

Curriculum Vitae

Dr. Christopher Kumar Anand

Revised: 9 September 2019

Address

Department of Computing and Software
McMaster University
1280 Main Street West
Hamilton, Ontario L8S 4K1
Canada

Phone: 905-525-9140 ;; 21397

E-mail: anandc@mcmaster.ca

Web: <http://www.cas.mcmaster.ca/~anand/>

E. Education

1994	Ph.D. (mathematics, supervisor: Jacques Hurtubise)	McGill University
1990	M.Sc. (mathematics, supervisor: Jacques Hurtubise)	McGill University
1988	BMath (pure mathematics)	University of Waterloo

F. Current Status

Associate Professor, Department of Computing and Software
Associate Member, School of Biomedical Engineering
Associate Member, School of Computational Science and Engineering

G. Professional Organization

Member, ACM.

H. Employment History

Academic

- 2008–present Associate Professor, Department of Computing and Software, McMaster University
- 2001–2008 Assistant Professor, Department of Computing and Software, McMaster University
- 1997–1998 Professeur associé, Université de Bretagne Occidentale,
Département de Mathématiques, Brest, France
- 1996–1997 NSERC Postdoctoral Fellow, DPMMS, University of Cambridge
supervisor: Nigel Hitchin
- 1995–1996 NSERC Postdoctoral Fellow, Mathematics Research Centre, University of Warwick
supervisor: Nigel Hitchin
- 1994–1995 Postdoctoral Fellow, Mathematics and Statistics, McGill University

Consultation

- 2006–present Fellow, IBM Centre for Advanced Study (honorary position)

Industrial

- 2008–present Chief Science Officer, Optimal Computational Algorithms, Inc.
- 1998–2001 Senior Staff Software Engineer and Staff Scientist,
Marconi Medical Systems, Cleveland, Ohio

I. Scholarly and Professional Activities

Committees

- 2007 Ministry of Education, High School Curriculum Advisor
- 2006 Council of Ontario Universities Task Force on Technological Education
- 2004 Brain Body Institute Review Committee
- 2003 SHARCNET Fellowship Selection Committee

Workshop and Conference Organization

- 2019 Co-Organizer, Two functional MDDs for the Price of One, CASCON 2019 Full-Day Workshop.
- 2017 Co-Organizer, Code The Future! Teach Kids To Program in Elm, CASCON 2017 Workshop.
- 2011 Co-Organizer, Minisymposium on Progress and Prospects in Model-Based Scientific Software Development, AMMCS 2011
- 2011 Cluster Chair, Mathematics and Medicine, CORS 2011
- 2010 Co-Chair, CASCON 2010 Workshop, High-Performance Computing with Sparsity and Structure: Challenges and Directions for Single-Core and Multicore Hardware
- 2009 Program Committee, Carleton University Cell BE Programming Workshop
- 2008 Co-Chair, Cell BE and Heterogeneous Multicore Systems: Architecture, Tools and Applications (2-day CASCON Workshop)
- 2007 Co-Chair, Cell BE and Heterogeneous Multicore Systems: Architecture, Tools, and Applications (2-day CASCON Workshop)
- 2006 Co-Chair, Leveraging Cell: Proven Techniques, Common Issues and New Applications, CASCON Workshop
- 2003 Organizer of McMaster Workshop in Magnetic Resonance Image Reconstruction
- 2003 Organizing Committee for McMaster Optimization Conference: Theory and Applications

J. Areas of Interest

- **Computer Science Education**

- **Model-Driven Development:** Using MDD, strong typing and pure functions to lower the barrier for developing and reasoning about web applications with concurrent, distributed users.
- **Algebraic Thinking:** Using student-directed problems in computer graphics to spur high-level thinking, which is exemplified by algebra.
- **Design Thinking:** Using Design Thinking methods to help children reflect on their own learning and improve their peers' learning environments.

- **Magnetic Resonance and Electron Microscopy**

- **Optimization:** Optimal experiment design. Optimal signal processing for MRI. Optimal design of sampling gradient pulse waveforms, reconstruction algorithms, and devices.

- **Computer Science**

- **Model-Driven Development:** Using MDD and strong typing to develop provably sound, high-performance implementations of mathematical algorithms, leveraging SIMD and multi-core parallelism.

K. Honors

2018	IBM Centre for Advanced Studies Project of the Year
2017	IBM Centre for Advanced Studies Faculty Fellow of the Year
2006–2018	IBM Centre for Advanced Studies Faculty Fellow
1996	NSERC Postdoctoral Fellowship, Cambridge University
1995	NSERC Postdoctoral Fellowship, University of Warwick
1992	FCAR Bourse, McGill University
1990	NSERC Postgraduate Scholarship B, McGill University
1988	NSERC Postgraduate Scholarship A, McGill University
1987	NSERC Undergraduate Summer Research Assistanceship, University of Waterloo
1985	Descartes Fellowship, University of Waterloo

L. Courses Taught

Undergraduate

Year	Course	Units	Title	# Students
2018–2019	Comp Sci 4ZP6	6	Senior Thesis Project	71
2018–2019	CS 4EN3	3	Software Entrepreneurship	17
2017–2018	Comp Sci 4ZP6	6	Senior Thesis Project	41
2017–2018	CS 4EN3	3	Software Entrepreneurship	33
2016–2017	CS 1MD3	3	Introduction to Programming (summer)	66
2016–2017	CS 1JC3	3	Introduction to Computational Thinking	136
2015–2016	CS 1MD3	3	Introduction to Programming (summer)	65
2015–2016	CS 1JC3	3	Introduction to Computational Thinking	133
2014–2015	CS 1JC3	3	Introduction to Computational Thinking	120
2014–2015	CS 4EN3	3	Software Entrepreneurship	28
2013–2014	SE/CS 4TE3	3	Continuous Optimization Algorithms	25
2013–2014	CS 1JC3	3	Introduction to Computational Thinking	118
2013–2014	CS 4EN3	3	Software Entrepreneurship	29
2012–2013	SE/CS 4TE3	3	Continuous Optimization Algorithms	11
2012–2013	CS 1MA3	3	Computer Based Problem Solving	84
2012–2013	CS 4EN3	3	Software Entrepreneurship	29
2011–2012	CS 1MA3	3	Computer Based Problem Solving	86
2011–2012	CS 4EN3	3	Software Entrepreneurship	28
2011–2012	SE/CS 4TE3	3	Continuous Optimization Algorithms	26
2009–2010	CS 1TA3	3	Elementary Computing and Computer Use	115
2009–2010	SE/CS 4TE3	3	Continuous Optimization Algorithms	23
2008–2009	SE/CS 4TE3	3	Continuous Optimization Algorithms	24
2008–2009	Comp Sci 4ZP6	6	Senior Thesis Project	10
2007–2008	CS 3CS3 / SE 3I03	3	Communication Skills	71
2007–2008	Comp Sci 4ZP6	6	Senior Thesis Project	8
2006–2007	Comp Sci 2CA3	3	Computer Architecture and Organization	11
2006–2007	Comp Sci 4ZP6	6	Senior Thesis Project	17
2005–2006	Sfwr Eng 3I03	3	Communication Skills	28
2005–2006	Comp Sci 4ZP6	6	Senior Thesis Project	16
2004–2005	Comp Sci 1MC3	3	Computer Science I	35
2004–2005	Comp Sci 1MC3	3	Computer Science I	69
2004–2005	Comp Sci 4ZP6	6	Senior Thesis Project	45
2003–2004	Comp Sci 1MC3	3	Computer Science I	37
2003–2004	CS/SE 4TG3	3	Sci. and Eng. of a Signal Processing System	12
2003–2004	Comp Sci 1MC3	3	Computer Science I	86
2003–2004	Comp Sci 4ZP6 ¹	3	Senior Thesis Project	60
2002–2003	Comp Sci 1MC3	3	Computer Science I	76
2002–2003	CS/SE 4TG3	3	Sci. and Eng. of a Signal Processing System	16
2002–2003	Comp Sci 1MC3	3	Computer Science I	164
2001–2002	CS/SE Eng 4TG3	3	Sci. and Eng. of a Signal Processing System	18
2001–2002	Sfwr Eng 3I03 ²	1	Communication Skills	80
1997–1998	M3	4	Intro to Mathematical Analysis (UBO)	160
1997–1998	MS2S	2	Introduction to Applied Mathematics (UBO)	30
1997–1998	MS4S	2	Complexity of Algebraic Computation (UBO)	40
1994–1995		3	Advanced Calculus (McGill)	30

Graduate

Year	Course	Units	Title	# Students
2018–2019	CAS/CES 750	3	Model-Based Image Reconstruction	9
2017–2018	CAS 781	3	CS Topics (Bayesian Networks)	13
2017–2018	CAS 750	3	Model-Based Image Reconstruction	4
2014–2015	CAS 733	3	Mobile UI Design	3
2011–2012	CAS/CES 750	3	Model-Based Image Reconstruction	2
2009–2010	CAS/CES 750 (summer)	3	Model-Based Image Reconstruction	6
2009–2010	CAS 781	3	Topics: Mobile UI Design	3
2009–2010	CAS 6TE3 / CES 722/723	3	Model-Based Image Reconstruction	6
2009–2010	CAS/CES 750	3	Model-Based Image Reconstruction	6
2008–2009	CAS 750	3	Model-Based Image Reconstruction	1
2008–2009	CAS 6TE3	3	Continuous Optimization Algorithms	1
2007–2008	CAS 750	3	Model-Based Image Reconstruction	3
2006–2007	CAS 750	3	Model-Based Image Reconstruction	3
2005–2006	CAS 781	3	Topics in Computer Science	4
2003–2004	CAS 6TG3	3	Sci. and Eng. of a Signal Processing System	1

