Annual Report

Marc Moreno Maza

November 15, 2011

Contents

Faculty of Science
Annual Report of Faculty Members
for period July 1, 2010 - June 30, 2013

1 General Information

Name: Marc MORENO MAZA
Home Department: Computer Science
Current Rank: Associate Professor

	Tenured	YES	Year Conferred	2008
Current Status:	Probationary	NO	Contract End Date	
	Limited Term		Contract End Date	

Academic Qualifications (attained or in progress)

Degree	University	Department	Year
Doctorate	Paris 6, France	Computer Science	1997
Master's	Paris 6, France	Computer Science	1992
Master's	Paris 6, France	Pure Mathematics	1991
Bachelor's	Paris 6, France	Applied Mathematics	1990

Areas of Academic Responsibility Teaching 40 % Research 40 % Service 20 %
Joint Appointments (if any)
Second Department: Applied Mathematics Percentage of Duties: _____%

2 Record of Performance in Teaching for the Period July 1, 2010 - June 30, 2013

2.1 Classroom Teaching

Year 2010-2011			
Department & Course number	Comp. Sc. CS211b	Comp. Sc. CS4402b + CS9535b	Comp. Sc. CS4435b + CS9624b
Total lecture hours/year	39	39	39
Total student enrollment	19	7 + 2	3 + 5
Student evaluation (overall mean effectiveness)	4.9 / 7	CS4402b: 6.0 / 7 CS9535b: 6.0 / 7	CS4435: 6.0 / 7 CS9634b: 6.0 / 7
Year 2011-2012			
Department & Course number	Comp. Sc. CS2101b	Comp. Sc. CS4402b + CS9535b	
Total lecture hours/year	39	39	
Total student enrollment	4	6 + 4	
Student evaluation (overall mean effectiveness)	6 / 7	CS4402b: 6.7 / 7 CS9535b: 7 / 7	
Year 2012-2013			
Department & Course number	Comp. Sc. CS2101b	Comp. Sc. CS3101	Comp. Sc. CS4402b + CS9535b
Total lecture hours/year	39	39	39
Total student enrollment	13	11	10 + 7
Student evaluation (overall mean effectiveness)	6.3 / 7	6 / 7	CS4402b: 6.2 / 7 CS9535b: 7 / 7

2.2 Feedback letters from students on CS4402/CS9535 and CS4435/CS9624

2.2.1 Feedback from Owen McCarthy

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Date: Mon, 18 Apr 2011 23:10:49 -0400
From: Owen McCarthy <omccarth@uwo.ca>
User-Agent: Mozilla/5.0 (X11; U; Linux x86_64; en-US; rv:1.9.2.14)
 Gecko/20110223 Thunderbird/3.1.8
To: Mike Katchabaw <katchab@csd.uwo.ca>, mercer@csd.uwo.ca
Cc: Marc Moreno Maza <moreno@csd.uwo.ca>
Subject: CS4402, CS4435
In-reply-to: <15B0970B-3CB3-4D54-A74C-ECCB29835F5D@csd.uwo.ca>

Gentlemen,

   This term I took both CS4402 - Parallel and Distributed Systems and
CS4435 - High Performance Computing. The course material taught me
concepts that I applied successfully in several other courses and have
influenced every line of code I have written since. The work I did
throughout both courses reinforced the importance of the theoretical
groundwork established in my first three years at Western and provided
concrete evidence of its use in moving the state of the art forward. I
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feel privileged to have had the opportunity to study this material as an undergrad and I believe it has given me a competitive edge as I venture into my new career.

Part of the strength of the courses was the excellent instruction provided by Marc Moreno Maza. His balanced and challenging assignments excited me about the possibilities provided by the course materials. When I finished the first assignment in both courses I felt like I had a new insight into writing well designed code. Solving the problems provided by Prof. Moreno Maza taught me the lessons he was trying to teach but did so in a way that felt like discovery; never before had I felt so sure of the answers I submitted for such a challenging assignment.

I have had many great experiences as a student at Western, these two courses stand with the best of them. After such a great learning experience I felt compelled to write you and let you know about it. The quality of the instruction provided as well as the material presented make me proud to have been a student at Western. I don't believe I would have learned as much at any other university in Canada.

Prof. Moreno Maza is a credit to this institution and CS4402 and CS4435 should be recognized as courses that illustrate the strength of the Computer Science program at Western.

Thank you,
Owen McCarthy

2.2.2 Feedback letter from Peter Goodman

From: Peter Goodman <peter.goodman@gmail.com>
Date: Fri, 22 Apr 2011 13:31:03 -0400
Subject: Highlights of my Undergraduate Experience - CSD at UWO
To: "Robert E. Mercer" <mercer@csd.uwo.ca>, Hanan Lutfiyya <hanan@csd.uwo.ca>
Cc: "Prof. Stephen Watt" <smwatt@gmail.com>,
Marc Moreno Maza <moreno@csd.uwo.ca>
X-pstn-neptune: 0/0/0.00/0
X-pstn-levels: (S:29.90083/99.90000 CV:99.9000 FC:95.5390 LC:95.5390
+R:95.9108 P:95.9108 M:97.0282 C:98.6951)

Prof. Mercer, Prof. Lutfiyya,

Last night I finished my final and only exam (in a topic unrelated to computer science) in my undergraduate career. With high probability, I will be graduating with an honors specialization in computer science degree.

This academic year I had the pleasure of taking two courses that I consider of utmost importance: Compiler Theory (with Prof. Stephen Watt), and High Performance Computing (with Prof. Marc Moreno Maza).

The former was a course that I worked hard to take. In a sense, the past three years of my undergraduate career was an exercise in meeting the prerequisites for CS4447. I enjoyed many of the courses along the way; however, my true goal was to take the compiler theory course. I was dismayed that CS4447 was neither required of honors students, nor was it offered (understandably, enrollment was low!) this academic year. Luckily, Prof. Watt took the time out of his busy schedule and was willing to teach the course to me.

That latter was a course that I was not aware of until the course registration period in advance of this academic year. Having taken CS4435, I can't imagine why the course was not promoted more, especially to undergraduate honors students. Looking back, I think CS4435, like CS4447 and CS3350, is among the most important courses that I've taken as an undergraduate. My understanding is that we are one of the few universities in North America that offer courses on high performance computing; what an honor!

I think offering and even requiring the aforementioned courses is necessary, but not sufficient. It was Prof. Watt's and Prof. Maza's approach to teaching and ability to communicate both the important theoretical and practical aspects of the course topics that has had such a lasting effect on me. I am grateful that I was able to take these courses and feel more prepared for the next stages of my academic and industrial life.

As a parting note, I would like to draw attention to two PhD students at UWO that have had a lasting positive effect on me: Andrew Delong and Michael Burell. I suppose a way of describing these two would be infinitely approachable, very helpful, and very knowledgeable.

Best Regards,

Peter Goodman,
http://www.petergoodman.me
70 Winston Circle,
Montreal, Quebec
H9S 4X6

2.2.3 Feedback letter from Sergio Carlos Morales Angeles

From: Sergio Carlos Morales Angeles <osphere@gmail.com>
Date: Tue, 26 Apr 2011 16:51:41 -0400
To: Marc Moreno Maza <moreno@csd.uwo.ca>
X-pstn-neptune: 0/0/0.00/0
X-pstn-levels: (S:64.74502/99.90000 CV:99.9000 FC:95.5390 LC:95.5390
+R:95.9108 P:95.9108 M:97.0282 C:98.6951)
X-pstn-settings: 3 (1.0000:0.1500) s cv GT3 gt2 gt1 r p m c
X-pstn-addresses: from <osphere@gmail.com> [23/1]

Hello Professor, I'm Sergio Carlos from your class of 4402b. I will be

leaving London in the next couple of days (or maybe tomorrow,still not sure)
because of some things from work back home, but I wanted to thank you:

The course was challenging however I do feel like I learned a lot, the
course really exceeded my expectations and for sure has made more aware of
the impact that efficiency has in algorithms, I'm sure that from now on I'll
be able to improve efficiency when possible using the tools and concepts
learned in class, making my programs more efficient (in my professional
work, school work and personal projects).

I'm very satisfied about your course and in overall the entire experience
that I had in Canada. I wanted to do this personally however because of work
things, finishing everything here in Canada academically and all that has
really consumed my time.

Thank you very much! and I hope to see you one day again!
Sergio Carlos Morales Angeles

2.2.4 Feedback letter from Boyu Zhang

Date: Tue, 5 Apr 2011 17:43:47 -0400
Subject: Present Matrix Transpose in Class
From: Zhang Boyu <zhang.boyu84@gmail.com>
To: moreno@csd.uwo.ca
X-pstn-neptune: 0/0/0.00/0
X-pstn-levels: (S: 3.79093/99.89407 CV:99.9000 FC:95.5390 LC:95.5390
+R:95.9108 P:95.9108 M:97.0282 C:98.6951)
X-pstn-settings: 3 (1.0000:0.1500) s cv GT3 gt2 gt1 r p m c
X-pstn-addresses: from <zhang.boyu84@gmail.com> [23/1]
Resent-From: moreno@csd.uwo.ca
Resent-Date: Wed, 6 Apr 2011 21:46:25 -0400
Resent-To: moreno@csd.uwo.ca

Dear Dr. Maza,

This is a graduate student from University of Delaware writing, my name is
Boyu Zhang. I am taking an advanced parallel programming course in my
department, and I need to present the matrix transpose problem in CUDA to
show the memory optimizations are done.

