

Curriculum Vitae

Dr. Christopher Kumar Anand

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Business

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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 Engineering and Science

G. Professional Organization

Member, ACM, SIAM and ISMRM.

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

- 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

- 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

- **Magnetic Resonance Imaging**
 - **Modelling:** Mathematical modelling and statistical estimation of signal/image generation.
 - **Optimization:** Optimal signal processing for MRI. Optimal design of pulse waveforms, reconstruction algorithms, and devices.

- **Software Engineering**
 - **Correctness:** Developing provably sound implementations of mathematical algorithms, and of development tools that make this possible.
 - **High Performance Computation:** Automated application of rules for parallelization, and code tuning to produce more efficient, reliable implementations.
 - **Automatic Code Generation:** Generating correct implementations of estimators from mathematical models.

K. Honors

- 2007 IBM Centre for Advanced Studies Faculty Fellow
- 2006 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
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	Science and Engineering of a Signal Processing System	12
2003–2004	Comp Sci 1MC3	3	Computer Science I	86
2003–2004	Comp Sci 4ZP6	3	Senior Thesis Project	60
2002–2003	Comp Sci 1MC3	3	Computer Science I	76
2002–2003	CS/SE 4TG3 ¹	3	Science and Engineering of a Signal Processing System	16
2002–2003	Comp Sci 1MC3	3	Computer Science I	164
2001–2002	CS/SE Eng 4TG3	3	Science and Engineering of a Signal Processing System	18
2001–2002	Sfwr Eng 3I03 ²	1	Communication Skills	80
1997–1998	M3	4	Introduction 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
2007–2008	CAS 750	4	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	Science and Engineering of a Signal Processing System	1

Totals

Year	Courses	Units	# Students
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 Zucker

²Taught with Dave Parnas and Devorah Abrams Farmer

M. Supervision

	Completed	In Progress
Master's	11	3
Doctoral	0	1
Supervisory Committees	1	2
CAS Senior Thesis Project Groups	11	2
Summer Students (Undergraduate)	19	
Summer Students (High School)	2	
Coop Students (High School)	1	
Examination Committees		
as external examiner	1	
as internal examiner	5	

Master's Students

Name	Degree	Title / Dates	Cosupervisor
Anuroop Sharma	MTech, IIT-Delhi	Design of Optimal Experiments Using Semi-Definite Programming <i>Jan 2008 –</i>	Mehra
Kevin Browne	MSc, CS	Scheduling for Multi-Core Architectures <i>Sept 2007 –</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 –</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– Aug 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

Zhenghua Nie	PhD, CES	Simulation and Optimization of Mult-quantum Spectroscopy <i>Sept 2005 (started as MASc) –</i>	Bain
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N. Research Funding

The principal investigator's name is underlined on each of the grants listed below.

By Year			By Grant		
Year	Total	Share	Grant	Total	Share
2008	36 000	26 000			
2007	40 000	30 000	CAS Fellowships	80 000	60 000
2006	33 000	33 000	MMO/Sentinelle	31 500	21 000
2005	44 500	34 000	CFI/OIT	220 000	110 000
2004	13 000	13 000	NSERC	52 000	52 000
2003	233 000	123 000			

Grants are recorded according to the year the money was available, CFI not including overhead.

Year	Agency	Title	Type	Amount
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 Imag- ing Coils using Tuned Simulation and SENSE Image Reconstruction,	Enabling Grant	\$ 30 000
2005	Sentinelle Medical	<u>Anand</u> , Carrette		\$ 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
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 rela- tional programs, <u>Anand</u> , Kahl	New Opportunities	\$ 91 000
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 italics.

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] 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 (12 publications)

- [3] Christopher Kumar Anand, Robust Solvers for Inverse Imaging Problems using Dense Single-Precision Hardware, submitted to Journal of Mathematical Imaging and Vision, on-line August 2008, 16 pages, DOI 10.1007/1085100801123.
- [4] Andrew Thomas Curtis, Christopher Kumar Anand, Volumetric k -Space Trajectories Via Genetic Algorithms, submitted to the International Journal of Biomedical Imaging, Volume 2008 (2008), Article ID 297089, 6 pages, DOI:10.1155/2008/297089.
- [5] 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.
- [6] 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.
- [7] 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.
- [8] 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.
- [9] 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.
- [10] Christopher Anand, A closed form for Unitons, Journal of the Mathematical Society of Japan, 50 (3) (1998) 737–751.
- [11] Christopher Anand, Ward's Solitons II: Exact solutions, Canadian Journal of Math, 50 (6) (1998) 1119–1137.

