

Navjot Kukreja

HIGH-PERFORMANCE COMPUTING · MACHINE LEARNING

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Qualifications

Imperial College London

DOCTOR OF PHILOSOPHY - COMPUTATIONAL SCIENCE

Title: High-performance backpropagation for structured grid solvers

London, England

2017-2020

University of Southampton

MASTER OF SCIENCE IN OPERATIONAL RESEARCH - DISTINCTION

- Dissertation: Automatic detection of diabetic retinopathy in eye images using Deep Learning

Southampton, England

2014-2015

Birla Institute of Technology and Science (BITS), Pilani

BACHELOR OF ENGINEERING (HONOURS) IN ELECTRICAL AND ELECTRONICS ENGINEERING

Pilani, India

2005-2009

Academic Appointments

Imperial College London

RESEARCH ASSISTANT, DEPARTMENT OF EARTH SCIENCE AND ENGINEERING

Research in high-performance computing, code generation, automatic differentiation, machine learning etc., originally motivated by applications in seismic imaging. Also exploring the use of cloud technologies to accelerate seismic imaging including Kubernetes and serverless computing (Lambda/ (Cloud) Functions). Coauthor on 15+ peer-reviewed publications and presented 12+ conference talks. Currently contributing to the following open-source projects:

- Devito: DSL and Compiler for high-performance finite-difference computations. First developer on project that now has 40 contributors and $\approx 200+$ users.
- pyRevolve: High-level interface to memory-saving checkpointing-recompute for adjoint computations. Includes multiple schedulers as well as lossy compression.
- PerforAD: Automatic differentiation for stencil loops

London

Jan 2017 - Present

Argonne National Laboratory

SUMMER INTERN, MATHEMATICS AND COMPUTER SCIENCE DIVISION

Lossy compression for floating point data, in the context of checkpointing and automatic differentiation.

SENAI CIMATEC

RESEARCH ASSISTANT, CENTER FOR HIGH PERFORMANCE COMPUTING

HPC research that involved modifying research-developed algorithms to scale across large clusters. Most of this work was targeted at the area of seismic imaging. During this time also developed a python based DSL compiler that would convert symbolic equations written in python to highly optimised C code (Devito), in collaboration with Imperial College and University of British Columbia.

Lemont, IL, United States

Aug 2018 - Nov 2018

Salvador, Brazil

July 2015 - Oct 2016

Industrial Experience

Trans Maldivian Airways

INDEPENDENT TECHNOLOGY CONSULTANT

Planning system for automatic scheduling and routing of aircraft across Maldives.

Male, Maldives

Sep 2013 - Feb. 2014

Gharpay Money Transfer

VICE PRESIDENT, TECHNOLOGY

Designed and developed the complete software stack that this technology-reliant startup used for all business functions including an on-the-fly order allotment system. This company was later acquired.

Hyderabad, India

May 2011 - Aug 2012

Bravo Lucy Technologies

PRODUCT DEVELOPER/SCRUM MASTER

Project Development and System Analysis/Design for multiple projects that applied algorithms based on cutting-edge operations research to solve real business problems in supply chain management, demand forecasting, inventory management, logistics and product placement. This company was founded and funded by a Professor of Operations Research at INSEAD.

Hyderabad, India

September 2009 - May 2011

Beleza Indiana

EXECUTIVE ASSISTANT TO CEO

- Apparel import business owned and operated by the family

Phokatcopy Student Advertising Pvt. Ltd.

MANAGER, TECHNOLOGY OPERATIONS

São Paulo Brazil

Sep 2012 - Aug 2013

New Delhi, India

Jun. 2009 - May 2012

Scholarships, Honours & Awards

2020	John S. Archer Award for Research Excellence , Department of Earth Science and Engineering	Imperial College London
2019	Best Paper Candidate (1 of 3) , International Conference of Parallel Processing	Kyoto, Japan
2016	Award of Excellence for MSc Dissertation , Centre for Operational Research, Management Science and Information Systems	University of Southampton
	Scholarship for Technological Innovation (DTI) , FINEP - Federal Government of Brasil	Nov 2015-Oct 2016
2015	Best research study in the category of computational modeling , Conference on Research on technological innovation (PTI) CIMATEC	SENAI Bahia
	Dhananjay Mohan Award for Scientific Innovation , Ritnand Balved Educational Foundation	
	National Talent Search Examination , Govt of India	
	Junior Science Talent Search Scholarship , Directorate of Education - Government of New Delhi	