I found your slides for the course CS9535/4402 in which you talked about
high performance computing with CUDA very detailed and did an excellent work
in presenting the process, I found it even more clear than reading the
NVIDIA documentation. Would you mind if I recycle some of your slides and
present it in my class? Thanks a lot for the time!

Thanks,
Boyu

Boyu Zhang

Ph. D. Candidate
Department of Computer and Information Sciences
University of Delaware

E-Mail: bzhang@udel.edu
URL: http://www.eecis.udel.edu/~bzhang/

2.2.5 Feedback letter from Brandon Castellano

Date: Tue, 23 Apr 2013 14:06:56 -0400
From: Brandon Castellano <bcastell@uwo.ca>
To: Santa Squid <moreno@csd.uwo.ca>
Subject: CS9535 Final Project (cudaFSME)

[-- Autoview using /usr/bin/w3m -dump -T text/html ''/tmp/mutt.html'' --]
Hello Dr. Moreno Maza;

I have finished going through the source code. You can download the final
version (including a test video) here:
http://www.bcastell.com/downloads/cudaFSME.tar.gz

Instructions for operation are included in the README file (I forgot to
mention, you add trackpoints by left-click and remove them with right-click).
I've also included a binary I built on an x86-64 version of Ubuntu, but there
is a Makefile included as well (it uses pkg-config to find the OpenCV library/
header files). If you run into any issues, don't hesitate to let me know.

Thank you for all your help this year, I really enjoyed the course.
Personally, I learned quite a lot, and found it a great experience overall.

Regards,
Brandon Castellano

2.2.6 Feedback letter from Michael Haye

Date: Tue, 23 Apr 2013 21:22:05 -0400
From: Michael Hayes <mhayes34@uwo.ca>
To: Santa Squid <moreno@csd.uwo.ca>
Subject: CSD9535 Final Project -- Hayes

[-- Attachment #1 --]
[-- Type: multipart/alternative, Encoding: 7bit, Size: 1.3K --]

[-- Autoview using /usr/bin/w3m -dump -T text/html ''/tmp/mutt.html'' --]
Hi Professor,

Attached you will find my final slides and source code for my final project.

I haven't had a moment to do the memory bandwidth benchmarks. I will try to get

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that done in the coming days and send it to you ASAP -- I figured I'd get you
my slides and source code as soon as possible though. I've tidied up the source
code a little bit, mostly by putting in some comments here and there.

Thank you for the great course -- definitely one of the most engaging and
interesting ones in my tenure at Western!

Mike
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2.3 Details of Curriculum Development or Course Design

During the period July 1, 2010 to June 30, 2013, I have designed **three new courses**:

- *CS 2101 – Foundations of Programming for High Performance Computing* [http://www.csd.uwo.ca/~moreno/cs2101a_moreno/index.html]
- *CS 3101 – Theory of High-performance Computing* [http://www.csd.uwo.ca/~moreno/CS3101-1213.html]
- *CS 9624 and CS 4435 – High Performance Computing: From Models of Computation to Applications.* [http://www.csd.uwo.ca/~moreno/CS9624-4435-1011.html]

Details are presented in Sections 2.3.1, 2.3.2 and 2.3.3.

I have also renewed and enhanced the contents of two existing courses:

- *CS211, Software Tools and Systems Programming.* [http://www.csd.uwo.ca/~moreno/cs2211_moreno/index.html]
- *CS 4402 and CS 9535 – Distributed and Parallel Systems* [http://www.csd.uwo.ca/~moreno/CS9535-4402-1011.html]

Details are presented in 2.3.4 and 2.3.5, respectively.

2.3.1 CS 2101 – Foundations of Programming for High Performance Computing

This course is an introduction to parallel computing and its applications in science. The emphasis is on the usage of modern parallel computer architectures and concurrency platforms rather than the design of parallel algorithms and the optimization of computer programs. The targeted audience is undergraduate students who are not engaged in a computer science program but who want to be exposed to the principles of HPC and take advantage of them in their field of study. Students will be introduced to the ideas and techniques that underline the usage of multicore architectures, GPUs and clusters. They will be presented with software that are commonly used in scientific computing, namely Matlab and Julia. They will study fundamental parallel algorithms (mainly from an experimental viewpoint) and assemble them in course projects within Julia.

Teaching materials include 300 slides and more than 20 lab exercises with detailed elements of correction.

2.3.2 CS 2101 – Theory of High-performance Computing

This course is built on the principle that, in parallelism, the models of computation that have a practical value are those which bear a relationship to what happens in hardware. Thus this course interleaves fundamental topics from computer architecture and algorithms including: memory hierarchy and issues with data traffic, performance analysis, control parallelism architecture models, highly data parallel architecture models, models of parallel computations and complexity analysis of parallel algorithms, patterns and paradigms of parallel algorithms, concurrent data structures, synchronization and scheduling.

Teaching materials include 300 slides.

2.3.3 CS 9624 and CS 4435 – High Performance Computing: From Models of Computation to Applications.

In this course, I present different theoretical tools (cache complexity, multithreaded parallelism, space-time tradeoffs, code optimization for parallelism and locality, etc.) that are adapted for taking best advantage of parallel architectures and hierarchical memories.

I also discuss a variety of applications (finite-difference methods, compression algorithms, artificial intelligence, metabolic networks, etc.) and compare the implementation techniques of a given algorithm on different hardware architectures (multicores, GPGPUs).

This course has evolved from CS855 which I initiated during the academic years 2005-2006 and 2006-2007. Teaching materials include 400 slides. The web site also lists a large collection of articles and links in the area of HPC.

2.3.4 CS211: Software tools and systems programming

The slides of CS211 were developed by the previous instructors. They include a lot of small computer programs (UNIX shell scripts and C language programs) in order to illustrate the course concepts. I decided to post on the course web site all these computer programs independently of the slides, in a format that made them very easy to run for the students. This happened to be very useful:

- first for myself in order to demonstrate these programs in class,
- secondly for the students, since they could easily experiment with the course concepts.

Actually, both could take place in class since most students had a laptop! Another benefit is to ensure that the example programs on slides can effectively run with the latest version of such or such software tool that the students use.

In addition to these small computer programs, I posted on the course web site many solutions and hints to exercises, together with software documentation and articles on the course concepts.

2.3.5 CS 4402 and CS 9535 – Distributed and Parallel Systems

This course studies the fundamental aspects of parallel systems and aims at providing an integrated view of the various facets of software development on such systems: hardware architectures, programming languages and models, software development tools, software engineering concepts and design patterns, performance modeling and analysis, experimenting and measuring, application to scientific computing.

Course topics may include but are not limited to: multi-core, SMP, clusters, GPU computing, scheduling, scalability, parallel and distributed data-structures, threads, message passing, MPI, distributed and shared memory, hierarchical memory, data parallel languages, and applications of parallel and distributed computing.

My contribution to the development of this course is to the introduction of multicore and GPU programming.

2.4 Supervision of Undergraduate Thesis or Research Projects, or Equivalent

2.5 Supervision of Graduate Student Research

The table below lists the theses I have been supervising during the period July 1, 2010 -June 30, 2013.

Student's Name	Period of Supervision	Degree Program
Farnam Mansouri	January 2013 - date	M.Sc. thesis
Sushek Shekar	September 2012 - date	M.Sc. thesis
Xiaohui Chen	September 2012 - date	PhD thesis
Ning Xie	September 2012 - date	PhD thesis
Parisa Alvandi	May 2012 - date	PhD thesis
Zunaid Haque	September 2010 - April 2012	M.Sc. thesis (defended)
Mohsin Ali	September 2010 - December 2012	M.Sc. thesis (defended)
Sardar Anisul Haque	January 2009 - November 2013	PhD thesis (defended)
Paul Vrbik	January 2009 - date	Ph D thesis (co-supervised)
Liyun Li	September 2008 - August 2010	M.Sc. thesis (defended)
Xin Li	September 2005 - April 2009	PhD thesis (defended))
Changbo Chen	September 2006 - August 2011	PhD thesis (defended)
Wei Pan	September 2006 - January 2011	PhD thesis (defended)
Raqeeb Rasheed	September 2007 - September 2009	PhD thesis (withdrawn)

The titles of these these appear hereafter.

Completed graduate students

1. Sardar Anisul Haque Hardware Acceleration Technologies in Computer Algebra: Challenges and Impact. UWO, started January 2009, defended November 2013.