- [12] Christopher Anand, Ward's Solitons, *Geometry and Topology*, 1 (1997) 9–20.
- [13] Christopher Anand, Unitons and their Moduli, *Electronic Research Announcements of the AMS*, 2 (1) (1996) 7–16.
- [14] Christopher Anand, Uniton Bundles, *Comm. Anal. Geom.* 3 (1995), 371–419.

e) Refereed Conference Proceedings (5 publications)

- [15] Christopher Kumar Anand, Wolfram Kahl, MultiLoop: Efficient Software Pipelining for Modern Hardware, submitted to CASCON 2007, ACM Digital Library, May 2007. (27% acceptance rate for short papers, 4 pages)
- [16] 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.
- [17] 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.
- [18] 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.
- [19] 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 (5 publications)

- [20] Christopher Anand, Alex D. Bain and Zhenghua Nie, Optimal N-D Fourier Transform Sampling Patterns, ENC Conference, Asilomar, March 2008.
- [21] Christopher K. Anand, Alex D. Bain and Zhenghua Nie, NMR Pulse Design Using Modern Optimization Methods, ENC Conference, Asilomar, March 2008.
- [22] Christopher K. Anand, Alex D. Bain and Zhenghua Nie, Steady-State NMR Experiments in Coupled Spin Systems, ENC Conference, Daytona Beach, April 2007.
- [23] 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>.
- [24] Kecheng Liu, Tom Cull, Christopher Anand, High Resolution SLINKY with Phased Array Coils, ISMRM, April 2000, Denver, 1824.

g) Patents (6 publications)

- [25] 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.

- [26] 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.
- [27] 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.
- [28] 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.
- [29] 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.
- [30] 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

- [31] 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.

iii) Accepted for Publication

b) Contributions to Books

- [32] 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, 46 pages.

c) Journal Articles

- [33] Christopher Kumar Anand, Wolfram Kahl, An Optimized Cell BE Special Function Library Generated by Coconut, accepted with minor revisions by IEEE Transactions on Computers, September 2008, 14 pages.
- [34] Christopher Anand, *Stephen Stoyan*, Tamás Terlaky, Energy-Optimizing the gVERSE RF Pulse Sequence: An Evaluation of Two Competitive Software Algorithms, 27 pages, accepted May 2008, to appear in Algorithmic Operations Research. Accepted in final form, May 2008, 27 pages.

e) Contributions to Refereed Conference Proceedings (3 publications)

- [35] 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, 11 pages. Accepted April 2008.
- [36] 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.), 213–228. Revised version accepted Feb. 2008.
- [37] 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. Accepted March 2007, 25 pages; pp. 25–48 in uncorrected proof.

vi) Unpublished Documents**a) Technical Reports** (14 publications)

- [38] 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 [32].
- [39] 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 [35].
- [40] Christopher Kumar Anand and Anuroop Sharma: Optimal Fourier Transform Sampling Patterns, AdvOL2007/13. Details supporting [??].
- [41] Christopher Kumar Anand and Andrew Thomas Curtis: Energy-Constrained Pulse Design for MRI and NMR, AdvOL2007/12.
- [42] 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 [33], with focus on programming language aspects and no timing information.
- [43] Andrew Thomas Curtis, Christopher Kumar Anand: Volumetric k -space trajectories via genetic algorithms, AdvOL2007/08. Earlier version of [4].
- [44] 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 [6].
- [45] 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 [7].
- [46] 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 [3].
- [47] 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 [17].)
- [48] Christopher Kumar Anand, Jacques Carette, Andrew Thomas Curtis, David Miller, "COG-PETS: Code Generation for Parameter Estimation in Time Series", SQRL Report No. 31, 17 pages. (Previous version of conference paper [18].)
- [49] 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 [37].)
- [50] 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 [8].)
- [51] Christopher Anand, Jacques Carette, Cale Gibbard, Wolfram Kahl, Ryan Lortie, Declarative Assembler, SQRL Report No. 20, 16 pages, 2004.

Presentations

i) Invited Conference Presentations (8 presentations)

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

i) Invited External seminar presentations (22 presentations)

- ⟨9⟩ Google, Tech Talk, “Coconut: COde CONstructing User Tool”, March 2008.
- ⟨10⟩ IBM Canada, Webcast, “Using Neumann Series to Solve Inverse Problems in Imaging”, February 2007.
- ⟨11⟩ IBM Research (Hawthorne), PLSE Seminar Distinguished Speaker: “Coconut: a tool for rapid development of safe, high performance signal processors”, 14 June 2006.
- ⟨12⟩ York University, Applied and Industrial Mathematics Seminar, “Rethinking the development process for scientific software”, 11 November 2005.
- ⟨13⟩ University of Lethbridge, Computer Science Seminar, The Coconut Project: Teaching Computers Mathematics, 26 September 2005.
- ⟨14⟩ Control Theory Seminar, Waterloo, “Optimal Pulse Design In Magnetic Resonance Imaging”, April 2005.
- ⟨15⟩ Dartmouth Math Colloquium, “Unitons and Solitons”, Jan 2000.
- ⟨16–30⟩ 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 (40 presentations)

- (31) Christopher Kumar Anand, Alex D. Bain, *Zhenghua Nie*, Optimal Pulse Design of Single Spin Systems, MOPTA, Guelph, August 18-20, 2008.
- (32) *Kevin Browne*, New Optimization Problems Raised by Novel Multi-Core, Network-on-a-Chip Computation, MOPTA, Guelph, August 18-20, 2008.
- (33) Christopher Kumar Anand, *Mehrdad Mozafari*, An Optimized Model-Based Tissue Segmentation Form Incomplete MR data, MOPTA, Guelph, August 18-20, 2008.
- (34) Christopher Kumar Anand, Robust Solvers for Inverse Imaging Problems using Dense Single-Precision Hardware, MOPTA, Guelph, August 18-20, 2008.
- (35) *Tahani Almabruk*, Christopher Kumar Anand, Regularization for MRI Diffusion Inverse Problem, MOPTA, Guelph, August 18-20, 2008.
- (36) 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.
- (37) 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.
- (38) (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.
- (39) Christopher Anand, *Anuroop Sharma*, Semidefinite Programming and Nuclear Magnetic Resonance, ICCOPT-MOPTA 2007, Hamilton, August 13-16, 2007.
- (40) *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.
- (41) *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.