Totals

Year	Courses	Units	# Students
2018–2019	3	12	87
2017–2018	3	12	90
2016–2017	2	6	202
2015–2016	2	6	198
2014–2015	3	9	151
2013–2014	3	9	172
2012–2013	3	9	124
2011–2012	4	12	142
2009–2010	5	15	157
2008–2009	3	12	36
2007–2008	3	12	82
2006–2007	3	12	31
2005–2006	3	12	48
2004–2005	4	12	149
2003–2004	4	12	196
2002–2003	3	9	256

¹Taught with Jeff Zucker²Taught with Dave Parnas and Devorah Abrams Farmer

M. Supervision

	Completed	In Progress	
Master's	31	9	
Doctoral	4	4	
Supervisory Committees	6	2	
CAS Senior Thesis Project Groups	14		
Examination Committees			
as external examiner	2		
as internal examiner	17		
Master's Students			
Name	Degree	Title / Dates	Cosupervisor
Zhuopeng Zhang	MEng, CS,	TBD <i>Sept 2019 –</i>	
Krutiga Karunakaran	MEng, CS,	TBD <i>Sept 2019 –</i>	
Rohan Patel	MEng, CS,	TBD <i>Sept 2019 –</i>	
Maryam seinkord	Hos- MAsc, CS,	TBD <i>Sept 2019 –</i>	
Padma Pasupathi	MAsc, CS,	TBD <i>May 2019 –</i>	
Nhan Thai	MAsc, CS,	TBD <i>May 2019 –</i>	
Tanya Bouman	MAsc, CS,	TBD <i>Sept 2018 –</i>	
Yasmin Sartipi	MAsc, CS,	embargoed <i>Jan 2018 – May 2019</i>	
Sepehr Bayat	MEng, CS	TBD <i>Sept 2017 –</i>	
Aidan Ross	MEng, CSE	Cognitive Concrete <i>Sept 2017 –</i>	Bassim
Curtis d'Alves	MSc, CS	A Scaled Gradient Descent Method for Un- constrained Optimization Problems With A Priori Estimation of the Minimum Value <i>Jan 2015 – Dec 2016</i>	Kahl
Helen Brown	MSc, CS	An iPad Application Design for Social Con- structivist E-Learning <i>May 2014 – July 2016</i>	
Simon Broadhead	MSc, CS	Type-Safe Domain-Specific Code Graph Con- struction Using Scala <i>Sept 2013 – Oct 2015</i>	

Master's Students (continued)

Name	Degree	Title / Dates	Cosupervisor
Kriston Costa	MEng, CS	An Approximation Algorithm Approach to Instruction Scheduling <i>Sept 2013 – Jan 2016</i>	
Samantha Chan	MASc, SE	Computer Games as an Experiential Tool for Teaching Computing <i>Sept 2012 – Sept 2014</i>	Smith
Subramanian Venkatesan	MEng, CS	Visualization of Optimality in Constrained Optimization <i>Sept 2012 – Feb 2014</i>	
Daniel Moore	MASc, SE	TBD <i>Sept 2011 – (part time)</i>	
Maryam Khalaji	MSc, CS	Rapid Re-optimization of Prostate Intensity-Modulated Radiation Therapy Using Regularized Linear Programming <i>Jan 2011 – March 2013</i>	Wierzbicki
Jing Chen	MSc, CS	A Single Precision, Pipelined Floating-Point Logarithm Computation Unit in Hardware <i>Sept 2010 – July 2012</i>	
Jessica Pavlin	MSc, CS	Symbolic Generation of Parallel Solvers for Unconstrained Optimization <i>May 2010 – May 2012</i>	Smith
Hesham El-Sewify	MEng, CES	Multi-Particle Collision Dynamics <i>May 2010 – May 2012</i>	Smith
Maryam Moghadas	MSc, CS	Type-Safety for Inverse Imaging Problems <i>May 2010 – September 2012</i>	Kahl
Michal Dobrogost	MSc, CS	Verifying Permutation Rewritable Hazard Free Loops <i>Jan 2010 – July 2011</i>	Kahl
Qiong Wu	MASc	A Semi-Definite, Nonlinear Model for Optimizing k-Space Sample Separation in Parallel Magnetic Resonance Imaging <i>Sept 2009 – July 2011</i>	
Anuroop Sharma	BME MSc, CS	Elementary Function Evaluation using New Hardware Instructions <i>May 2009 – Aug 2010</i>	
Damith Karunaratne	MSc, CS	TBD <i>May 2009 – (part time)</i>	
Sean Watson	MASc, SE	Locating Carbon Bonds from INADEQUATE Spectra using Continuous Optimization Methods and Non-Uniform K-Space Sampling <i>May 2009 – May 2011</i>	
Yogesh Chinta Venkateswarao	MEng, CES	Sparse Sampling of Velocity MRI <i>May 2009 – July 2011</i>	
Anuroop Sharma	MTech, IIT-Delhi	Design of Optimal Experiments Using SDP <i>Jan 2008 – Dec 2009</i>	Mehra

Master's Students (continued)

Name	Degree	Title / Dates	Cosupervisor
Kevin Browne	MSc, CS	Performance Simulation with the Coconut Multicore Framework for the Cell/B.E. <i>Sept 2007 – Sept 2009</i>	
Nael El Shawwa	MEng, CES	Visualization in Aid of Design in MRI <i>Sept 2006 – Jan 2008</i>	
Merdad Mozafari	MSc, CS	Model-Based Tissue Quantification from Simulated Partial k-Space MRI Data <i>Sept 2006 – Aug 2008</i>	
Paul Polak	MASc, BME	Real-Time Volumetric MRI <i>Sept 2006 – May 2009</i>	Noseworthy
Wei Li	MASc, SE	MRI Velocity Quantification Implementation and Evaluation of Elementary Functions for the Cell Broadband Engine <i>Sept 2005 – June 2007</i>	
Tahani Almabruk	MSc, CS	Regularized Reconstruction of Diffusion Fiber Tractography <i>Sept 2005– Sept 2008</i>	
Wolfgang Thaller	MSc, CS	Explicitly Staged Software Pipelining <i>Sept 2004 – Aug 2006</i>	Kahl
Gordon Uzskay	MSc, CS	HUSC Language and Type System <i>Sept 2003 – May 2006</i>	Carette
Olesya Peshko	MSc, CS	Contour Extraction for Radiotherapy Planning <i>May 2003 – Aug 2005</i>	Terlaky
Ting Ting Ren	MSc, CS	An Optimal Design Method for MRI Teardrop Gradient Waveforms <i>Sept 2003 – Aug 2005</i>	Terlaky
Zhuo Zheng	MASc, SE	Magnetic Resonance Tissue Quantification using Optimal Pulse Sequence Design <i>Sept 2003 – Aug 2005</i>	Terlkay
Stephen Stoyan	MSc, Math	Variable Rate Selective Excitation RF Pulse in MRI <i>Sept 2002 – Aug 2004</i>	Terlaky
Alexandre Korobkine	MASc, SE	Model-Based Visual Tracking via Maple Code Generation <i>Sept 2002 – Aug 2004</i>	Lawford

Doctoral Students

Name	Degree	Title / Dates	Cosupervisor
Sean Aubin	PhD, CS	TBD <i>Sept 2019 –</i>	
Habib Ghaffari-Hadigheh	PhD, CS	TBD <i>Jan 2019 –</i>	Bassim
Nasim Khoonkari	PhD, CS	TBD <i>Jan 2019 –</i>	Bassim
Curtis d'Alves	PhD, CS	Approximation Algorithms for Instruction Scheduling <i>Sept 2016 –</i>	Kahl
Venu Kurella	PhD, CES	Algorithms for Metrology <i>Sept 2016 – June 2018</i>	Spence
Robert Fuller	PhD, CS	Type-Level Correctness of Models in Scientific Computation <i>Sept 2012 – (withdrawn in good standing)</i>	Kahl
Alvin Ihsani	PhD, CES	Dynamic Myocardial SPECT Imaging Using Single-Pinhole Collimator Detectors: Distance-Driven Forward and Back-Projection, and KDE-based Image Reconstruction Methods <i>Jan 2010 (transferred to CES from SE) – June 2015</i>	Farncombe
Kevin Browne	PhD, CS	Theoretical Aspects of Mobile User Interface Design <i>Sept 2009 – April 2016</i>	
Zhenghua Nie	PhD, CES	Simulation and Optimization of Multi-quantum Spectroscopy <i>Sept 2005 (started as MASc) – July 2011</i>	Bain

N. Research Funding

By Year			By Grant		
Year	Total	Share	Grant	Total	Share
2021	87 500	43 750			
2020	110 000	42 500	(25K NR)		
2019	172 500	68 785	(35K NR)		
2018	149 500	102 250	(30K NR)		
2017	89 500	44 750			
2016	70 000	47 500	(25K NR)		
2015	20 000	20 000	NR		
2014	25 000	25 000			
2013	20 000	20 000	NR		
2012	16 000	16 000			
2011	172 430	102 202	CAS Fellowships	294 000	243 000
2010	182 429	113 408	MMO/Sentinelle	31 500	21 000
2009	143 349	90 662	CFI/OIT	220 000	110 000
2008	36 000	26 000	NSERC	794 208	472 273
2007	40 000	30 000			
2006	33 000	33 000			
2005	44 500	34 000			
2004	13 000	13 000			
2003	233 000	123 000			

Notes:

- Grants are recorded according to the year the money was available, CFI not including overhead.
 - The principal investigator's name is underlined on each of the grants listed below.
- NR indicates non-research grants for science promotion.