2. Md Mohsin Ali *On the Factor Refinement Principle and it's Implementation on Multicore Architectures.* Master thesis UWO, started September 2010, defended December 2011.

3. Zunaid Haque *Multi-threaded real root isolation on multi-core architectures.* Master thesis UWO, started September 2010, defended April 2012.

4. Jiajian Yang *Fast polynomial arithmetic on the GPU.* Directed Study UWO, started September 2011, defended December 19, 2011

5. Changbo Chen *Solving Polynomial Systems via Triangular Decomposition.* PhD thesis UWO, started in September 2007, defended August 30, 2011.

6. Wei Pan *Algorithmic Contributions to the Theory of Regular Chains.* PhD thesis UWO, started in September 2006, defended January 25, 2011.

7. Liyn Li *Efficient Evaluation of Large Polynomials.* Master thesis UWO, started in September 2008, defended August 23, 2010.

Titles of theses in progress

1. Supervision of the PhD thesis of Parisa Alvandi, *On Saturated Ideals*, UWO, started in May 2012.

2. Supervision of the PhD thesis of Paul Vrbik, *Probabilistic Algorithms and Implementation Techniques for Triangular Decompositions of Polynomial Systems*, join-supervision with Éric Schost. UWO, started January 2009.

3. Supervision of the PhD Thesis of Ning Xie. *A hybrid manycore model for symbolic computation.* UWO, started September 2012.

4. Supervision of the PhD Thesis of Xiaohui Chne. *Computing program loop invariants via sparse polynomial.* UWO, started September 2012.

5. Supervision of the MS Thesis of Sushek Shekar. *MetaFork: A Metalanguage for Concurrency Platforms Targeting Multicores.* UWO, started September 2012.

6. Supervision of the MS Thesis of Farnam Mansouri. *Adapative parallel polynomial multiplication and applications.* UWO, started January 2013.

The following is a list of the competitive awards and scholarships received by my students under my supervision.

Year	**Student**	**Scholarship or Award**
2010	Wei Pan	MITACS Accelerate internship
2010	Changbo Chen	MITACS Accelerate internship
2010	Paul Vrbik	NSERC Post-Graduate Doctoral Scholarship
2011	Anisul S. Haque	Queen Elizabeth II Graduate Scholarship
2012	Anisul S. Haque	Queen Elizabeth II Graduate Scholarship
2012	Anisul S. Haque	MITACS Accelerate internship

2.6 Duties as Adviser or Thesis Examiner for Graduate Students

Academic Year	Adviser	Thesis Examiner
2010-2011	1	3
2011-2012	1	4
2012-2013	1	3

I have served as a thesis adviser for the following graduate students.

Yiming Zhang. PhD Thesis, Appl. Maths, started September 2009, defended September 2013.

I have served as a thesis examiner for the following graduate students.

Yanxin Li. *Integrated development and parallelization of automated dicentric chromosome identification software to expedite biodosimetry analysis.* Master Thesis, CS, UWO, Tuesday, April 16, 2013.

Asaduzzaman Babu. *Ratio-Based Edge Detection Inspired Speckle Reducing Anisotropic Diffusion.* Master Thesis, CS, UWO, Wednesday, April 3, 2013.

Ilse Leal Aulenbacher. *Generating Log File Analyzers.* Master Thesis, CS, UWO, Tuesday, August 21, 2012.

Irene Cheung. *Forgiveness in close relantionships.* PhD Thesis, Social Sciences, UWO, Wednesday, April 10, 2012.

Zhendong Shao. *The Research on the L(2,1)-labeling problem from Graph Theoretic and Graph Algorithmic Approaches.* PhD Thesis, CS, UWO, Wednesday, April 18, 2012.

Jonathan Leaver. *Multi-Core Unit Propagation in Functional Languages.* Master Thesis, CS, UWO, Tuesday, April 17, 2012.

Jahedur Chowdhury; *State Complexity of Combined Operations on Finite Languages.* Master Thesis, CS, UWO, Thursday, December 15, 2011.

Mehdi Garrousian. *Algebraic and Combinatorial aspects the Logarithmic Ideals of Arrangements and Multiarrangements.* PhD Thesis, Maths, UWO, April 21, 2011.

Yehia Kotb. *Workflow-Based cooperative multi-agent systems.* PhD Thesis, CS, UWO, Wednesday, August 17, 2011.

Javad Doliskani. *Point Counting On Genus 2 Curves.* Master Thesis, CS, UWO, Thursday, April 21, 2011.

2.7 Supervision of Post-doctoral Fellows

Fellow's Name	Period of Supervision	Funding program	If completed, then Current Job
Changbo Chen	September 2011 - date	ADF + MITACS Elevate	N/A
Rong Xiao	September 2009 - date	MITACS Elevate	N/A
Yuzhen Xie	May 2011 - January 2012	MITACS Elevate	Maplesoft

2.8 Teaching Awards Received

(1) I have appeared on the USC Teaching Honour Roll 2012-2013 [http://www.usc.uwo.ca/teaching_awards/Honour_Roll_2011-2012.pdf]

(2) In December 2011, on behalf of our Computer Science Department, I submitted a proposal to the *Early Adopter Program* of the NSF/IEEE-TCPP Curriculum Initiative on Parallel and Distributed Computing Core Topics for Undergraduates.
[http://www.cs.gsu.edu/~tcpp/curriculum/?q=home]

My proposal was awarded and I was invited to the present it at the IPDPS 2012 EduPar Workshop.
[http://www.cs.gsu.edu/~tcpp/curriculum/?q=early-adopter-spring-12.html]

(3) In May 2010, I received the *MITACS Mentorship Award of Excellence* [http://www.uwo.ca/sci/publications/news/MorenoMaza.html]

3 Record of Performance in Research for the Period July 1, 2010 - June 30, 2013

For each article, authors are listed in alphabetic order. Students names are in bold fonts.

3.1 Books or Monographs

M. Moreno Maza *SNC '11: Proceedings of the 4th International Workshop on Symbolic-Numeric Computation.* ISBN: 978-1-4503-0515-0. ACM Press, 204 pages, New York, NY, USA, 2011.

M. Moreno Maza and J.-L. Roch. *PASCO '10: Proceedings of the 2010 international workshop on Parallel symbolic computation.* ISBN 978-1-4503-0067-4. ACM Press, 194 pages, 2010.

3.2 Publications in Refereed Journals

F. Boulier, F. Lemaire and ***M. Moreno Maza***. Computing differential characteristic sets by change of ordering. *Journal of Symbolic Computation*, 45(1), 124-149, 2010.
TOP 7 HOTTEST ARTICLE in JSC in 2009-2010. [http://top25.sciencedirect.com/subject/mathematics/16/journal/journal-of-symbolic-computation/07477171/archive/29]

F. Lemaire, ***M. Moreno Maza***, **W. Pan** and **Y. Xie**. When does $\langle T \rangle$ equal Sat(T)? *Journal of Symbolic Computation*, 46(12): 1291-1305, 2011.

X. Li, ***M. Moreno Maza***, **R. Rasheed** and É. Schost. The `Modpn` library: bringing fast polynomial arithmetic into Maple. *J. of Symbolic Computation*, 46(7): 841-858, 2011.

M. Moreno Maza and **Y. Xie**. Balanced Dense Polynomial Multiplication on Multi-cores. *International Journal of Foundations of Computer Science*, 22(5): 1035-1055, 2011.

C. Chen and ***M. Moreno Maza***. Algorithms for computing triangular decompositions of polynomial systems. *J. of Symbolic Computation*, 47(6): 610-642, 2012.
TOP 7 HOTTEST ARTICLE in JSC in 2012. [http://top25.sciencedirect.com/subject/mathematics/16/journal/journal-of-symbolic-computation/07477171/archive/42/]

W. Pan and ***M. Moreno Maza***. Fast polynomial multiplication on a GPU. High Performance Computing Symposium (HPCS'10). *Journal of Physics: Conference Series* vol. 256, 2011.

W. Pan and ***M. Moreno Maza***. Solving Bivariate Polynomial Systems on a GPU. High Performance Computing Symposium (HPCS'11). *Journal of Physics: Conference Series* vol. 341, 2011.

S. A. Haque and ***M. Moreno Maza***. Determinant Computation on the GPU using the Condensation Method. High Performance Computing Symposium (HPCS'11). *Journal of Physics: Conference Series* vol. 341, 2011.

C. Chen, ***M. Moreno Maza*** and **Y. Xie**. Cache Complexity and Multicore Implementation for Univariate Real Root Isolation. High Performance Computing Symposium (HPCS'11). *Journal of Physics: Conference Series*, vol. 341, 2011.

C. Chen, J.H. Davenport, J.P. May, ***M. Moreno Maza***, B. Xia and **R. Xiao**. Triangular decomposition of semi-algebraic systems. *J. of Symbolic Computation*, vol. 49, 3-26, 2013.