Supervision

Machine learning to identify craters on Mars surface images

YITONG JIN - MSc APPLIED COMPUTATIONAL SCIENCE AND ENGINEERING

Summer 2020

Use of machine learning to automate seismic image interpretation

MICHEL SFEIR - MSc APPLIED COMPUTATIONAL SCIENCE AND ENGINEERING

Summer 2020

Transfer learning from weakly supervised training for seismic image segmentation

PING-CHEN TSAI - MSc APPLIED COMPUTATIONAL SCIENCE AND ENGINEERING

Summer 2020

Joey - using Devito to accelerate neural computations

YORGOS CHATZITHEOKLITOS - MSc APPLIED COMPUTATIONAL SCIENCE AND ENGINEERING

Summer 2020

Machine learning to identify social media astroturfing during Covid

TIANZONG YU - MSc APPLIED COMPUTATIONAL SCIENCE AND ENGINEERING

Summer 2020

Use of machine learning to automate well-log interpretation

TURKI ALAZRANI - MSc PETROLEUM ENGINEERING

Summer 2019

Unbiased classification of facies using well-log data

RUNZHI ZHOU - MSc APPLIED COMPUTATIONAL SCIENCE AND ENGINEERING

Summer 2019

Teaching

Machine Learning

MSc. APPLIED COMPUTATIONAL SCIENCE AND ENGINEERING (36 HOURS)

Taught half the lectures

Imperial College London

May 2020

Introduction to Machine Learning

GRADUATE SCHOOL (6 HOURS)

30 PhD students from different departments

Imperial College London

June 2019

Machine Learning (teaching assistant)

MSc. APPLIED COMPUTATIONAL SCIENCE AND ENGINEERING (36 HOURS)

Imperial College London

May 2019

Python II + Unix Shell

SOFTWARE CARPENTRY (4 + 4 HOURS)

Imperial College London

Feb 2018/Feb 2019

Programming for Android

POSTGRADUATE SPECIALISATION IN PROGRAMMING FOR MOBILE. (40 HOURS)

SENAI CIMATEC, Brazil

Dec 2015 - Feb 2016

Other Work

Geoscientific Model Development

REVIEWER

2019

European Geosciences Union

Journal of Supercomputing

REVIEWER

2019

Springer Journal

EuroAD

CO-ORGANISER (1 OF 3) AT IMPERIAL COLLEGE LONDON

2019

European workshop on Automatic Differentiation

Computers and Fluids

REVIEWER

2019

Elsevier Journal

EuroPar 2018

SUB-REVIEWER

24th International European Conference on Parallel and Distributed Computing

Android App “Ciggie - Quit smoking”

DEVELOPED AS A HOBBY PROJECT

May 2011

- App installed on over 10000 phones worldwide

Invited Talks

University of São Paulo

Brazil

WORKSHOP ON SOFTWARE TECHNOLOGIES FOR MODELLING AND INVERSION

Apr and Sep 2019

SENAI CIMATEC, Salvador

Brazil

WORKSHOP ON FULL WAVEFORM INVERSION

Apr 2019

INRIA Bordeaux

France

ACCELERATING ADJOINT COMPUTATIONS BY COMBINING CHECKPOINTING AND COMPRESSION

Dec 2018

Skills

Programming Python, C, Java(including for Android)

Web Cloud infrastructure (including Kubernetes), Javascript/NodeJS

Data Analysis R

Agile methodologies Scrum, TDD

Languages English, Hindi, Portuguese (Brazilian)

Other Hobbies Photography (<http://500px.com/navjotk>)

Professional memberships IEEE, SIAM, The OR Society

Publications

Combining Checkpointing and Data Compression to Accelerate Adjoint-Based Optimization Problems

EuroPar

NAVJOT KUKREJA, J. HÜCKELHEIM, M. LOUBOUTIN, P. HOVLAND, G. GORMAN

2019

Automatic Differentiation for Adjoint stencil loops

ICPP

J. HÜCKELHEIM, NAVJOT KUKREJA, S. H. K. NARAYANAN, F. LUPORINI, G. GORMAN, P. HOVLAND

2019

Training on the Edge: The why and how

IPDPS

NAVJOT KUKREJA, A. SHILOVA, O. BEAUMONT, J. HÜCKELHEIM, N. FERRIER, P. HOVLAND, G. GORMAN

2019

Workshop on Parallel AI Systems on the Edge

A large-scale framework for symbolic implementations of seismic inversion algorithms in Julia