Year	Agency	Title	Type	Amount
2019	NSERC	Approximation algorithms for instruction scheduling, <u>Anand, Kahl</u>	CRD	\$ 87 500
2020				\$ 85 000
2021				\$ 87 500
2019	IBM	Generating Cryptographic Kernels Using Co-conut, <u>Anand</u>	CAS Fellowship (Tanya Bouman)	\$ 25 000
2018	NSERC	Mining for hidden information in scanning electron microscope subpixels, <u>Anand</u>	ENGAGE	\$ 25 000
2018	IBM	Generating Cryptographic Kernels Using Co-conut, <u>Anand</u>	CAS Fellowship (James You)	\$ 26 000

Year	Agency	Title	Type	Amount
2020	NSERC	Software: Tool for Change, NR <u>Anand</u>	PromoScience	\$ 25 000
2019		NR		\$ 35 000
2018		NR		\$ 30 000
2017	NSERC	Optimal bandwidth-limited gradient wave- form design (continued) <u>Anand</u>	ENGAGE plus	\$ 25 000
2016	NSERC	Approximation algorithms for instruction scheduling, <u>Anand, Kahl</u>	CRD	\$ 33 000
2017				\$ 42 500
2018				\$ 44 500
2019	IBM	Approximation Algorithms for Instruction Scheduling, <u>Anand</u>	CAS Fellowship (Curtis d'Alves)	\$ 25 000
2018				\$ 24 000
2017				\$ 20 000
2016				\$ 20 000
2016	NSERC	Optimal bandwidth-limited gradient wave- form design, including eddy-current compen- sation, <u>Anand</u>	ENGAGE	\$ 25 000
2014	NSERC	Optimal Colour Calibration for Seamless Video Walls, <u>Anand</u>	ENGAGE	\$ 25 000
2016	NSERC	Software: Tool for Change, NR <u>Anand</u>	PromoScience	\$ 25 000
2015		NR	PromoScience	\$ 20 000
2014		suspended due to medical leave		
2013		NR	PromoScience	\$ 20 000
2011	NSERC	Way Beyond Markup, <u>Anand</u>	ENGAGE	\$ 25 000
2009	NSERC	Leveraging Structure and Sparsity on SIMD and Multicore Architectures, <u>Anand, Hossain, Kahl, Smith</u>	CRD	\$ 87 349
2010				\$ 114 429
2011				\$ 116 430
2012	IBM	Generating Floating-Point Kernels for FPGAs using Coconut, <u>Anand</u>	CAS Fellowship (Jing Chen)	\$ 20 000

Year	Agency	Title	Type	Amount
2011	IBM	New Algorithms for Special Functions, <u>Anand</u>	CAS Fellowship (Maryam Moghadas)	\$ 20 000
2011	IBM	Generating Floating-Point Kernels for FPGAs using Coconut, <u>Anand</u>	CAS Fellowship (Jing Chen)	\$ 20 000
2010	IBM	New Algorithms for Special Functions, <u>Anand</u>	CAS Fellowship (Anuroop Sharma)	\$ 26 000
2010	IBM	Multi-Core Software Pipelining, <u>Anand</u>	CAS Fellowship (Kevin Browne)	\$ 26 000
2009	IBM	VMX MASS, <u>Anand</u>	CAS Fellowship (Anuroop Sharma)	\$ 20 000
2009	IBM	Multi-Core, <u>Anand</u>	CAS Fellowship (Kevin Browne)	\$ 20 000
2008	IBM	Multi-Core, <u>Anand</u>	CAS Fellowship (Kevin Browne)	\$ 20 000
2007	IBM	Efficient Computation of Math Functions on Cell processors, continuation, <u>Anand</u>	CAS Fellowship (Mehrdad Mozafari)	\$ 20 000
2007	IBM	Understanding Cell Scheduling Issues, <u>Anand</u> , Kahl	CAS Fellowship (Shiqi Cao)	\$ 20 000
2006	IBM	Efficient Computation of Math Functions on Cell processors, <u>Anand</u>	CAS Fellowship (Wei Li)	\$ 20 000
2005	MMO	Optimal Design of Magnetic Resonance Imaging Coils using Tuned Simulation and SENSE Image Reconstruction, <u>Anand</u> , Carette	Enabling Grant	\$ 30 000
2005	Sentinel Medical			\$ 1 500
2003	Apple Canada	Coconut Project, <u>Anand</u>	Grant	\$ 10 000
2008	NSERC	Optimization in MRI and NMR, <u>Anand</u>	Discovery	\$ 16 000
2009				\$ 16 000
2010				\$ 16 000
2011				\$ 16 000
2003	NSERC	Optimization of Image and Signal Processing, <u>Anand</u>	Discovery	\$ 13 000
2004				\$ 13 000
2005				\$ 13 000
2006				\$ 13 000
2003	CFI	Automatic code generation of efficient and provably correct image processing and relational programs,	New Opportunities	\$ 91 000

Year	Agency	Title	Type	Amount
2003	OIT	<u>Anand</u> , Kahl		\$ 91 000
2003	in-kind	(mostly Apple)		\$ 38 000
2002	McMaster CLL	CSubmit (Web learning), <u>Anand</u> , Carrette	eLearning	\$ 13 230

O. Lifetime Publications

The principal author's names are underlined on each of the entries below. No name is underlined for equal contributions. Names of **students** I supervised are in bold.

i) Peer Reviewed

a) Books

- [1] Christopher Anand, Paul Baird, Eric Loubeau, John Wood, editors, Harmonic morphisms of metric graphs, in Harmonic morphisms, harmonic maps and related topics, Pitman (2000).

b) Contributions to Books

- [2] Michal Dobrogost, Christopher Anand, Wolfram Kahl, Verified Multicore Parallelism using Atomic Verifiable Operations, accepted for publication in *Multicore Technology: Architecture, Re-configuration and Modeling*, Muhammad Yasir Qadri and Stephen J. Sangwine (eds), CRC Press., 2013, 107–151.
- [3] Christopher Kumar Anand, Wolfram Kahl, Synthesising and Verifying Multi-Core Parallelism in Categories of Nested Code Graphs; “Process Algebra for Parallel and Distributed Processing (Algebraic Languages in Specification-Based Software Development)”, eds. Michael Alexander and William Gardner, Chapman and Hall/CRC, 2008, 3–45.
- [4] Christopher Anand, Harmonic morphisms of metric graphs, in Anand, Baird, Loubeau, Wood (eds.), Harmonic morphisms, harmonic maps and related topics, (2000) 109–112.

c) Journal Articles (27 publications)

- [5] **Kevin Browne**, Christopher Anand, An Empirical Evaluation of Reading Comprehension Tablet Software Utilizing the Question Generation Strategy, *Journal of Literacy and Technology*, 19 Winter (2018) 2–49.
- [6] **Christopher W. Schankula**, Christopher Kumar Anand, Nabil D. Bassim, Multi-Angle Plasma FIB Curtaining Artefact Correction using a Fourier-based Linear Optimization Model. *Microscopy & Microanalysis*, accepted, August 2018.
- [7] Christopher Anand, Bob Berno, Stephen Boulton, Michael A. Brook, Richard Epand, Timothy R. Field, Gillian R. Goward, Paul Hazendonk, Giuseppe Melacini, A tribute to Alexander Davidson Bain: An NMR pioneer and mentor at McMaster University. *Concepts Magn Reson Part A*, Volume 45A, Issue 6, 2016;45A:e21418, published on-line 29 April 2018
doi:10.1002/cm.a.21418
- [8] **Anuroop Sharma** and Christopher Kumar Anand, A Domain-Specific Architecture for Elementary Function Evaluation, *International Journal of Mathematics and Mathematical Sciences*, vol. 2015, Article ID 843851, 8 pages, 2015.
doi:10.1155/2015/843851
- [9] Kevin Browne and Christopher Anand and Elizabeth Gosse, Gamification and serious game approaches for adult literacy tablet software, *Entertainment Computing*, 5 (2014) 135–146.
dx.doi.org/10.1016/j.entcom.2014.04.003
- [10] Christopher K Anand, Alex D Bain, Andrew Thomas Curtis, **Zhenghua Nie** Designing Optimal Universal Pulses Using Second-Order, Large-Scale, Nonlinear Optimization, *J. Magn. Reson.* 219 (2012) 61–74. <http://dx.doi.org/10.1016/j.jmr.2012.04.004>