C. Chen, J.H. Davenport, M. Moreno Maza, B. Xia and **R. Xiao**. Computing with semi-algebraic sets: Relaxation techniques and effective boundaries. *J. of Symbolic Computation*, vol. 52, 72-96, 2013.
TOP 20 HOTTEST ARTICLE in JSC in 2013. [http://top25.sciencedirect.com/subject/mathematics/16/journal/journal-of-symbolic-computation/07477171/archive/44/]

S. Haque and M. Moreno Maza. Plain polynomial arithmetic on GPU. *J. of Physics: Conference Series*, 385, 10 pages, 2012.

M. Md. Ali and M. Moreno Maza and Y. Xie. On the Factor Refinement Principle and its Implementation on Multicore Architectures. *J. of Physics: Conference Series*, 385, 10 pages, 2012.

M. Moreno Maza, B. Xia and **R. Xiao**. On solving parametric polynomial systems. J. of Mathematics in Computer Science, 6(4): 457-473, 2012.

C. Chen, R.M. Corless, M. Moreno Maza, P. Yu, Y. Zhang. An application of regular chain theory to the study of limit cycles. To appear in the International Journal of Bifurcation and Chaos. Accepted March 2013.

C. Chen, F. Lemaire, **L. Liyun**, ***M. Moreno Maza***, **W. Pan** and **Y. Xie**. Computing with Constructible Sets in MAPLE. Submitted.

X. Li, M. Moreno Maza, **W. Pan.** GCD Computations Modulo Regular Chains. Submitted.

3.3 Publications in Refereed Conference Proceedings

C. Chen, J.H. Davenport, J.P. May, ***M. Moreno Maza***, B. Xia and **R. Xiao**. Triangular decomposition of semi-algebraic systems. In *Proc. of ISSAC 2010*, ACM Press, pp 187–194, 2010.

Charles E. Leiserson, **Liyun Li**, ***M. Moreno Maza*** and **Yuzhen Xie**. Parallel computation of the minimal elements of a poset. In *Proc. of the 4th International Workshop on Parallel and Symbolic Computation (PASCO'10)*, ACM Press, 2010, pp. 53–62.

S. A. Haque, Shahadat Hossain and ***M. Moreno Maza***. Cache friendly sparse matrix-vector multiplication In *Proc. of the 4th International Workshop on Parallel and Symbolic Computation (PASCO'10)*, ACM Press, 2010, pp. 175-176.

L. Meng, Y. Voronenko, J. R. Johnson, ***M. Moreno Maza***, F. Franchetti and **Y. Xie**. SPIRAL-generated modular FFT algorithms. In *Proc. of the 4th International Workshop on Parallel and Symbolic Computation (PASCO'10)*, ACM Press, 2010, pp. 169-170.

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C. Chen, J.H. Davenport, F. Lemaire, ***M. Moreno Maza***, **N. Phisanbut**, B. Xia, **R. Xiao** and Y. Xie. Solving semi-algebraic systems with the RegularChains library in Maple. In *Proceedings of the Fourth Internationa Conference on Mathematical Aspects of Computer Science and Information Sciences* (MACIS 2011), Edited by Stefan Raschau, pp. 38–51, 2011.

S. Marcus, M. Moreno Maza, **P. Vrbik**. On Fulton's Algorithm for Computing Intersection Multiplicities, *Proc. Computer Algebra in Scientific Computing (CASC)*, p. 198-211, LNCS Vol. 7442, Springer, 2012.

M. Moreno Maza, É. Schost, **P. Vrbik**. Inversion Modulo Zero-Dimensional Regular Chains, *Proc. CASC'12*, p. 224-235, LNCS Vol. 7442, Springer, 2012.

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R.M. Corless, D.J. Jeffrey, ***M. Moreno Maza*** and and **S. Thornton**. Using the RegularChains Library to Compute the Rank of a Parametric Matrix under Semi-algebraic Constraints. Submitted to LATIN2014.

3.4 Published software

I am developing major mathematical software packages which are *part of the computer algebra system* MAPLE, commercialized by Maplesoft, Waterloo, Canada and which has more than *5,000,000 licenses worldwide*. These packages include:

- low-level routines for fast polynomial arithmetic written in C (the `modpn` library) and,
- high-level code for algebraic algorithms (the REGULARCHAINS library).

Among other things, these software packages *support* MAPLE*'s* `solve` for solving systems of polynomial equations and inequalities. This command is at the heart of the system: many other functionalities rely on `solve` directly or indirectly. More details are given in Section 3.4.1 and 3.4.2.

I am also developing three stand-alone software libraries for *high-performance scientific computing*: BPAS, CUMODP and META_FORK, which *can be used independently of* MAPLE. The first two aim at supporting symbolic computation and are written respectively in `CilkPlus` and `CUDA`, while the latter is a suite of source-to-source compilers for multithreaded languages targeting multicore architectures. More details are presented in Section 3.4.3, 3.4.4 and 3.4.5.

These packages and libraries implement algorithms that I have designed myself or with my students only. I believe that good software packages are often as useful to the academic community as refereed articles. Note that a package submitted to the computer algebra system MAPLE goes through two levels of refereeing:

- by the MAPLESOFT company itself and then
- by beta-testers worldwide.

The significance of my software contributions is explained in Sections 3.4.1, 3.4.2 3.4.3, 3.4.4 and 3.4.5. See also the comments by Jürgen Gerhard (Research Director at Maplesoft) in Section 3.4.6.

Except for the `modpn` library which is distributed with the CUMODP library, each of the software projects mentioned above has a website:

REGULARCHAINS: [http://www.regularchains.org]

BPAS: [http://www.bpaslib.org]

cumodp: [http://www.cumodp.org]

Meta_Fork: [http://www.metafork.org]

3.4.1 The RegularChains library

In the course of the past 9 years, the REGULARCHAINS library has become a comprehensive and powerful toolkit for solving polynomial systems. No other software package offers the same range of functionalities.

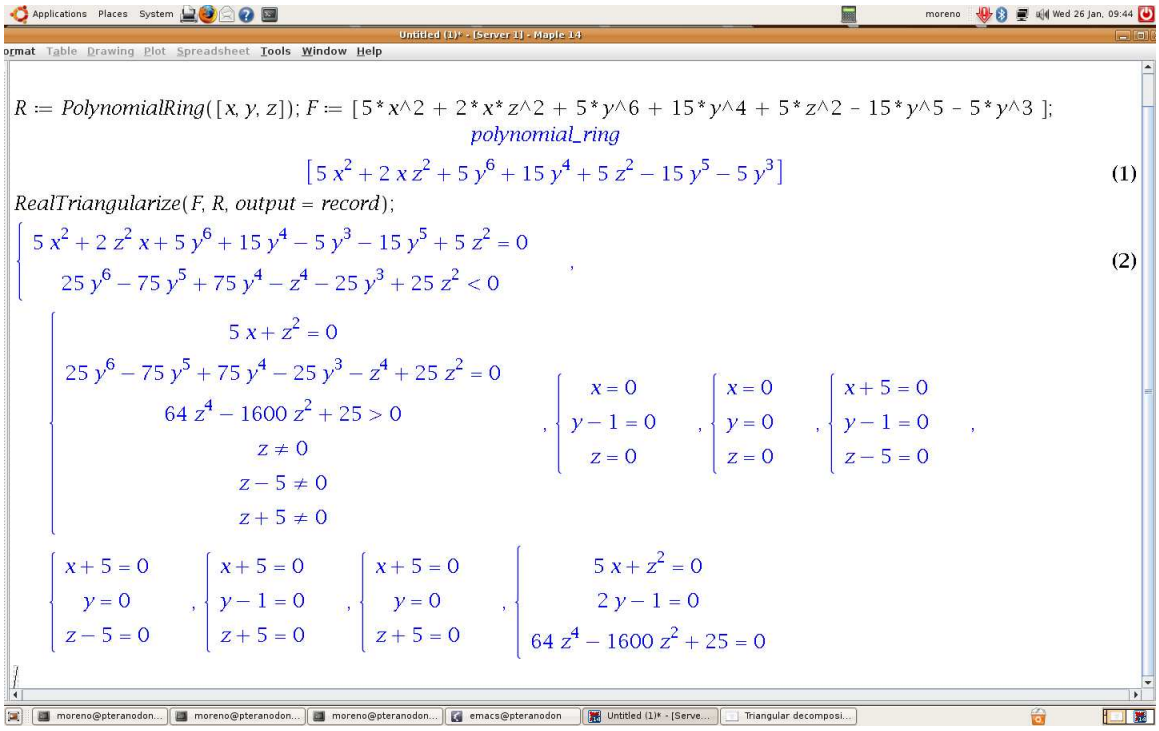


Figure 1: Computing the real solutions of polynomial system exactly.

