	AI/ML, Neural Networks, Complex Neural Dynamics Modeling and Simulation	Polytechnique Montreal, Vienna Technical University
2007	An Integrative Perspective in Modeling neural activity - the Brain as a Predictor-Corrector applying Dynamic-attractor Neural Networks (DAN)	Matlab, Novel **Neural Network Architecture** that practically **does not require pre-training**	AI/ML, Neural Networks, Complex Neural Dynamics Modeling and Simulation	GRSNC U.Montreal

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2006	Statistical analysis of ***synergy*** patterns in motor cortex and muscles activity, related to walking and obstacle clearing; Identification the neural synergies in gait control	SPSS, Matlab, Original **Associative Clustering Algorithm;** original Neural Network Models and their optimal parameter estimation - with Prof. Dr Schittkowski - a world authority in Optimization Algorithms	AI/ML, Neural Networks, Complex Neural Dynamics Modeling and Simulation	GRSNC U.Montreal; Prof. Dr Schittkowski - U. Bayreuth Germany

Key Engineering Industry Expertise Assets

Level	Domain	Exposure/Projects	Technology
Expert 10+ years	**AI/ML;** **Neural Networks;** **Modeling;** **Original RNN achitecture**	Vast experience with various models: Formulation, Optimization, Training and Use of most classic and current architectures **Projects:** Computer vision, Pattern recognition and classification, Art-style transfer (*2) Neural network dynamics in the rodent (*1, *2), primate and human brain (*1).	Keras/Tensorflow (*2), PyTorch, C/C++ (*1, *2) Advanced python3 and Matlab use Notes: (*1) Original model architecture contributions - see Publications (*2) Including use of the McGill Guillimin super-comp clusters
Expert 10+ years	**Data Science;** **Operations-Research;** **Numerical algorithms;** **System dynamics and business modeling**	Advanced Statistics (ANOVA, Stochastic control), Data Modeling and Mining (*5a); Real-time tensor visualization in an ML model is particularly interesting (*5b); **Numerical Algorithms and Operations Research:** Ever since graduate studies in Bulgaria have been passionate about advanced Algorithms (*5) and Numerical Optimization and Numerical Calculus (*6, *7) Insider knowledge of multiple de-facto standard libraries (*7) and of RDBMS's and SQL (*8)	Advanced C/C++, python3 and Matlab use Notes: (*5a) including use of advanced data visualization in multiple dimensions to facilitate the creation and interpretation of the data modeling and mining results; (*5b) with Zetane (*6) Skills and knowledge just revalidated and updated through diligent Coursera coursework and certification (*7) e.g. Comsol, CPLEX, scipy, numpy, LINPACK, UNCMIN, NAG (*8) incl. dialects such as MySQL