- [11] **Kevin Browne**, Christopher Anand, An empirical evaluation of user interfaces for a mobile video game, *Entertainment Computing*, 3 (2011) 1–10. [dx.doi.org/10.1016/j.entcom.2011.06.001](https://doi.org/10.1016/j.entcom.2011.06.001)
- [12] Christopher Kumar Anand, PhD, Alex D Bain, **Sean C Watson**, Use of Continuous Optimization Methods to Find Carbon Links in 2D INADEQUATE Spectra, *J. Magn. Reson.* 210 (2011) 146–150. [http://dx.doi.org/10.1016/j.jmr.2011.02.018](https://doi.org/10.1016/j.jmr.2011.02.018)
- [13] Christopher K. Anand, **Stephen J. Stoyan**, Tamás Terlaky, Energy-Optimizing the gVERSE RF Pulse Sequence: An Evaluation of Two Competitive Software Algorithms, *Algorithmic Operations Research*. 6 (2011) 1–19.
- [14] Alex D. Bain, Christopher Kumar Anand, **Zhenghua Nie**, Exact Solution of the CPMG Pulse Sequence with Phase Variation Down the Echo Train: Application to R2 Measurements, *J. Magn. Reson.* 209 (2011) 183–194, DOI 10.1016/j.jmr.2011.01.009.
- [15] Christopher K. Anand and **Anuroop Sharma**: Unified Tables for Exponential and Logarithm Families, *TOMS* 37 (2010).
- [16] Alex D. Bain, Christopher Kumar Anand, **Zhenghua Nie**, Exact solution to the Bloch equations and application to the Hahn echo, *J. Magn. Reson.* 206 (2010) 227–240, DOI 10.1016/j.jmr.2010.07.012.
- [17] Alex D. Bain, Donald W. Hughes, Christopher K. Anand, **Zhenghua Nie** and Valerie J. Robertson, Problems, artifacts and solutions in the INADEQUATE NMR experiment, to appear in *Magn. Reson. Chem.* (48) (2010) 630–641, DOI 10.1002/mrc.2639.
- [18] Christopher Kumar Anand, Wolfram Kahl, An Optimized Cell BE Special Function Library Generated by Coconut, *IEEE Trans. Computers*, 58 (8) (2009) 1126–1138.
- [19] CK Anand, AD Bain, **A Sharma**, Optimized Sampling Patterns for Multidimensional T_2 Experiments, *J. Magn. Reson.* 197 (2009), 63–70, DOI 10.1016/j.jmr.2008.12.005.
- [20] Christopher Kumar Anand, Robust Solvers for Inverse Imaging Problems using Dense Single-Precision Hardware, *J. of Math. Imag. and Vision*, 33 (1) (2009), 105–120, DOI 10.1007/1085100801123.
- [21] **Andrew Thomas Curtis**, Christopher Kumar Anand, Volumetric k -Space Trajectories Via Genetic Algorithms, *International Journal of Biomedical Imaging*, Volume 2008 (2008), Article ID 297089, 6 pages, DOI:10.1155/2008/297089.
- [22] Christopher Kumar Anand, **Tingting Ren**, Tamás Terlaky, Optimizing Teardrop, and MRI Sampling Trajectory, *Optimization Methods and Software*, 23 (4) (2008), 575–592, on-line Feb. 2008, DOI: 10.1080/10556780701874996.
- [23] Christopher Kumar Anand, **Andrew Thomas Curtis** and **Rakshit Kumar**, Durga: A heuristically-optimized data collection strategy for volumetric magnetic resonance imaging, *Engineering Optimization*, 40 (2) (2008) 117–136.
- [24] Christopher Kumar Anand, Alex D. Bain, **Zhenghua Nie**, Simulation of steady-state NMR of coupled systems using Liouville space and computer algebra methods, *J Magn Reson* 189 (2) (2007) 200–208. doi:10.1016/j.jmr.2007.09.012.
- [25] Christopher Kumar Anand, Renata Sotirov, Tamás Terlaky, **Zhuo Zheng**, Magnetic resonance tissue quantification using optimal bSSFP pulse-sequence design, *Optimization and Engineering*, 8 (2) (2007) 215–238.

- [26] Christopher Anand, Tamás Terlaky, Bixiang Wang, Rapid, Embeddable Design Method for Magnetic Resonance Image Reconstruction Resampling Kernels, Optimization and Engineering, 5 (4) (2004), 485–502.
- [27] Christopher Anand, A closed form for Unitons, Journal of the Mathematical Society of Japan, 50 (3) (1998) 737–751.
- [28] Christopher Anand, Ward’s Solitons II: Exact solutions, Canadian Journal of Math, 50 (6) (1998) 1119–1137.
- [29] Christopher Anand, Ward’s Solitons, Geometry and Topology, 1 (1997) 9–20.
- [30] Christopher Anand, Unitons and their Moduli, Electronic Research Announcements of the AMS, 2 (1) (1996) 7–16.
- [31] Christopher Anand, Uniton Bundles, Comm. Anal. Geom. 3 (1995), 371–419.

e) Refereed Conference Proceedings (15 publications)

- [32] **James You**, Qi Zhang, **Curtis d’Alves**, Bill O’Farrell, Christopher Anand, Using z14 Fused-Multiply-Add Instructions to Accelerate Elliptic Curve Cryptography, CASCON ‘19 (2019). (in press)
- [33] Christopher K. Anand, **Lucas Dutton**, **Adele Olejarz**, Robert Enenkel, Wolfram Kahl, Hardware/Software CoDesign for Mathematical Function Acceleration, CASCON ‘18 (2018) 168–177.
- [34] **John Zhang**, **Anirudh Verma**, **Chinmay Sheth**, **Christopher W. Schankula**, **Stephanie Koehl**, Andrew Kelly, **Yumna Irfan**, Christopher K. Anand, Graphics Programming in Elm Develops Math Knowledge & Social Cohesion, CASCON ‘18 (2018) 157–167.
- [35] Christopher Kumar Anand, **Curtis d’Alves**, **Yumna Irfan**, **Biya Kazmi**, **Stephanie Koehl**, **Stephanie Lin**, **Christopher William Schankula**, **Chinmay Jay Sheth**, **Pedram Yazdinia**, **John Zhang**, A Framework for Preadolescent Programmers to Create Cooperative Multiplayer Reading Games, IMCL 2018, presented 11 Oct 2018, in press.
- [36] **Curtis d’Alves**, **Tanya Bouman**, **Christopher Schankula**, **Jenell Hogg**, **Levin Noronha**, **Emily Horsman**, **Rumsha Siddiqui** and Christopher K. Anand, Using Elm to Introduce Algebraic Thinking to K-8 Students, TFPIE 2017, EPTCS 270 (2018) 18–36. doi:10.4204/EPTCS.270.2
- [37] Umme Salma Gadriwala, Christopher Kumar Anand, **Curtis d’Alves**, **Bill O’Farrell**, Accelerating Poly1305 Cryptographic Message Authentication on z14, CASCON 2017. In Proceedings of the 27th Annual International Conference on Computer Science and Software Engineering, IBM Corp., (2017), 48–54.
- [38] **Kevin Browne**, Christopher Anand, Gamification and Serious Game Approaches for Introductory Computer Science Tablet Software, Proceedings of the First International Conference on Gameful Design, Research, and Applications, (2013), 50–57.
- [39] Jacques Carette, Spencer Smith, John McCutchan, Christopher Anand, **Alexandre Korobkine**, Case Studies in Model Manipulation for Scientific Computing, Proc. of the 9th Inter. Conference on Artificial Intelligence and Symbolic Computation (AISC), (2008), 24–37.