Actually, since 2011, the REGULARCHAINS library offers the **first software solver applicable to any input system of polynomial equations, inequations and inequalities.** In particular, this is the first solver capable of producing an exact description of the real solutions of an arbitrary polynomial system. This corresponding command, called `RealTriangularize`, is illustrated by Figure 1. With `RealTriangularize`,

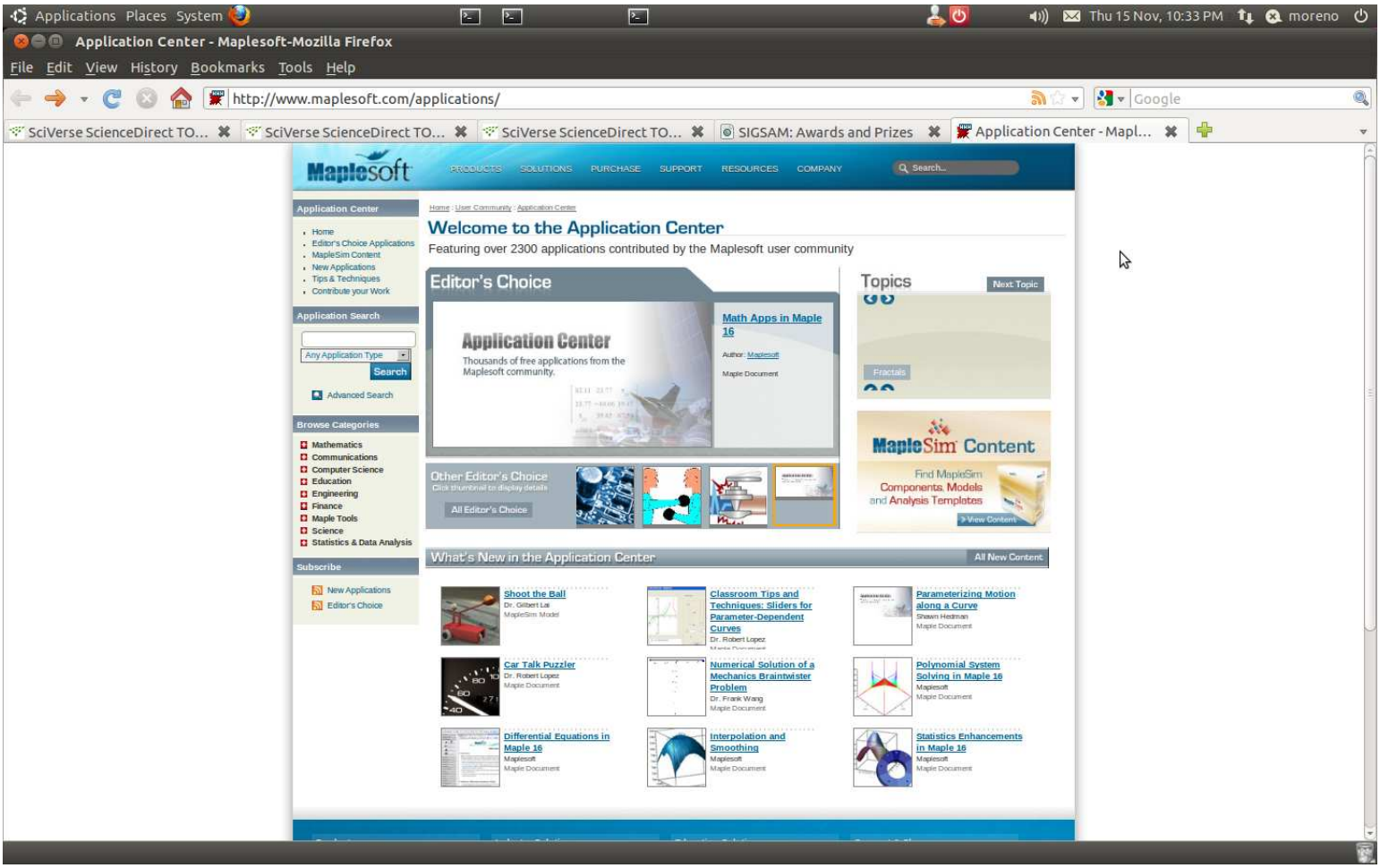


Figure 2: Maplesoft uses our polynomial system solving software to advertise Maple.

MAPLE becomes the first computer algebra system equipped with a solver capable of computing exactly the real solutions of any polynomial system. This gives a decisive advantage upon its competitors.

On its *Application Center*, Maplesoft uses our polynomial system solving software to advertise Maple. See the second item in the third column in the lower part of Figure 2.

The REGULARCHAINS library is being successfully applied to the areas of optimization and control through Maplesoft's industrial consulting projects, such as the following where Toyota leverages symbolic computation in control systems engineering [http://www.maplesoft.com/company/publications/articles/view.aspx?SID=143072&ref=femail].

As far as performance is concerned, I would like to highlight the following fact. As mentioned above, the `solve` command in MAPLE is at core of many of computations in MAPLE and this command is one of the most often called by end-users. **Since the release 15 of MAPLE, the `solve` command relies on the RegularChains library for solving systems of polynomial equations.** Since MAPLE has more than 5,000,000 licenses world-wide, this is a strong recognition for my work and that of my students.

Some other figures about the REGULARCHAINS library are listed below.

- 131 exported functions,
- more than 300 internal functions,
- 67,000 lines of MAPLE source code,
- 10,000 lines of test programs,
- 3,000 lines of software development source code (C, LEX, scripts),
- 12,000 lines of documentation,
- 260 pages for the specification document.

At the Internal Symposium of Symbolic and Algebraic Computation (ISSAC) 2011, I received the **Distinguished Software Presentation Award** for a presentations of the REGULARCHAINS library. [http://www.sigsam.org/awards/index.phtml]

3.4.2 The `modpn` library

The `modpn` library is dedicated to fast arithmetic for multivariate polynomials. It was at the core of the PhD theses of my students Xin Li and Wei Pan. Today, Xin Li and Wei Pan are full-time researchers respectively at the *Chinese Academy of Science* and *Intel Corp.*

For the integration of `modpn` into MAPLE, they have received the the *2009 MITACS Award* for the

Best Novel Use of Mathematics in Technology Transfer

The main objective of `modpn` is to provide highly efficient routines for supporting the implementation of algebraic algorithms in high-level programming languages such as MAPLE. This library consists of

- 36,000 lines of C and ASSEMBLY code
- 5,000 lines of MAPLEcode
- 74 exported functions in the MAPLE interface.

The performances of the `modpn` library has been reported and published in peer-reviewed venues. At ISSAC 2008 (ISSAC is the premier yearly meeting in the area of computer algebra) I gave a software presentation of the `modpn` library. This was also a peer-reviewed contribution.

Figure 3 illustrates the performances of the `modpn` library: we consider here the running time for solving systems of bivariate polynomials, on generic input systems with partial degrees d_1 and d_2 and with finite field coefficients. It is clear that, when the input data are large enough, our code outperforms the computer algebra MAGMA (our strongest competitor on such problems).

3.4.3 The *Basic Polynomial Algebra Subroutines* library

As of today, none of the computer algebra software packages publicly available offers either multicore implementation nor GPU support for fast polynomial arithmetic. We are currently filling this gap. To this end, Dr Yuzhen Xie and I decided to design and develop what would play the role for polynomial systems that the *Basic Linear Algebra Subroutines* (BLAS) plays for linear systems. Naturally, we call this new project *Basic Polynomial Algebra Subroutines* (BPAS). BPAS target hardware acceleration technologies (multicores, GPGPUs, FGPAs) and are realized in the `Cilk/Cilk++` concurrency platform developed by `Intel`.

Efficient implementation of algorithms on parallel architectures makes necessary to consider non-standard complexity measures such as *parallel speed-up* and *cache complexity* (memory traffic). Dr Xie and I have analyzed the performances of dense polynomial multiplication, based on multi-dimensional FFT computations, for these complexity measures. We have shown that the best configuration was when the input polynomials are *bivariate* and *balanced*. This latter term means that the partial degrees of their product are equal. Our experimentation study has confirmed this prediction on multi-core architectures and on a large variety of test problems. This is an amazing discovery since many algorithms on polynomial tend to reduce to the univariate case, not to the bivariate one. Our poster presented these results at the *International Symposium on Symbolic and Algebraic Computation (ISSAC) 09* received a **Best Poster Award**.

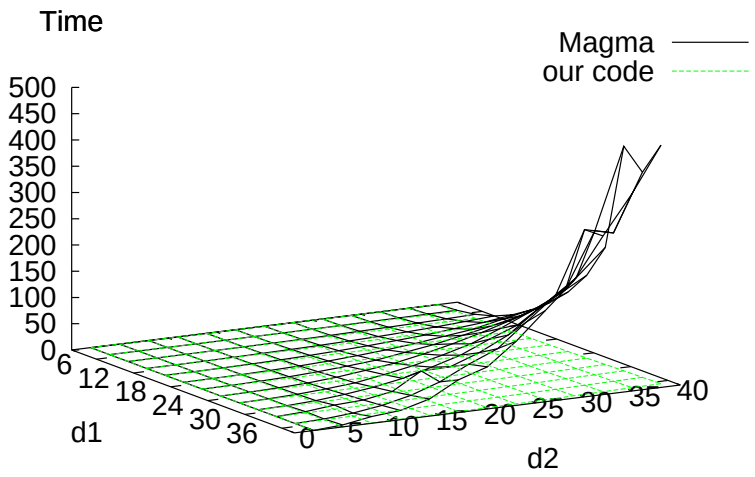


Figure 3: Generic bivariate systems: MAGMA vs. us.