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Expert **10+ years**	**Software Engineering**	Master a vast number of Programming Languages (*9) Prototyping (*10) and Development Frameworks (*11a) **Projects:** (some key ones) # Full-stack and back-end web cloud computing and data processing (*11b) # Optimal and Real-time Control; Robotics (*12a) # Automated Big Data processing (*12b) # Mentoring and Specialized Courses (*12c) # Original Neural and AI/ML architectures implementations # Facilitation layers for specialized uses of standard tools (*5b, *7) # Computer Vision and Pattern Recognition and Classification # Image stacks registration	Github, Atlassian/Bitbucket/Jira, AWS, Jenkins, Kanban, Agile Notes: (*9) including (but not limited to) C/C++, python, C#, Java, javascript, regex, Perl, awk, R, Ada, Cobol, Pascal, Visual Basic, SQL, Fortran (all the way to the 2023 update to the language), etc etc. (*10) Matlab, unix shell and MS scripting, (*11a) e.g. Visual Studio, vscode, PyCharm, IntelliJ (*11b) e.g. Docker, AWS, Spring Boot (*12a) with Prof Kalaska at UdM, with Iguana Robotics (IL, USA) (*12b) Implementation of real-time control, automated backend services and data (ELT and ETL) pipelines; e.g. neurophysiology and aerospace real-time data acquisition, full-stack integration testing, Jenkins B&T pipelines etc. (*12c) with TU Sofia, IBM Bulgaria, U.Montreal, Polytechnique Montreal, CAE, ORS etc
Advanced **7+ years**	**Quality Assurance (QA)**	Frameworks for QA: # Unit Tests Collections (*3a) # Standalone and integrated local backend services runs and debugging (*3a) # Integration Testing (*3a) # QA and Test-driven development (*12c) # AI-assisted QA (*3a, *4) # Use of additional tools to elucidate and reproduce complex and esp. unexpected behaviours (*3c)	XTrace - with the CAE flight simulators QA Splunk, Datadog, Selenium - with Plusgrade See also (*12b) Notes: (*3a) for specific validations and resolving issues (*3b) for full-stack Testing (*4) Experience integrating AI assistants within IDE's - e.g. PyCharm, IntelliJ (*3c) with the CAE AP community elucidated the erratic behaviour of an AP system due to the deviating stats of simulated GPS signal - using standalone dynamic simulation
Advanced **5+ years**	**AI Agents use**	Frameworks for: # Enterprise-wide Confluence Documentation (*3) Collection created with the help of advanced python-based code-based automated Confluence page(s) generation # AI-assisted new application code generation and QA (*4)	 **Hugging Face Certified**: AI Agents Fundamentals Advanced python3 and Java using AI agents: Google Gemini, Amazon Q, Microsoft Copilot, ChatGPT etc. Notes: (*3d) for Airline Taxes Development and Auditing Reference Documentation (*4) Experience integrating AI assistants within IDE's - e.g. PyCharm, IntelliJ

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Work Experience

Plusgrade Inc., Montreal (Quebec)

Software Engineer, August 2022 – August 2025

- Designed and implemented back-end software for data-logic analysis and performance-related data persistence using advanced, object-oriented Java and the Spring Boot framework.
- Developed and deployed service code for inventory management and third-party payment providers, utilizing Docker and various scripting languages.
- Served as a Subject Matter Expert (SME) in international airline passenger duties, taxes, and fees, applying this domain knowledge to enhance product compliance.

ORS / Comet Inc., Montreal (Quebec)

Software Developer / Data Scientist, December 2021 – July 2022 (Contract)

- Contract - with main objective to develop a framework for real-time control of a plasma generator
- Developed advanced, object-oriented algorithmic code in Python and C++ to support the company's data science and visualization platforms.
- Applied data science methodologies using libraries like pandas and scikit-learn to process and visualize data.

Zetane Systems Inc., Montreal (Quebec)

ML/AI Engineer, September 2020 – November 2021 (Contract)

- Contributed to the development of cutting-edge real-time visualization tools for deep neural network tensors.
- Collaborated with advanced teams at IBM and Microsoft to provide efficient and seamless access to core visualization tools.

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CAE Inc., Montreal (Quebec)

Controls Systems and QA Engineer, July 2018 – September 2020 (Contract)

● Automated real-time testing and certification of closed-loop, Software-in-the-Loop (SIL) systems for the Airbus A3xx vehicle simulation.
● Mastered tools for real-time aircraft identification data acquisition and matching, directly contributing to the rigorous testing and certification process of flight simulators.

Adacel Inc. - Aviation and Aerospace Component Manufacturing

Software Engineer, January 2018 – July 2018 (Contract)

● Designed and implemented software enhancements for real-time system-test automation, supporting Air Traffic Management (ATM) and Air-Tower Control (ATC) product lines.
● Developed advanced, original Object-Oriented (OO) code in C/C++ to create QA automation tools.

Montreal Neurological Institute & Hospital, McGill University

Postdoctoral Fellow, January 2014 – December 2017

- Experience with image processing: Used and refined biomedical imaging algorithms for the registration of MRI image stacks, ensuring precise alignment for analysis.
- Experience with advanced modeling and algorithms, leveraging tools such as TensorFlow and Keras, model conversions and optimization tools
- Experience porting code between languages and from research level code in Matlab or Python to real-time and highly-parallel and high-performance (aka super-computing) C/C++ code
- Familiarity with commonly used libraries: e.g. OpenCV, scipy, numpy.