Geophysics

P. WITTE, M. LOUBOUTIN, NAVJOT KUKREJA, F. LUPORINI, M. LANGE, G. GORMAN, F. HERRMANN

2019

Architecture and performance of Devito, a system for automated stencil computation

Transactions on Mathematical Software

F. LUPORINI, M. LANGE, M. LOUBOUTIN, NAVJOT KUKREJA, J. HÜCKELHEIM, C. YOUNT, P. WITTE, P. KELLY, G. GORMAN, F. HERRMANN

2018

Devito: an embedded domain-specific language for finite differences and geophysical exploration

Geoscientific Model Development

M. LOUBOUTIN, M. LANGE, F. LUPORINI, NAVJOT KUKREJA, P. WITTE, F. HERRMANN, P. VELESKO, G. GORMAN

2018

Full-waveform inversion, Parts 1-3 : Forward modeling, adjoints, and optimisation

The Leading Edge (SEG)

M. LOUBOUTIN, P. WITTE, M. LANGE, NAVJOT KUKREJA, F. LUPORINI, G. GORMAN AND F. HERRMANN

2017-18

Towards Self-Verification in Finite Difference Code Generation

Correctness

J. HÜCKELHEIM, Z. LUO, F. LUPORINI, NAVJOT KUKREJA, M. LANGE, G. GORMAN, S. SIEGEL, M. DWYER, P. HOVLAND

2017

- Held in conjunction with SC 2017

Optimised finite difference computation from symbolic equations

SciPy

M. LANGE, NAVJOT KUKREJA, F. LUPORINI, C. YOUNT, M. LOUBOUTIN, J. HÜCKELHEIM AND G. GORMAN

2016

Performance prediction of finite-difference solvers for different computer architectures

Computers and Geosciences

M. LOUBOUTIN, M. LANGE, F. HERRMANN, NAVJOT KUKREJA, G. GORMAN

2016

Devito: automated fast finite difference computation.

WolfHPC

NAVJOT KUKREJA, M. LOUBOUTIN, F. VIEIRA, F. LUPORINI, M. LANGE AND G. GORMAN

2016

- Held in conjunction with SC 2016

The use of deep learning in automatic detection of diabetic retinopathy

IFBA

NAVJOT KUKREJA AND VALTER DE SENNA

2016

- Chapter in the book “Applications of computational modelling in the area of healthcare” (Brazilian portuguese)
- <http://www.editora.ifba.edu.br/book/tecnologias-aplicadas-a-saude/> ISBN: 978-85-67562-09-4

Conference Talks

Combining lossy compression with checkpointing to accelerate adjoint-based optimisation

EUROPAR 2019 GÖTTINGEN

Aug 2019

Automatic differentiation of adjoint stencil loops

EUROAD WORKSHOP ON AUTOMATIC DIFFERENTIATION

Jul 2019

Training Neural networks on the Edge: The Why and the How

INTERNATIONAL PARALLEL AND DISTRIBUTED PROCESSING SYMPOSIUM

May 2019

Parallel AI Systems on the Edge (PAISE) Workshop

Lossy compression for checkpointing

EUROAD WORKSHOP ON AUTOMATIC DIFFERENTIATION

Nov 2018

High-level abstractions for checkpointing in adjoint-based optimisation

INTERNATIONAL SYMPOSIUM FOR MATHEMATICAL PROGRAMMING

Jul 2018

Rapid development of seismic imaging applications using symbolic mathematics

THIRD EAGE WORKSHOP ON HIGH PERFORMANCE COMPUTING FOR UPSTREAM

Sep 2017

Leveraging symbolic math for rapid development of applications for seismic imaging

HIGH PERFORMANCE COMPUTING IN OIL AND GAS AT RICE UNIVERSITY

Mar 2017

Symbolic Math for Automated Fast Finite Difference Computations

SIAM-CSE 2017

Feb 2017

MS84 Domain-Specific Abstractions for Full-Waveform Inversion