Figures 4 and 5 give running time and speed-up factor of 4-variate multiplication on unbalanced input computed via balanced bivariate multiplication. On both figures, the black and red curves illustrate the performances of our new and previous approaches, respectively. On Figure 5, "net speed-up" is the total gain from 4-D FFT multiplication to multiplication via balanced bivariate multiplication, that is, from our previous to our new approach. On our test, this net speed-up is 31 on 16 cores, due to the good cache performance of our balanced bivariate multiplication.

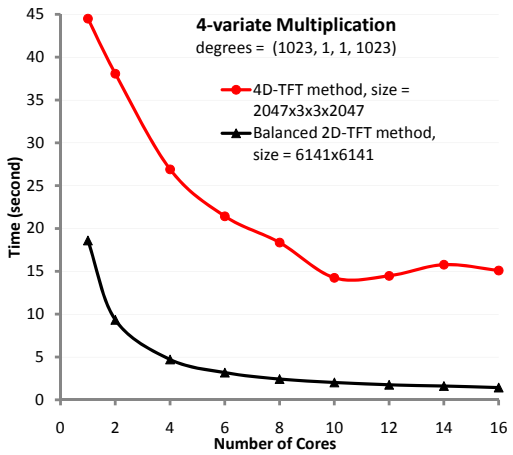


Figure 4: Timing (s) of 4-variate multiplication on unbalanced input via balanced bivariate multiplication.

Motivated by these theoretical and experimental results, we have shown how multivariate (and univariate!) multiplication could be efficiently reduced to *balanced bivariate multiplication*. In practice, we reach speed-up factors of 15 on 16 cores, for sufficiently large input data. This works is reported in *Balanced polynomial multiplication on multi-cores* (International Journal of Foundations of Computer Science, 2011).

Equipped with this efficient kernel (balanced bivariate multiplication) we have investigated how higher-

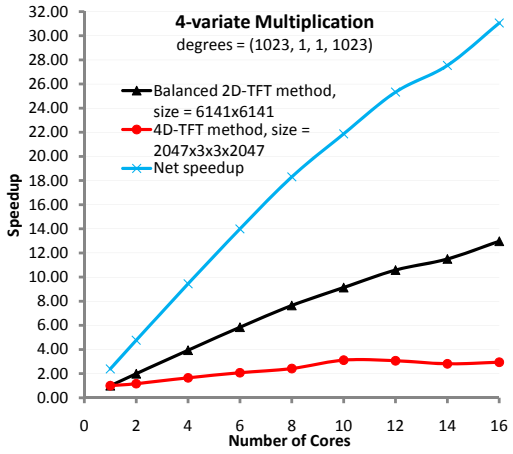


Figure 5: Speed-up factors of 4-variate multiplication on unbalanced input via balanced bivariate multiplication.

level algorithms could be developed on top of it. Composing parallel applications is not an easy task due to memory traffic issues. In *FFT-based dense polynomial arithmetic on multi-cores* (HPCS 09). we have shown that parallel normal form computations could in fact greatly benefit from parallel polynomial multiplication. Once again we achieve speed-up factors close to 15 on 16 cores, which improves on previous work in a significant manner. Today, we have a complete set of arithmetic operations (multiplication, division, normal form computation) for dense multivariate polynomials targeting multi-cores.

3.4.4 The cumodp library

With my PhD student Wei Pan and Sardar Anisul Haque, I have developed a GPU counterpart of the BPAS library. We have realized the *first polynomial system solver based on GPU code*. Figure 6 shows that

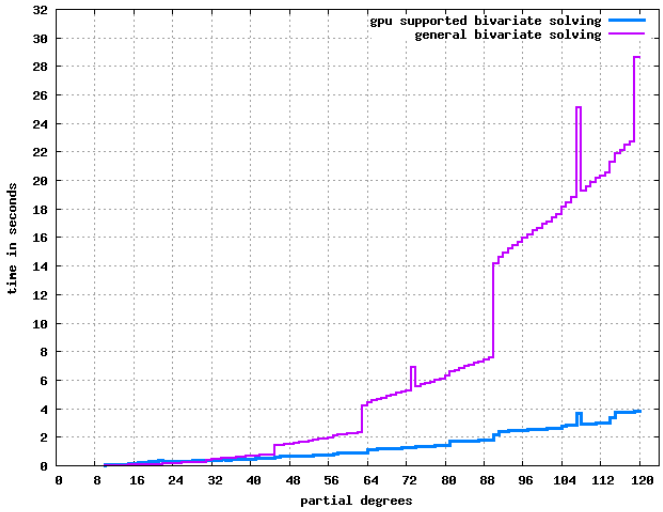


Figure 6: Solving bivariate systems: CPU vs GPU code.

our GPU supported code outperforms our pure CPU code, even when both are called from Maple. Both are implementing the same algebraic algorithm, but are taking into account the specificities of the targeted architecture. This GPU-based solver will be available in the next release of Maple.

Not only our work is integrated into Maple, it has also gained the interest of other software projects in high-performance scientific computing, namely the `LinBox` (for symbolic linear algebra) and `SPIRAL` (for

Digital Signal Processing) with whom we are now actively cooperating.

3.4.5 The Meta_Fork library

This project is supported financially and technically by the IBM Toronto labs as IBM CAS Project CAN13001-880.

Meta_Fork is a metalanguage for multithreaded algorithms based on the fork-join parallelism model and targeting multicore architectures. By its parallel programming constructs, this language is currently a common denominator of CilkPlus and OpenMP. However, this language does not compromise itself in any scheduling strategies (work stealing, work sharing, etc.) Thus, it does not make any assumptions about the run-time system.

A driving application of Meta_Fork is to facilitate automatic translations of programs between the above mentioned concurrency platforms. To date, our experimental framework includes translators between CilkPlus and Meta_Fork (both ways) and, between OpenMP and Meta_Fork (both ways). Hence, through Meta_Fork, we are able to perform program translations between CilkPlus and OpenMP (both ways). Adding Intel TBB to this framework is a work in progress. As a consequence, the Meta_Fork program examples given in this note were obtained either from original CilkPlus programs or from original OpenMP programs.

3.4.6 Comments from Jürgen Gerhard, Research Director, Maplesoft

Dr. Jürgen Gerhard
Director of Research
Maplesoft
615 Kumpf Drive
Waterloo ON, N2V1K8
Canada

To whom it may concern

Waterloo, December 16, 2010

Letter of support for Dr. Marc Moreno Maza

Maplesoft is an innovative software company that has been developing and marketing mathematical software for more than 20 years. Our flagship product, the advanced symbolic and numeric computation engine Maple, is used in universities and research institutes around the world, and has achieved an excellent reputation in the academic community. Combined together with Maplesoft's physical modeling techniques, these technologies enable the creation of our most recent high-performance, multi-domain modeling and simulation tool for physical systems, MapleSim. Maplesoft technology is employed by several million users world-wide.

As Director of Research at Maplesoft, I have been in charge of collaborations between my company and research institutes around the world, among them both the University of Lille I and the Symbolic Computation Lab at the University of Western Ontario, for the past seven years. My task has been to coordinate the research cooperations at a technical and scientific level, discuss the contents of current and future research and development projects, train external developers in the use of Maple and Maplesoft's development tools, and review and integrate contributions from external developers into Maple.

In order to achieve the high quality standards that our customers expect from Maple with respect to algorithm design, efficiency, and user interfaces, every contribution from an external developer is subjected to careful and systematic algorithm and documentation review and is required to pass an extensive test suite before it can be accepted and integrated into Maple. Typically several productive rounds of discussion between Maplesoft reviewers and external developers take place in the process. It is not uncommon that submissions get rejected because they do not satisfy Maplesoft’s quality standards.

I have been working with Dr. Moreno Maza and his team for the past six years. During that time, the group has submitted and continuously developed the RegularChains package for algebraic computations with systems of polynomial equations in Maple. This package has been one of the most valuable additions to our product from external developers in the past years. The algorithms and documentation submitted by Dr. Moreno Maza have clearly satisfied Maplesoft's quality standards.

Today, the RegularChains package is a comprehensive set of tools for polynomial system solving with 135 commands covering subjects such as parametric systems, constructible sets, semi-algebraic sets, fast polynomial arithmetic, and linear algebra over non-integral domains. The most recent contribution to the RegularChains package offers the first Maple command ever capable of describing the real solutions of arbitrary systems of polynomial equations, inequations and inequalities, without any restrictions on the input system.