Polytechnique Montréal - Dept. Biomedical Engineering

Ph.D. Biomedical Engineering and Computational Neuroscience, May 2009 - Jan 2015

- Conducted multi-scale computational modeling from the microscopic to the mesoscopic level, demonstrating expertise in analyzing complex systems.

UNIVERSITÉ de MONTRÉAL

Research Associate (Member SGPPUM), October 1999 – April 2009

- Authored or co-authored 15+ original publications in high-impact, peer-reviewed journals.
- Contributed key scientific findings that advanced the understanding of motor neurophysiology and the brain's synergistic control of movement.

CAE Inc., Montreal (Quebec)

Energy Control Systems - Controls and OR Engineer, August 1996 – December 1999

- Implemented turn-key Energy Management Systems with smart SCADA-based real-time energy-distribution control.
- The system optimizer utilized large-scale MIP formulations and the CPLEX library, ensuring grid stability and preventing costly power outages.

IBM Bulgaria, Sofia (Bulgaria) - IBM Services

Project Manager, December 1992 – August 1996

- Project manager for midrange systems - AS-OS/400, RS-AIX/6000
- National Language support and standards; Technical writing and mentoring
- Pioneered the IBM BG National Education Center from the ground up, reconciling the high-cost training model with a fledgling post-totalitarian market.
- Transformed the center from a one-person operation into a robust enterprise by recruiting and directing a team of technical instructors.

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Education

Coursera

Business-Analysis-Oriented Optimization and Operations Research, 2024 - 2025

Polytechnique MONTRÉAL

PhD, Biomedical Engineering and Computational Neuroscience, 2009 - 2015
(R&D focus)

- Graduate Degree in Biomedical Engineering

TU Sofia - Faculty of Automation

M.Sc. in Electrical Engineering (Automation/Control System Engineering), 1989 - 1992

- Graduate Degree in Electrical Engineering

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Selected Publications

- **From Squid to Mammals with the HH Model through the Na_v Channels' Half-Activation-Voltage Parameter**
  - *Nedialko I. Krouchev, F. Rattay, M. Sawan, A. Vinet. PLoS ONE 10(12), 2015.*
  - *This research demonstrates the application of **non-linear dynamics theory** to understand and model **complex biological systems.**

- **Energy-Optimal Electrical-Stimulation Pulses Shaped by the Least-Action Principle**
  - *Nedialko I. Krouchev, S. M. Danner, A. Vinet, F. Rattay, M. Sawan. PLoS ONE 9(3), 2014.*
  - *This paper uses **optimization** and physical principles to analyze and **improve complex bio-systems.**

- **Motor cortical regulation of sparse synergies during precision walking**
  - *Nedialko Krouchev, Trevor Drew. Frontiers in computational neuroscience 7, 2013.*
  - *This paper explores **motor control and coordination in complex biological systems.**

- **Motor control in a meta-network with attractor dynamics**
  - *N. I. Krouchev, J. F. Kalaska. Progress in Brain Research 165, 2007.*
  - *This research demonstrates the application of **non-linear dynamics theory** to understand and model **complex neural networks.**

- **Sequential activation of muscle synergies during locomotion in the intact cat as revealed by cluster analysis and direct decomposition**
  - *N. Krouchev, J. F. Kalaska, T. Drew. Journal of neurophysiology 96 (4), 2006.*
  - *This work contributed key scientific findings about the **brain's synergistic control of movement** in complex biological systems.

- **Context-dependent anticipation of different task dynamics: rapid recall of appropriate motor skills using visual cues**
  - *N. I. Krouchev, J. F. Kalaska. Journal of Neurophysiology 89(2), 2003.*
  - *This research provided insights into the **encoding of motor skills** and the brain's ability to adapt to new tasks, a key area of **motor neurophysiology.**

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