- [40] Christopher Kumar Anand, Wolfram Kahl, Code Graph Transformations for Verifiable Generation of SIMD-Parallel Assembly Code, Applications of Graph Transformations with Industrial Relevance, AGTIVE 2007, A Schürr, M Nagl, A Zündorf (eds.), Springer, (2008) 213–228.
- [41] Christopher Anand, **Stephen Stoyan**, Tamás Terlaky, Energy-Minimizing Slice-Select Pulses for MRI, to appear in H.G. Bock, E. Kostina, H.X. Phu, R. Rannacher (eds), Modeling, Simulation and Optimization of Complex Processes. Proceedings of the International Conference on High Performance Scientific Computing, March 6–10, 2006, Hanoi, Vietnam. Springer 2008, 25–48.
- [42] Christopher Kumar Anand, Wolfram Kahl, MultiLoop: Efficient Software Pipelining for Modern Hardware, CASCON 2007, ACM Digital Library, May 2007. (27% acceptance rate for short papers, 4 pages)
- [43] Christopher Kumar Anand, Alex D. Bain, **Zhenghua Nie**, The Simulation and Optimization of NMR Experiments using a Liouville Space Method, Maple Conference Proceedings (2006), ed. Ilias S. Kotsireas, 203–216.
- [44] **O. Peshko**, C. K. Anand, T. Terlaky, Surface reconstruction from structured-light images for radiation therapy, Proc. SPIE Vol. 5969, Photonic Applications in Biosensing and Imaging, (Editors: Warren C. Chan, Kui Yu, Ulrich J. Krull, Richard I. Hornsey, Brian C. Wilson, Robert A. Weersink), (2005) 427–436.
- [45] Christopher Anand, Jacques Carette, **Andrew Curtis**, **David Miller**, CoG-PETS: Code Generation for Parameter Estimation in Time Series, Maple Conference 2005, ed. Ilias S. Kotsireas, (2005) 198–212.
- [46] Wolfram Kahl, Christopher Kumar Anand, Jacques Carette, Control-Flow Semantics for Assembly-Level Data-Flow Graphs, *8th International Conference on Relational Methods in Computer Science, RelMiCS 8*, eds. Ivo Düntsch et al. LNCS 3929 (2005), 147–160.
- f) Peer-reviewed conference abstracts (10 publications)**
- [47] **Christopher Schankula**, **Lucas Dutton**, **Nhan Thai**, **Emily Ham**, **Jessica Schultz**, **Ankit Kapoor**, **Yumna Irfan**, **Padma Pasupathi**, **Stephanie Koehl**, **Tanya Bouman**, **Chitwan Sharma**, **Pedram Yazdinia**, **Curtis d’Alves** and Christopher K. Anand, Modelling Distributed Computation with Petri Nets so Children Can Program Multiplayer Universes, TFPIE 2019, <https://wiki.tfpie.science.ru.nl/TFPIE2019>
- [48] **Christopher W. Schankula**, Christopher K. Anand, and Nabil D. Bassim . Plasma Focused Ion Beam Curtaining Artifact Correction by Fourier-Based Linear Optimization Model, Microscopy and Microanalysis, 24(S1) (2018) 588–589. doi:10.1017/S1431927618003434
- [49] **Andrew T Curtis**, and Christopher K Anand, Smallest Singular Value: a metric for assessing k-space sampling patterns, ISMRM 2015.
- [50] **Andrew T Curtis**, Berkin Bilgic, Kawin Setsompop, Ravi S Menon, and Christopher K Anand, Wave-CS: Combining wave encoding and compressed sensing, ISMRM 2015.
- [51] **A.T.Curtis**, C.K.Anand, C.K.Jones, L.M.Klassen, and R.S.Menon, Numerical Optimization of Minimum Phase RF Pulses for UTE Imaging, ISMRM 2009.
- [52] Christopher Anand, Alex D. Bain and **Anuroop Sharma**, Optimal N-D Fourier Transform Sampling Patterns, ENC Conference, Asilomar, March 2008.

- [53] Christopher K. Anand, Alex D. Bain and **Zhenghua Nie**, NMR Pulse Design Using Modern Optimization Methods, ENC Conference, Asilomar, March 2008.
- [54] Christopher K. Anand, Alex D. Bain and **Zhenghua Nie**, Steady-State NMR Experiments in Coupled Spin Systems, ENC Conference, Daytona Beach, April 2007.
- [55] Christopher Anand, Michael Thompson, Dee H. Wu, Tom Cull, Teardrop: a novel trajectory for TrueFISP, Proceedings of the International Society for Magnetic Resonance in Medicine Annual Meeting, Glasgow (2001) p. 1804, <http://cds.ismrm.org/ismrm-2001/PDF7/1804.pdf>.
- [56] Kecheng Liu, Tom Cull, Christopher Anand, High Resolution SLINKY with Phased Array Coils, ISMRM, April 2000, Denver, 1824.

g) Patents (11 publications)

- [57] US application, LOAD EXPLOITATION AND IMPROVED PIPELINEABILITY OF HARDWARE INSTRUCTIONS, Robert Enenkel, Christopher Anand, **Adele Olejarz**, **Lucas Dutton**, filed 06-09-2018.
- [58] US application 15/690795, METHOD AND SYSTEM OF FREQUENCY CONSTRAINED GRADIENT WAVEFORM PRODUCTION, filed 2017-08-30.
- [59] US Patent 9,256,434: Generalized bit manipulation instructions for computer processor (part 2), Christopher K. Anand, **Simon Broadhead**, Robert Enenkel, 02-09-2016.
- [60] US Patent 9,146,743: Generalized bit manipulation instructions for computer processor (part 1), Christopher K. Anand, **Simon Broadhead**, Robert Enenkel, 09-29-2015.
- [61] US Patent 8,914,801: Hardware Instructions to Accelerate Table-Driven Mathematical Function Evaluation, Christopher K. Anand, Robert Enenkel, **Anuroop Sharma**, Daniel Zabawa, granted 16 Dec 2014.
- [62] US Patent 6,804,546: Multiple contrast echo-planar imaging for contrast-enhanced imaging, Michael R. Thompson, Dee H. Wu, Wayne R. Dannels, Christopher K. Anand, 2004.
This patent describes pulse sequence designs in which full or partial k -space data is collected for several images using multiple EPI readouts per excitation. My main contribution was the design of the sampling trajectory in which odd and even k -space lines in the high-frequency part of k -space are sampled once each for two images with different nominal echo times, so that this data can be shared, and thereby either reduce the total acquisition time, or improve the resolution.
- [63] US Patent 6,566,877: Band-Limited Gradient Waveforms, Christopher K. Anand, Michael R. Thompson, 2003.
This patent presents a method of reducing the high-frequency components in gradient waveforms to reduce distortion caused by explicit and implicit analogue filtering within the gradient amplifier and coil components, which, near operating frequencies, behaves as a linear system. My innovation was to take gradient waveform designs specified in terms of impulses (delta functions) at a lower rate of sampling than the clock rate of the digital-analogue converter (ADC), and convolve them with a band-limited function (e.g., a piecewise polynomial function, whose Fourier transform is easy to calculate) before resampling at the clock rate of the ADC. This is especially significant for non-Cartesian k -space trajectories with minimum echo and/or repeat times.

- [64] US Patent 6,549,008: Steady-State Imaging Sequence, Christopher K. Anand, Michael R. Thompson, Dee H. Wu, 2003.
This patent describes the Teardrop sampling trajectory. The main innovation here is the way in which data from sequences that collect the centre of k -space more than once (e.g. at the beginning and end of sampling) can be pre-processed to obtain calibration information for off-resonance and gradient errors.
- [65] US Patent 6,639,211: Contrast-Enhanced MRA including an Effective Zero-Latency Bolus Detection Method, Christopher K. Anand, Paul M. Margosian, Michael R. Thompson, 2003.
This patent describes a method to improve the detection of a bolus of contrast agent as it arrives in anatomy of interest. My contribution was to use an indefinite time-series of small field of view volume images to detect the bolus, in such a way that the last lines of k -space collected to detect the bolus are also used to reconstruct a high-resolution volume after triggering. Performance can be improved by collecting multiple lines of k -space per excitation and using two compatible segmentations of k -space for the detection and high-resolution phases.
- [66] US Patent 6,414,487: Time and memory optimized method of acquiring and reconstructing multi-shot 3D MRI data, Christopher K. Anand, James A. Halamek, C. Michael Steckner, 2002.
This patent presents a method of organizing data collection and reconstruction for multi-echo sequences using 3D Cartesian k -space sampling. The purpose of the reorganization is to reduce the maximum amount of memory required to reconstruct a given volume, which would enable reconstruction computers with limited memory to reconstruct larger volumes faster.
- [67] US Patent 6,411,089: Two-dimensional phase-conjugate symmetry reconstruction for 3d spin-warp, echo-planar and echo-volume magnetic resonance imaging, Christopher K. Anand, Paul M. Margosian, Francis H. Bearden, 2002.
This patent describes the reconstruction of images from partial k -space data using the fact that after low-frequency corrections, k -space data is usually conjugate-symmetric. The innovation is in novel segmentations of k -space.

ii) Not Peer Reviewed

e) Proceedings articles

- [68] Christopher Anand, Jacques Carette, **Alexandre Korobkine**, Target Detection using Maple Code Generation, Proceedings of the Maple Summer Workshop July 11–14, Waterloo, Ontario (2004) 13 pages.

vi) Unpublished Documents

a) Technical Reports (20 publications)

- [69] **Christopher Schankula, Emily Ham, Jessica Schultz, Yumna Irfan, Nhan Thai, Lucas Dutton, Padma Pasupathi, Chinmay Sheth, Taranum Khan, Salima Tejani, Dima Amad, Robert Fleisig, Christopher Kumar Anand**, NewYouthHack: Using Design Thinking to Reimagine Settlement Services for New Canadians, CAS-19-02-CA.
<http://www.cas.mcmaster.ca/~anand/CAS-19-02-CA.pdf>
- [70] **Christopher W. Schankula**, Christopher Kumar Anand, Nabil D. Bassim, Multi-Angle Plasma FIB Curtaining Artefact Correction using a Fourier-based Linear Optimization Model, CAS-18-01-CA.