Since 2004, Dr. Moreno Maza and his team have been developing a C library, called Modpn, for high-performance computing with polynomials, based on Fast Fourier Transforms (FFTs) and Straight-Line Programs (SLPs). The integration of Modpn into Maple in 2008 has brought to our computer algebra system the latest state-of-the-art algorithms for polynomials over finite fields. For this reason, in 2009 Dr. Moreno Maza and his team received the MITACS (Mathematics of Information Technology and Complex Systems) "Best Novel Use of Mathematics in Technology Transfer" award. Recently, Dr. Moreno Maza and his team have enhanced the Modpn library by including GPU (Graphic Processor Unit) supporting code leading to additional significant speedups.

In addition, Dr. Moreno Maza's group has worked on a prototype for a structured documentation toolkit (similar to javadoc) for Maple. The purpose is to enable Maple programmers to embed technical and user level documentation as well as unit tests into the source code and have it extracted and formatted automatically. The design of the prototype developed by Dr. Moreno Maza and his team formed the basis for mpldoc, a toolkit for structured Maple documentation that has been developed in house and is now used in Maplesoft's own development processes.

Dr. Moreno Maza and his team are actively cooperating with Maplesoft engineers through the MITACS full project "Mathematics of Computer Algebra and Analysis". The integration of the RegularChains and Modpn libraries into Maple has required several person months of full-time work from Maplesoft employees. At the same time two PhD students and one post-doctoral fellow have spent or will spend several months at Maplesoft's headquarters through MITACS internships and fellowships (financially supported by both MITACS and Maplesoft).

Traditionally, Canada has played a substantial role in symbolic mathematical and scientific computation, both on the research side and the software development side, and Maplesoft has held a unique position within Canada as provider of general purpose symbolic-numeric mathematical software. The collaboration between Maplesoft, Dr. Moreno Maza and his team helps our company to expand this role as a leading mathematical software provider and remain competitive in the international market.

My own research expertise covers various areas of symbolic computation, including algorithmic polynomial algebra, and I am one of the two coauthors of the widely used textbook "Modern Computer Algebra". Although working in industry for the past seven years, I have participated actively in research conferences as well as refereed both journal and conference publications. I therefore believe that I am qualified to not only evaluate Dr. Moreno Maza's software development activities but also his research achievements. His research on algorithms for systems of polynomial equations has been innovative and very relevant to both the scientific computation research community and the designers of high performance mathematical software such as Maplesoft. His works are well represented at conferences in the field and highly respected by the research community. He has substantially advanced research in the area of algorithms for polynomial equations by integrating current developments in related fields, such as asymptotically fast arithmetic, parametric problem solving, and parallel computation.

I've also had the distinct pleasure, on several occasions, to attend a presentation given by Dr. Moreno Maza. These presentations have always been well-structured and clear, visually appealing, and mathematically intriguing.

Working with Dr. Moreno Maza has always been a pleasure, and I am looking forward to see more excellent research as well as contributions to Maple from him in the future.

Best regards,

Dr. Jürgen Gerhard

3.5 Presentations at Conferences, Colloquia and Professional Meetings

For all the talks listed below, I was an invited speaker and received financial support, except for those located at UWO.

UIC 2013 *Computing the real solutions of polynomial systems with the RegularChains library in Maple.* University of Illinois at Chicago, Ocotober 2, 2013.

WG14C *MetaFork: A Metalanguage for Concurrency Platforms Targeting Multicores.* WG14 C Standards Committee Meeting, Chicago, October 1st, 2013.

U. Bath 2013 *Computing the Limit Points of Quasi-componets of Regular Chains in Diemnsion One.* University of Bath, UK, July 19, 2013.

SHARCNET 2013 *Optimizing Algorithms and Code for Data Locality and Parallelism: A SHARCNET Tutorial.* SHARCNET Summer Seminar, London, Ontario, June 17, 2013.

WLU13 *Optimizing Algorithms and Code for Data Locality and Parallelism Targeting Multicore Architectures Using Cilk.* University Wilfrid Laurier, Waterloo, March 25, 2013.

CASCON 2012 *Parallelization Overheads.* CASCON, Toronto, November, 2012.

SHARCNET 2012 *Optimizing Algorithms and Code for Data Locality and Parallelism: A SHARCNET Tutorial.* SHARCNET Summer Seminar, London, Ontario, July 5, 2012.

SHARCNET 2012 *Parallelization Overheads.* SHARCNET Summer Seminar, London, Ontario, July 12 & July 19, 2012.

IPDPS 2012 *Curriculum Initiative on Parallel and Distributed Computing at the University of Western Ontario.* NSF/TCPP Workshop on Parallel and Distributed Computing Education - EduPar. Shanghai, May, 2012.

ECNU 2012 *Generating polynomial loop invariant via interpolation.* East China Normal University, Shanghai, May, 2012.

CASCON 2011 *Optimizing Computer Algebra Software for Data Locality and Parallelism.* CASCON, Toronto, November, 2011.

Magixalix 2011 *Optimizing FFT-based Polynomial Arithmetic for Data Locality and Parallelism.* MaGiXaLIX Workshop, Ecole Polytechnique, Palaiseau, France, September 20, 2011.

SHARCNET 2011 *Optimizing Algorithms and Code for Data Locality and Parallelism: A SHARCNET Tutorial.* SHARCNET Summer Seminar, London, Ontario, August 3, 2011.

ICIAM 2011 *Exact Computation of the Real Solutions of Arbitrary Polynomial Systems.* ICIAM 2011, Computer Algebra Mini-symposium, Vancouver BC, July 18, 2011.

Kyushu 2010 *Triangular decomposition of semi-algebraic systems.* Kyushu University, September 21, 2010.

All posters and software presentations listed below were peer reviewed. A selection of those posters are available from `http://www.csd.uwo.ca/~moreno`.

ISSAC 2010 C. Chen, ***M. Moreno Maza*** and Y. Xie. Cache Complexity and Multicore Implementation for Univariate Real Root Isolation.

ISSAC 2010 S. A. Haque, Shahadat Hossain and ***M. Moreno Maza***. Cache friendly sparse matrix-vector multiplication.

ISSAC 2011 C. Chen, J.H. Davenport, F. Lemaire, ***M. Moreno Maza***, B. Xia, **R. Xiao** and Y. Xie. *Computing the real solutions of polynomial systems with the RegularChains library in Maple.* ISSAC 2011 Distinguished Software Presentation Award.

ECCAD 2012 M. Moreno Maza and R. Xiao. *Generating polynomial loop invariant via interpolation.* East Coast Computer Algebra Day (ECCAD) Oakland University, Rochester, Michigan, 12 May 2012.

ECCAD 2012 C. Chen and M. Moreno Maza. *An Incremental Algorithm for Computing Cylindrical Algebraic Decompositions.* ECCAD 2012, 12 May 2012.

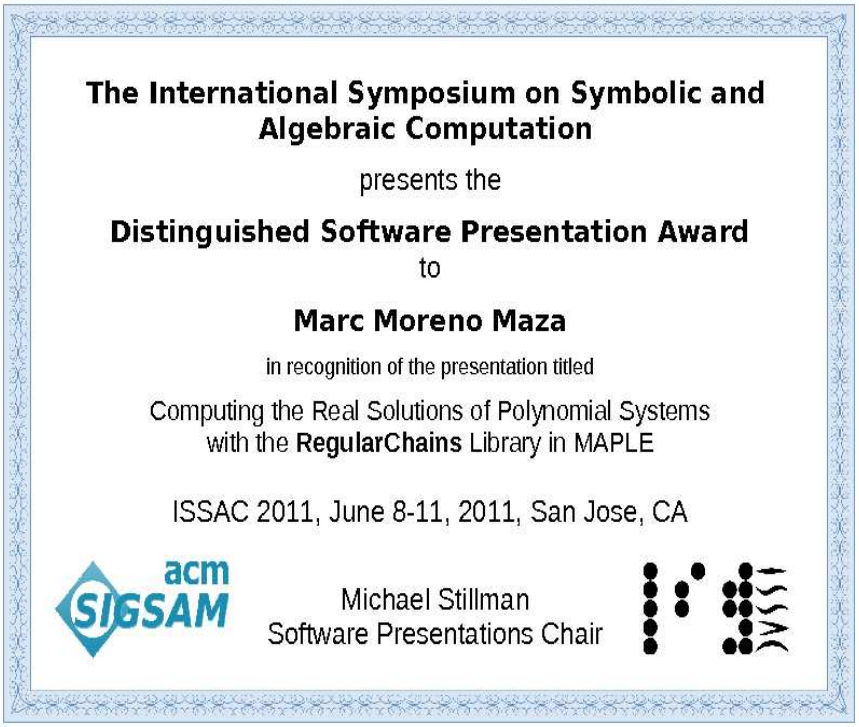
ECCAD 2012 S. Marcus, M. Moreno Maza, **P. Vrbik**. *On Fulton's Algorithm for Computing Intersection Multiplicities*, ECCAD 2012, 12 May 2012.