- (42) *Andrew Curtis*, Meta-heuristics for MRI sampling trajectory design, ICCOPT-MOPTA 2007, Hamilton, August 13–16, 2007.
- (43) (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.
- (44) *Christopher Anand*, *Andrew Curtis*, *Rakshit Kumar*, Durga and Fountain: Designing Optimal 3D MRI Data Collection using SOCP, MOPTA 2006, Waterloo, July 24–27.
- (45) *R. Sotirov*, C. Anand, T. Terlaky, An Algorithm for Solving Nonlinear SDP, EURO XXI in Iceland, July 2–5, 2006.
- (46) Christopher K. Anand, Alex D. Bain and *Zhenghua Nie*, Steady-state spectroscopy — CW NMR Lives!, MOOT NMR Conference, Guelph, On, Sept. 2006.
- (47) *Andrew Curtis*, Christopher Anand, Trust region design of energy minimizing MRI excitation pulses, MOPTA, Waterloo, July 24–27, 2006.
- (48) *Wei Li*, Christopher Anand, MRI Velocity Quantification using Iterative Methods, MOPTA, Waterloo, July 24–27, 2006.
- (49) Christopher Anand, Renata Sotirov, Tamas Terlaky, *Zhuo Zheng*, Optimal MRI Pulse-Sequence Design for Tissue Quantification, MITACS 6th Annual Conference, Calgary, May 2005
- (50) *Tingting Ren*, Christopher Anand and Tamas Terlaky, An Optimal Design Method for MRI Teardrop Gradient Waveforms, MITACS 6th Annual Conference, Calgary, May 2005
- (51) *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.
- (52) *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.
- (53) *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.
- (54) Christopher Anand, *Olesya Peshko*, Tamas Terlaky, Surface reconstruction using structured-light images in low-light conditions, MITACS 6th Annual Conference, Calgary, May 2005
- (55) *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 [19].)
- (56) *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.
- (57) *Olesya Peshko*, Tamas Terlaky, Christopher Anand, Surface contour reconstruction using structured-light images in low-light conditions, MOPTA 2005, Windsor, July 2005.

- (58) Zhuo Zheng, Christopher Anand, Optimal MR pulse sequence design and field map, MOPTA 2005, Windsor, July 2005.
- (59) 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.
- (60) 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.
- (61) Zhuo Zheng, Christopher Anand, Renata Sotirov and Tams Terlaky, Optimal SSFP Pulse-Sequence Design for Tissue Density Estimation, WindSOR/SWORD 2004.
- (62) S. Stoyan, T. Terlaky and C. Anand, Optimizing RF Pulses in MRI via Optimal Control, MITACS, Halifax, June 2004.
- (63) O. Peshko, T. Terlaky, C. Anand, Surface contour reconstruction using structured-light images in low-light conditions, WindSOR/SWORD 2004, University of Windsor.
- (64) (*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.
- (65) S. Stoyan, T. Terlaky and C. Anand, Optimizing RF Pulses in MRI via Optimal Control, MOPTA 2004, p. 7.
- (66) 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.
- (67) (*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.
- (68) Christopher Anand, Rapid, Embeddable Design Method for Magnetic Resonance Image Reconstruction Resampling Kernels, MOPTA 2003, McMaster University, (participants' proceedings) p 63.
- (69) Christopher Anand, Conjugate Gradient 3D MR Image Reconstruction, MOPTA 2003, McMaster University, (participants' proceedings) 49–51.
- (70) 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

- (71) 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

Faculty:

- 2002–2003 Joint Engineering Safety Committee

University:

- 2003–2004 Science and Engineering Library Users Committee
- 2007–2008 Science and Engineering Library Users Committee

S. Other Responsibilities

- I organized an experimental **high-school outreach** activity which consisted of self-paced learning, two lab/lecture activities on campus, and a series of visits by an undergraduate student to local high schools.
- I supervised the development of CSubmit by undergraduate students, an educational tool which enables students to do programming assignments on-line, including immediate and meaningful feedback and marking. I used this in CS1MC3. It was funded, in part, by a grant from the Centre for Leadership and Learning and Work Study. The failure rate in this course dropped significantly as a result of this work.
- Using the explicit formulae for Ward's solitons that I developed, I wrote a module for Richard Palais's 3D-XploreMath to visualize the solutions. Some of the more interesting particle-like interactions I observed were used as the **cover illustration of the January 2000 Notices of the American Mathematical Society**.