- [71] **Anuroop Sharma**, Christopher Kumar Anand, A Domain-Specific Architecture for Elementary Function Evaluation, CAS-14-06-CA.
- [72] **Jessica L M Pavlin** and Christopher Kumar Anand, Symbolic Generation of Parallel Solvers for Inverse Imaging Problems, CAS-14-05-CA.
- [73] **Maryam Moghadas, Yuriyy Toporovskyy**, Christopher Kumar Anand, Type-Safety for Inverse Imaging Problems, CAS-14-04-CA.
- [74] Christopher Kumar Anand and **Anuroop Sharma**: Unified Tables for Exponential and Logarithm Families, AdvOL2009/02. (Same as [15].)
- [75] Christopher Kumar Anand, Wolfram Kahl, "Synthesising and Verifying Multi-Core Parallelism in Categories of Nested Code Graphs", SQRL Report 50, 2008. Earlier version of chapter [3].
- [76] Jacques Carette, Spencer Smith, John McCutchan, Christopher Anand, **Alexandre Korobkine**, Model Manipulation as Part of a Better Development Process for Scientific Computing Code, SQRL Report 49, 2008. Earlier version of paper [39].
- [77] Christopher Kumar Anand and **Anuroop Sharma**: Optimal Fourier Transform Sampling Patterns, AdvOL2007/13. Details supporting [19].
- [78] Christopher Kumar Anand and **Andrew Thomas Curtis**: Energy-Constrained Pulse Design for MRI and NMR, AdvOL2007/12.
- [79] Christopher Kumar Anand, Wolfram Kahl, "A Domain-Specific Language for the Generation of Optimized SIMD-Parallel Assembly Code", SQRL Report 43, 2007. Earlier version of submitted paper [18], with focus on programming language aspects and no timing information.
- [80] **Andrew Thomas Curtis**, Christopher Kumar Anand: Volumetric k -space trajectories via genetic algorithms, AdvOL2007/08. Earlier version of [21].
- [81] Christopher Kumar Anand, **Andrew Thomas Curtis**, **Rakshit Kumar**: Durga: A heuristically-optimized data collection strategy for volumetric magnetic resonance imaging, AdvOL2007/07. Earlier version of [23].
- [82] Christopher Kumar Anand, Alex D. Bain, **Zhenghua Nie** Simulation of steady-state NMR of coupled systems using Liouville space and computer algebra methods, AdvOL2007/06. Same as [24].
- [83] Christopher Kumar Anand, A first-order framework for inverse imaging problems, AdvOL2007/02, 25 pages, 2007. Beta-release of the submitted paper "Robust Solvers for Inverse Imaging Problems using Dense Single-Precision Hardware". Version circulated for comment before submitting [20].
- [84] **Olesya Peshko**, Christopher K. Anand and Tamás Terlaky, Algorithmic Aspects of Surface Reconstruction from Structured-Light Images in Noisy Conditions, AdvOL2005/19, 12 pages. (Mathematical view of Conference Paper [44].)
- [85] Christopher Kumar Anand, Jacques Carette, **Andrew Thomas Curtis**, **David Miller**, "COGPETS: Code Generation for Parameter Estimation in Time Series", SQRL Report No. 31, 17 pages. (Previous version of conference paper [45].)

- [86] Christopher Anand, **Stephen Stoyan** and Tamás Terlaky, Optimizing the gVERSE RF Pulse Design via Optimal Control, AdvOL2005/06, 17 pages. (Earlier version of accepted conference paper [41].)
- [87] C. Anand, R. Sotirov, T. Terlaky, **Z. Zheng**, Magnetic Resonance Tissue Density Estimation using Optimal SSFP Pulse-Sequence Design, Technical Report, Advanced Optimization Laboratory, AdvOL2004/19, McMaster University, Canada. (Previous version of accepted paper [25].)
- [88] Christopher Anand, Jacques Carette, **Cale Gibbard**, Wolfram Kahl, **Ryan Lortie**, Declarative Assembler, SQRL Report No. 20, 16 pages, 2004.

Presentations

i) Invited Conference Presentations (11 presentations)

- ⟨1⟩ INADEQUATE Sparse Data and Carbon Skeletons, Fields-MITACS Conference on Mathematics of Medical Imaging, Toronto, June 20-24, 2011.
- ⟨2⟩ New Instructions for Parallel Special Function Evaluation, IBM CAS University Days, Compilers and Multi-core, Markham, April 13-15, 2010.
- ⟨3⟩ Hands-on Coconut Workshop, Carleton University Cell BE Programming Workshop, May 13-15, 2009.
- ⟨4⟩ Carleton University Cell BE Programming Workshop. Co-instructor with Robert Enenkel and Michael Perrone. My advanced presentations included “Introduction to Coconut” and “Medical Imaging”.
- ⟨5⟩ ENC Conference, Optimal N-D Fourier Transform Sampling Patterns, promoted to talk from poster [52].
- ⟨6⟩ SHARCNET HPTC Summer School 2007, High Performance Computing Day, Hamilton, High-Performance Code for the Cell Broadband Engine, 22 June 2007.
- ⟨7⟩ CAIMS-MITACS 2006 Joint Annual Conference, Toronto, Generating Efficient Code Symbolically, 18 June 2006.
- ⟨8⟩ INFORMS Annual Meeting, San Francisco, Optimal MRI Tissue Segmentation using Sequential, Semidefinite Optimization, November 2005.
- ⟨9⟩ SIAM Conference on Mathematics for Industry, Detroit, Better Semantics for Better, Faster Signal Processors, 26 October 2005.
- ⟨10⟩ SIAM Optimization Conference, Using Symbolic Code Generation to Construct an Efficient Energy-Minimizing Pulse Designer for Magnetic Resonance Imaging, Stockholm, May 2005.
- ⟨11⟩ Plenary Lecture, Brest 97, Harmonic Morphisms, Harmonic Maps and related topics, 1997.

i) Invited External seminar presentations (26 presentations)

- ⟨12⟩ IIT-Delhi, Mathematics Department, “High Performance Medical Image Reconstruction. What could go wrong?”, 1 April 2015.
- ⟨13⟩ Université de Montréal, Colloque du DIRO, “Coconut: An experiment in safe, high-performance code generation”, March 2010.

- (14) Heinrich-Heine-Universität Düsseldorf, Optimierung, “Semidefinite Optimization in NMR and MRI”, July 2009.
- (15) Philipps-Universität Marburg, Computer Science, “Coconut: COde CONstructing User Tool”, June 2009.
- (16) Google, Tech Talk, “Coconut: COde CONstructing User Tool”, March 2008.
- (17) IBM Canada, Webcast, “Using Neumann Series to Solve Inverse Problems in Imaging”, February 2007.
- (18) IBM Research (Hawthorne), PLSE Seminar Distinguished Speaker: “Coconut: a tool for rapid development of safe, high performance signal processors”, 14 June 2006.
- (19) York University, Applied and Industrial Mathematics Seminar, “Rethinking the development process for scientific software”, 11 November 2005.
- (20) University of Lethbridge, Computer Science Seminar, The Coconut Project: Teaching Computers Mathematics, 26 September 2005.
- (21) Control Theory Seminar, Waterloo, “Optimal Pulse Design In Magnetic Resonance Imaging”, April 2005.
- (22) Dartmouth Math Colloquium, “Unitons and Solitons”, Jan 2000.
- (23–37) Université de Nantes;
 École Polytechnique (Paris);
 Université de Bretagne Occidentale;
 Complex methods in harmonic maps, ICMS Edinburgh, July 1997;
 University of New Brunswick;
 University of Toronto;
 Oxford University, COW Seminar, “Solitons and Holomorphic Bundles”, October 1995.
 Cambridge University;
 Humbolt Universität zu Berlin;
 University of Warwick;
 University of Leeds;
 Edinburgh University;
 Durham University;
 McMaster University;
 Université de Québec Montréal

ii) Contributed Conference Presentations

a) Peer reviewed (from (49), listing presenting author only) (73 presentations)

- (38) **Curtis D’Alves**, Christopher Anand, Robert Enenkel, Bill O’Farrell and Wolfram Kahl, Continuous Optimization Model for Instruction Scheduling.
- (39) **Christopher Shankula, Lucas Dutton, Nhan Thai, Emily Ham, Jessica Schultz, Ankit Kapoor, Yumna Irfan, Padma Pasupathi, Stephanie Koehl, Tanya Bouman, Chitwan Sharma, Pedram Yazdinia, Curtis d’Alves** and Christopher K. Anand Modelling Distributed Computation with Petri Nets so Children Can Program Multiplayer Universes, TFPIE 2019, June 11, 2019.
- (40) **Curtis d’Alves**, Christopher Anand, Wolfram Kahl, William O’Farrell, Robert Enenkel, **James You**, Stochastic Algorithms for instruction scheduling and rapid prototyping in coconut, Compiler Driven Performance Workshop, CASCON 2018, Oct 31, 2018.