ECCAD 2012 M. Moreno Maza and **W. Pan**. *Solving Bivariate Polynomial Systems on a GPU*, ECCAD 2012, 12 May 2012.

ECCAD 2012 M. Md. Ali and M. Moreno Maza and Y. Xie. *On the Factor Refinement Principle and its Implementation on Multicore Architectures*, ECCAD 2012, 12 May 2012.

3.6 List of Honors and Awards Received for Research

Year	Award	Purpose
2011	ISSAC'11	Distinguished Software Presentation Award.



3.7 List of Grants and Contracts During the Period July 1, 2010 - June 30, 2013

Start Date	End Date	Principal Investigator	Co-Investigators	Granting Agency	Grant Title	Total Amount	Amount/year for myself
2012/09	2013/04	myself		MITACS	Accelerate	$25,000	$25,000
2011/05	2012/04	myself	I. Kotsireas	MITACS	**Elevate**	$55,000	$55,000
2011/05	2012/04	myself	R.M. Corless P. Yu	ADF	**Major grant**	$50,000	$50,000
2010/11	2012/11	myself		MITACS	**Elevate**	$140,000	$70,000
2010/04	2011/03	myself	R.E. Mercer É Schost	NSERC	**RTI**	$150,000	N/A
2010/05	2012/08	myself		MITACS	Accelerate	$25,000	$25,000
2009/04	2010/03	M. Monagan	myself	MITACS	MOCAA (Web site)	$5,000	$5,000 [100%]
2009/04	2011/03	M. Monagan G. Labahn	19 across Canada	MITACS Maplesoft	MOCCA Project	$420,000	$12,500 [16%]
2008	2008	M. Monagan	myself	MITACS	MOCAA-08 Workshop	$6000	N/A
2009/01	2010/12	myself		SHARCNET	Graduate Fellowship	$26,000	$13,000 [100%]
2008/04	2013/03	myself		NSERC	Discovery	$135,000	$27,000
2013/04	2015/03	myself		NSERC	Discovery	$100,000	$20,000
2013/07	2015/06	myself		MITACS	**Elevate** & **Accelerate** Cluster	$204,000	$102,000
2013/05	2014/04	myself		IBM	CAS	$2,000	$2,000

Notes:

Short name	**Full name or URL**
MapleSoft	[http://www.maplesoft.com]
MITACS	Mathematics of Information Technology and Complex Systems [http://www.cecm.sfu.ca/~pborwein/MITACS]
MOCAA	Mathematics Of Computer Algebra and Analysis
NSERC	Natural Sciences and Engineering Research Council of Canada
PASCO	Parallel Symbolic Computation Workshop
SNC	Symbolic/Numeric Computation Conference
SFU	Simon Fraser University
IBM CAS	IBM Center for Advanced Studies [https://www-927.ibm.com/ibm/cas/]

- In case of a grant held by several researchers, the percentage in square brackets represents my share of the total.

4 Record of Performance in Service During the Period July 1, 2010 - June 30, 2013

4.1 Committee or Equivalent Duties Performed at the Department, Faculty or University Level

University	Department	Description	Year
UWO	Computer Science	Graduate Executive Committee	2009-2013
UWO	Computer Science	Curriculum Committee	2009-2010
UWO	Computer Science	Appointment Committee	2009-2010
UWO	Faculty of Science	"Consult the Experts" sessions (providing advice to graduate students writing scholarships)	2011-2013

4.2 Activities External to the University Relevant to the Member's Academic Responsibilities in the Area of Service

Since 2008, I have been serving on the *Resource Allocation Committee* of SHARCNET. In particular, I was a reviewer for the Round VI, Round VII, Round VIII, Round IX and Round X of the Fellowships/Dedicated Resources competitions. In total, I was in charge of more than 60 applications as a primary reviewer and about the same amount as a secondary reviewer.

Since 2011, I have been participating to the IEEE/NSF Technical Committee on Parallel Processing (TCPP) on the *Curriculum Initiative on Parallel and Distributed Computing*.

4.3 Any Other Significant Duties Relevant to the Member's Academic Responsibilities in the Area of Service

4.3.1 Referee

ISRN-Algebra. Editor for the ISRN *Journal of Algebra*.

JSSC. Editor for the *Journal of Systems Science and Complexity*.

NSA. Reviewer for the *NSA Mathematical Sciences Grant Program*.

NSERC. Reviewer for the *Strategic Grant Proposal Program*.

JSC. regular article referee for the *Journal of Symbolic Computation*.

MCS. Article referee for the Journal *Mathematics in Computer Science*.

IFIP-TCS. Article referee for the *4th IFIP-TCS conference.* `http://www.wcc-2006.org/`

CASC-2011. Program Committee Member of the Internat. Conf. *Computer Algebra in Scientific Computing*.

CASC-2012. Program Committee Member of the Internat. Conf. *Computer Algebra in Scientific Computing*.

CASC-2013. Program Committee Member of the Internat. Conf. *Computer Algebra in Scientific Computing*.

ISSAC-2011. Program Committee Member of the International Symposium of Symbolic and Algebraic Computation.

SNC-2011. Program Committee Member of the International Workshop on *Symbolic-Numeric Computation*.

4.3.2 Conference and Workshop Organizer

Conference/Workshop	Location & Date	Activity
SIAM AB 2013	Fort Collins, USA, August, 2013	Mini-symposium co-organizer
SIAM DM 2012	Halifax, Canada, July, 2012	Mini-symposium co-organizer
CAIMS 2012	Toronto, Canada, June, 2012	Mini-symposium co-organizer
AMMCS 2011	Waterloo, Canada, July, 2011	Mini-symposium co-organizer
PASCO 2010	Grenoble, France, July, 2010	Co-chair and PC Chair

- *SIAM Workshop on Cylindrical Algebraic Decomposition and Quantifier Elimination.* [http://meetings.siam.org/sess/dsp_programsess.cfm?SESSIONCODE=16789]
- *SIAM Workshop on the Interactions between Computer Algebra and Discrete Mathematics.* [http://meetings.siam.org/sess/dsp_programsess.cfm?SESSIONCODE=14645]
- *CAIMS Workshop on the Applications of computer algebra in applied and industrial mathematics.* [http://www.fields.utoronto.ca/programs/scientific/11-12/CAIMS_SCMAI/program.html]
- *AMMCS Workshop on High Performance Computing: From Models of Computation to Applications .* [http://www.ammcs2011.wlu.ca/SS-HPC.html]
- *HPCA Workshop on High-Performance Computer Algebra.* [http://www.csd.uwo.ca/~moreno/HPCA-ACA-2009/hpca_abstract.htm]
- *PASCO: ACM International Workshop on Parallel Symbolic Computation* [http://pasco2010.imag.fr]

At the International Symposium of Symbolic and Algebraic Computation (ISSAC), in July 2010, I was elected member of the Steering Committee of ISSAC, the *premier annual meeting in the area of Computer Algebra.*

In June 2012, I was elected Chair *of the ISSAC Steering Committee.*

Topics

- Design and analysis of parallel algorithms for computer algebra
- Practical parallel implementation of symbolic or symbolic-numeric algorithms
- High-performance software tools and libraries for computer algebra
- Applications of high-performance computer algebra
- Distributed data-structures for computer algebra
- Hardware acceleration technologies (multi-cores, GPUs, FPGAs) applied to computer algebra
- Cache complexity and cache-oblivious algorithms for computer algebra
- Compile-time and run-time techniques for automating optimization and platform adaptation of computer algebra algorithms

Important Dates

Paper submission deadline:	**April 2, 2010**
Notification of acceptance:	**May 10, 2010**
Camera-ready version:	**May 28, 2010**
Tutorials and Workshop:	**July 21-23, 2010**

Program Committee

- **Marc Moreno Maza**
- Daniel Augot
- Jean-Claude Bajard
- Olivier Beaumont
- Bruce Char
- Gene Cooperman
- Gabriel Dos-Reis
- Jean-Christophe Dubacq
- Jean-Guillaume Dumas
- Jean-Charles Faugere
- Matteo Frigo
- Thierry Gautier
- Pascal Giorgi
- Stef Graillat
- Jeremy Johnson
- Erich Kaltofen
- Herbert Kuchen
- Philippe Langlois
- Jean-Louis Roch
- Anton Leykin
- Gennadi Malaschonok
- Michael Monagan
- Winfried Neun
- Clement Pernet
- Nicolas Pinto
- Manuel Prieto-Matias
- Markus Pueschel
- Nathalie Revol
- David Saunders
- Eric Schost
- Wolfgang Schreiner
- Arne Storjohann
- Sivan Toledo
- Gilles Villard
- Yuzhen Xie
- Kazuhiro Yokoyama

Signature: _____M__Moreno_Maza_____

Date: _____15_November_2013_____