- (41) **Christopher Schankula**, Christopher K. Anand, Plasma Focused Ion Beam Curtaining Artefact Correction by Fourier-Based Linear Model, CASCON 2018, Oct 31, 2018.
- (42) **Christopher Anand**, **Lucas Dutton**, **Adele Olejarz**, Robert Enenkel, Math function performance acceleration via integrated HW and algorithm design, CASCON 2018, Oct 30, 2018.
- (43) **John Zhang**, **Anirudh Verma**, **Chinmay Sheth**, **Christopher Schankula**, **Stephanie Koehl**, Andrew Kelly, **Yumna Irfan**, Christopher K. Anand, Graphics Programming in Elm Develops Math Knowledge & Social Cohesion, CASCON 2018, Oct 29, 2018.
- (44) **Christopher Anand**, **Lucas Dutton**, **Adele Olejarz**, Robert Enenkel, Wolfram Kahl, Hardware/Software CoDesign for Mathematical Function Acceleration, CASCON 2018, Oct 29, 2018.
- (45) Christopher Kumar Anand, **Curtis d'Alves**, **Yumna Irfan**, **Biya Kazmi**, **Stephanie Koehl**, **Stephanie Lin**, **Christopher William Schankula**, **Chinmay Jay Sheth**, **Pedram Yazdinia**, **John Zhang**, A Framework for Preadolescent Programmers to Create Cooperative Multiplayer Reading Games, IMCL 2018, Oct 11, 2018.
- (46) **Christopher W. Schankula**, Christopher K. Anand, and Nabil D. Bassim . Plasma Focused Ion Beam Curtaining Artifact Correction by Fourier-Based Linear Optimization Model, Microscopy and Microanalysis, Aug 7, 2018.
- (47) **Anirudh Verma**, **Pedram Yazdinia**, **Yusra Irfan**, **Yumna Irfan**, **Stephanie Lin**, **John Zhang**, **Stephanie Koehl**, **Biya Kazmi**, **Chinmay Sheth**, **Christopher W. Schankula**, Christopher Anand, Michael Trink, Wordathon: A Tool for Social Learning, July 27, 2018.
- (48) **Anirudh Verma**, **Pedram Yazdinia**, **Yusra Irfan**, **Yumna Irfan**, **Christopher W. Schankula**, supervised by Dr. Christopher Anand, Applying Cognitive Load Theory to Improve K-12 Computer Science Education: An Automated Tool, July 27, 2018.
- (49) Christopher Kumar Anand, High-Level Abstraction, Safety and Code Generation in Coconut, 13th CASCON Workshop on Compiler Driven Performance, November 5, 2014.
- (50) **Jessica Pavlin**, Application of Novel Symbolic Computation to MRI Velocity Inverse Problem, 15th SIAM Conference on Parallel Processing for Scientific Computing, February 15-17, 2012.
- (51) Christopher Anand, Linear-Time Verification of Correct Parallelization, 15th SIAM Conference on Parallel Processing for Scientific Computing, February 15-17, 2012.
- (52) **Maryam Moghadas**, MRI Velocity Imaging: A Novel Application of Physical Units to Type Safety, International Conference on Applied Mathematics, Modeling and Computational Science, July 25-29, 2011
- (53) **Jessica L. M. Pavlin**, MRI Velocity Imaging: A Case Study in Symbolic Code Generation, International Conference on Applied Mathematics, Modeling and Computational Science, July 25-29, 2011
- (54) **Qiong Wu**, A Semi-Definite, Nonlinear Model for Optimizing k-Space Sample Separation in Parallel Magnetic Resonance Imaging, Fields-MITACS Conference on Mathematics of Medical Imaging, Toronto, June 20-24, 2011.
- (55) **Yogesh Chinta Venkateswarao**, Sparse Sampling of Velocity MRI, Fields-MITACS Conference on Mathematics of Medical Imaging, Toronto, June 20-24, 2011.

- (56) **Jessica L. M. Pavlin**, Determining a Flow Profile from Multi-Scale Phase Contrast Angiographic MRI Data, Fields-MITACS Conference on Mathematics of Medical Imaging, Toronto, June 20-24, 2011.
- (57) Christopher Kumar Anand, Optimal K-space sampling in MRI, Canadian Operational Research Society, Toronto, May 30-June 2, 2011.
- (58) **Zhenghua Nie**, Optimizing phases of CPMG pulse sequence and applying exact solution to measure relaxation time, Canadian Operational Research Society, St John's, May 30-June 2, 2011.
- (59) **Sean Watson**, Using continuous optimization to assist in solving for carbon couplings from 2-D INADEQUATE spectra, Canadian Operational Research Society, St John's, May 30-June 2, 2011.
- (60) **Qiong Wu**, A semi-definite, nonlinear model for optimizing k-space sample separation in parallel MRI, Canadian Operational Research Society, St John's, May 30-June 2, 2011.
- (61) **Jessica L. M. Pavlin**, Determining a flow profile from multi-scale phase contrast angiographic MRI data, Canadian Operational Research Society, St John's, May 30-June 2, 2011.
- (62) Christopher Anand, Robert Enenkel, Shahadat Hossain, CASCON 2010 Workshop: High-Performance Computing with Sparsity and Structure: Challenges and Directions for Single-Core and Multicore Hardware, including McMaster talks: (i) New Instructions To Remove Parallelization Bottlenecks in Elementary Functions, Christopher Anand. (ii) Co-evolving Numerical Computation and Network-on-a-Chip, **Kevin Browne**. (iii) MultiCore Task and Data Scheduling Using Group Theory, **Michal Dobrogost**.
- (63) **Sean Watson**, Use of Continuous Optimization Methods to Find Carbon Links In 2D INADEQUATE Spectra, 12th Annual Midwest Optimization Meeting.
- (64) **Jessica Pavlin**, A Regularized Inverse Problem to Determine Both Fast and Slow Flow from Multi-Scale Phase Contrast Angiographic Magnetic Resonance Imaging, MOPTA 2010.
- (65) **Zhenghua Nie**, Measuring NMR Relaxation Time Using an Exact Solution of the Bloch Equations, MOPTA 2010.
- (66) **Sean Watson**, Use of Continuous Optimization Methods to Find Carbon Links In 2D INADEQUATE Spectra, MOPTA 2010.
- (67) Christopher Anand, Optimizing NMR and MRI experiments, EUROPT, Remagen, Germany, July 3-4, 2009.
- (68) A.D. Bain, D.W. Hughes, B. Berno, **Z. Nie**, C.K. Anand and V.J. Robertson, Shortcomings of Inadequate, ENC, Asilomar, March 29 - April 3, 2009.
- (69) Christopher K. Anand, Alex D. Bain, Andrew T. Curtis, and **Zhenghua Nie**, Design of a Universal Refocusing Pulse by Large-scale Nonlinear Optimization, SMASH, Santa Fe, September 7-10, 2008.
- (70) Christopher Kumar Anand, Alex D. Bain, **Zhenghua Nie**, Optimal Pulse Design of Single Spin Systems, MOPTA, Guelph, August 18-20, 2008.
- (71) **Kevin Browne**, New Optimization Problems Raised by Novel Multi-Core, Network-on-a-Chip Computation, MOPTA, Guelph, August 18-20, 2008.

- (72) Christopher Kumar Anand, **Mehrdad Mozafari**, An Optimized Model-Based Tissue Segmentation Form Incomplete MR data, MOPTA, Guelph, August 18-20, 2008.
- (73) Christopher Kumar Anand, Robust Solvers for Inverse Imaging Problems using Dense Single-Precision Hardware, MOPTA, Guelph, August 18-20, 2008.
- (74) **Tahani Almabruk**, Christopher Kumar Anand, Regularization for MRI Diffusion Inverse Problem, MOPTA, Guelph, August 18-20, 2008.
- (75) Christopher Kumar Anand, Case Study: Using Coconut to Optimise non-Cartesian MRI for the Cell BE, Workshop on the Effective Use of High Performance Workstations In Scientific Computing , August 4-6, 2008.
- (76) **Mehrdad Mozafari**, Christopher Anand, Regularized Tissue Quantification from Incomplete MRI Data, July 7-9, 2008.
- (77) Christopher Kumar Anand, **Kevin Browne**, Shiqi Cao, Gabriel Grant, Wolfram Kahl, Coconut Multi-Core Run Time for Cell BE, SHARCNET Symposium on GPU and CELL Computing 2008, 27 May 2008.
- (78) (contributed session) Christopher Anand, Robert Enenkel, Milt Halem, Yelena Yesha, "Cell BE and Heterogeneous Multicore Systems: Architecture, Tools, and Applications", includes presentations by Robert Enenkel, Christopher Anand, John Dorband, Raymond Spiteri, Jagan Jayaraj (for Paul Woodward), James Green, Michael McCool, Lujie Zhan, Phil Bording, Shujia Zhou, and Milton Halem, CASCON 2007, Toronto, 23-24 October 2007.
- (79) Christopher Anand, **Anuroop Sharma**, Semidefinite Programming and Nuclear Magnetic Resonance, ICCOPT-MOPTA 2007, Hamilton, August 13–16, 2007.
- (80) **Andrew Curtis**, Christopher Anand, Using Maple Code Generation and IPOPT to Design Radio Frequency Pulses for use in Spectroscopy (NMR) and Imaging (MRI), ICCOPT-MOPTA 2007, Hamilton, August 13–16, 2007.
- (81) **Zhenghua Nie**, Christopher Anand, Alex Bain, Optimizing the pulse sequence for detection of NAA by Liouvillian Space and Symbolic Computation Methods, ICCOPT-MOPTA 2007, Hamilton, August 13–16, 2007.
- (82) **Andrew Curtis**, Meta-heuristics for MRI sampling trajectory design, ICCOPT-MOPTA 2007, Hamilton, August 13–16, 2007.
- (83) (contributed session) Christopher Anand, Robert Enenkel, "Leveraging Cell: Proven Techniques, Common Issues and New Applications", includes presentations by Robert Enenkel, IBM Toronto; Shahadat Hossain, University of Lethbridge; Michael McCool, University of Waterloo and RapidMind; Phil Bording, Memorial University; Christopher Anand, McMaster University, CASCON 2006, Toronto, 17 October 2006.
- (84) Christopher Anand, **Andrew Curtis**, **Rakshit Kumar**, Durga and Fountain: Designing Optimal 3D MRI Data Collection using SOCP, MOPTA 2006, Waterloo, July 24–27.
- (85) R. Sotirov, C. Anand, T. Terlaky, An Algorithm for Solving Nonlinear SDP, EURO XXI in Iceland, July 2–5, 2006.
- (86) Christopher K. Anand, Alex D. Bain and **Zhenghua Nie**, Steady-state spectroscopy — CW NMR Lives!, MOOT NMR Conference, Guelph, On, Sept. 2006.

- (87) **Andrew Curtis**, Christopher Anand, Trust region design of energy minimizing MRI excitation pulses, MOPTA, Waterloo, July 24–27, 2006.
- (88) **Wei Li**, Christopher Anand, MRI Velocity Quantification using Iterative Methods, MOPTA, Waterloo, July 24–27, 2006.
- (89) Christopher Anand, Renata Sotirov, Tamas Terlaky, **Zhuo Zheng**, Optimal MRI Pulse-Sequence Design for Tissue Quantification, MITACS 6th Annual Conference, Calgary, May 2005
- (90) **Tingting Ren**, Christopher Anand and Tamas Terlaky, An Optimal Design Method for MRI Teardrop Gradient Waveforms, MITACS 6th Annual Conference, Calgary, May 2005
- (91) **Christopher Kumar Anand**, Using Symbolic Code Generation to Construct an Efficient Energy-Minimizing Pulse Designer for Magnetic Resonance Imaging, SIAM Optimization Conference, Stockholm, May 2005.
- (92) **Christopher Kumar Anand**, **Andrew Thomas Curtis**, Energy-Minimizing Pulse Design for Magnetic Resonance Imaging using Interior Point Methods Remez Exchange Surrogate Models, and Symbolic Computation in Lie Groups, IMACS International Symposium on Iterative Methods in Scientific Computing, Toronto, May 2005.
- (93) **R. Sotirov**, C. Anand, T. Terlaky, **Z. Zheng**, Designing optimal SSFP pulse-sequences for tissue quantification, ANZIAM 2005, Napier, New Zealand, February 2005, p. 58.
- (94) Christopher Anand, **Olesya Peshko**, Tamas Terlaky, Surface reconstruction using structured-light images in low-light conditions, MITACS 6th Annual Conference, Calgary, May 2005
- (95) **Wolfram Kahl**, Christopher Anand, Jacques Carette, Choices in Data Flow for Declarative Assembly, RelMiCS Conference 8, Feb. 22–26, 2005 (participants' proceedings), 121–128. (Preliminary version of [46].)
- (96) **O. Peshko**, T. Terlaky, C. Anand, Surface contour reconstruction using structured-light images in low-light conditions, MITACS 6th Annual Conference, May 11–14, 2005, Calgary.
- (97) **Olesya Peshko**, Tamas Terlaky, Christopher Anand, Surface contour reconstruction using structured-light images in low-light conditions, MOPTA 2005, Windsor, July 2005.
- (98) **Zhuo Zheng**, Christopher Anand, Optimal MR pulse sequence design and field map, MOPTA 2005, Windsor, July 2005.
- (99) **Zhuo Zheng**, Christopher Anand, Tamás Terlaky, Total Variation Based Medical Image Segmentation and Field Mapping, Mathematical Programming in Data Mining and Machine Learning, Hamilton, June 2005.
- (100) **R. Sotirov**, C. Anand, T. Terlaky, **Z. Zheng**, Magnetic Resonance Tissue Density Estimation: New Model and Algorithm, International Conference on Optimization Techniques and Applications, Ballarat, Australia, December 2004.
- (101) **Zhuo Zheng**, Christopher Anand, Renata Sotirov and Tamas Terlaky, Optimal SSFP Pulse-Sequence Design for Tissue Density Estimation, WindSOR/SWORD 2004.
- (102) **S. Stoyan**, T. Terlaky and C. Anand, Optimizing RF Pulses in MRI via Optimal Control, MITACS, Halifax, June 2004.

- (103) **O. Peshko**, T. Terlaky, C. Anand, Surface contour reconstruction using structured-light images in low-light conditions, WindSOR/SWORD 2004, University of Windsor.
- (104) (*student prize for oral presentation*) Christopher Anand, Renata Sotirov, Tamás Terlaky, **Zhuo Zheng**, Optimal SSFP Pulse-Sequence Design for Tissue Segmentation, WindSOR/SWORD 2004, University of Windsor.
- (105) **S. Stoyan**, T. Terlaky and C. Anand, Optimizing RF Pulses in MRI via Optimal Control, MOPTA 2004, p. 7.
- (106) **Tingting Ren**, Christopher Anand, and Tamás Terlaky, An Optimal Design Method for Teardrop, a Non-Raster Readout for True FISP, Montreal Scientific Computing Days, Centre de recherche mathématique, 2004.
- (107) (*poster first prize in student competition*) **S. Stoyan**, T. Terlaky, and C. Anand, Optimizing RF Pulses in MRI via Optimal Control, MITACS 2004, Dalhousie University.
- (108) Christopher Anand, Rapid, Embeddable Design Method for Magnetic Resonance Image Reconstruction Resampling Kernels, MOPTA 2003, McMaster University, (participants' proceedings) p 63.
- (109) Christopher Anand, Conjugate Gradient 3D MR Image Reconstruction, MOPTA 2003, McMaster University, (participants' proceedings) 49–51.
- (110) Kecheng Liu, Tom Cull, Christopher Anand, High Resolution SLINKY with Phased Array Coils, XIth International MRA Club, Sept. 22–25, 1999, Lund, Sweden.

b) Not peer reviewed

- (111) **Wei Li**, Christopher Anand, Robert Enenkel, MASS for CELL SPU, CASCON 2006, Markham, Ontario.

Administrative Responsibilities

Department:

- 2003–2004 Coordinator, May@Mac (student posters and demonstrations)
- 2004–2005 Chair, Recruitment Committee
- 2004–2005 Coordinator, Science and Engineering Olympics (developed SE robotics event)
- 2004–2005 Coordinator, May@Mac (student posters and demonstrations)
- 2004–2005 Coordinator, Science and Engineering Olympics (refined SE event and developed CS visual programming event)
- 2005–2006 Contributor to May@Mac (student demonstrations, two presentations on undergraduate opportunities for research)
- 2006–2007 Coordinator Science and Engineering Olympics SE event
- 2007–2008 Member, Recruitment Committee
- 2008–2009 Member, Recruitment Committee
- 2009–2010 Member, Recruitment Committee
- 2009–2010 Coordinator, ACM Programming Competition
- 2009–2010 Member, CS Curriculum Committee
- 2009–2010 May@Mac contributor
- 2009–2010 CS-I Liaison
- 2009–2010 Coordinator, Graduate/Undergraduate Networking
- 2010–2011 Agitator, Software Entrepreneurship @ Mac
- 2011–2012 Outreach Coordinator
- 2011–2012 CS I Advisor (one semester)
- 2012–2013 Outreach Coordinator, including Software: Tool for Change
- 2013–2014 Outreach Coordinator 0.5, including Software: Tool for Change
- 2014–2015 Organizer, Software: Tool for Change
1550 students
published “Image 2 Bits” for iPad
- 2015–2016 Computer Science Graduate Admissions Committee
- 2015–2016 Undergraduate Advisor for Computer Science
- 2015–2016 Undergraduate Awards Committee
- 2015–2016 Organizer, Software: Tool for Change
- 2016–2017 Organizer, Software: Tool for Change
- 2016–2017 Examiner, Comprehensive Part A (CS)
- 2017–2018 Organizer, Software: Tool for Change
over 10000 students taught
published “ElmJr” and “TouchMRI”
- 2017–2018 Member, CS Curriculum Committee
- 2017–2018 Examiner, Comprehensive Part A (CS)
- 2018–2019 Equity and Inclusion Facilitator for Faculty Hiring Areas and Strategy
- 2018–2019 Examiner, Comprehensive Part A (CS)
- 2018–2019 Member, CS Curriculum Committee
- 2019–2020 Examiner, Comprehensive Part A (CS)
- 2019–2020 Member, CS Curriculum Committee

Faculty:

2002–2003 Joint Engineering Safety Committee
2011–2013 Recruitment Committee
2015–2016 Faculty Student and Professional Affairs Committee
2016–2017 Faculty Student and Professional Affairs Committee
2017–2018 Faculty Student and Professional Affairs Committee
2018–2019 Faculty Student and Professional Affairs Committee
2019–2020 Faculty Student and Professional Affairs Committee
2019–2020 Faculty Committee on Chairing Doctoral Thesis Examinations

University:

2003–2004 Science and Engineering Library Users Committee
2007–2008 Science and Engineering Library Users Committee
2008–2009 Computational Engineering and Science Prestige Scholarship Committee
2008–2009 Biomedical Engineering Scholarship Committee
2014–2015 Member, Student Research Ethics Committee (Engineering and Business)
2015–2016 Member, Student Research Ethics Committee (Engineering and Business)
2016–2017 Member, Student Research Ethics Committee (Engineering and Business)
2017–2018 Member, Student Research Ethics Committee (Engineering and Business)
2018–2019 Member, Student Research Ethics Committee (Engineering and Business)
2019–2020 Member, Student Research Ethics Committee (Engineering and Business)