Matthieu Dorier, PhD, normalien

High-Performance Computing Scientist

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*Making data management fast
and scalable on the largest
supercomputers!*

SKILLS

Research and development in high-performance computing, parallel and distributed computing, input/output, parallel data storage, analysis, and visualization, numerical scientific simulations, event-driven simulations, distributed algorithms, software architecture design and development.

PROFESSIONAL EXPERIENCE

Argonne National Laboratory, Lemont, IL - *Postdoctoral Appointee*

FEBRUARY 2015 - PRESENT

- Research on HPC I/O, in situ visualization, and MPI communication algorithms
- Under the supervision of Dr. Rob Ross

Ecole Normale Supérieure de Rennes, France - *PhD Student, Teaching Assistant*

SEPTEMBER 2011 - DECEMBER 2014

- Research on HPC I/O, parallel storage, in situ visualization (see Education section)
- Under the supervision of Dr. Gabriel Antoniu and Prof. Luc Bougé
- Teaching at ENS Rennes and INSA Rennes (see Teaching section)

IRISA / Inria Rennes Bretagne-Atlantique, KerData Research Team - *Master Intern*

FEBRUARY 2011 - JUIN 2011

- Research on HPC I/O, under the supervision of Dr. Gabriel Antoniu

National Center for Supercomputing Applications, Urbana, IL - *Master Intern*

MAY 2010 - AUGUST 2010

- Research on HPC I/O, under the supervision of Dr. Franck Cappello and Prof. Marc Snir

IRISA / Inria Rennes Bretagne-Atlantique, PARIS Research Team - *Bachelor Intern*

JUNE 2009 - AUGUST 2009

- Research on Distributed Cloud Storage for MapReduce
- Under the supervision of Prof. Luc Bougé and Dr. Bogdan Nicolae

EDUCATION

Ecole Normale Supérieure de Rennes - *PhD*

SEPTEMBER 2011 - DECEMBER 2014

"Addressing the Challenges of I/O Variability in Post-Petascale HPC Simulations", defended on December 9th, 2014, directed by Dr. Gabriel Antoniu and Prof. Luc Bougé

Ecole Normale Supérieure de Cachan - *Magistère*

SEPTEMBER 2008 - JUNE 2012

Computer Science and Telecommunications

ENS Cachan / University of Rennes 1 - *Master*

SEPTEMBER 2009 - JUNE 2011

Research in Computer Science, specialized in Parallel and Distributed Computing, obtained with honors and the rank of 1st / 70

ENS Cachan / University of Rennes 1 - *Bachelor*

SEPTEMBER 2008 - JUNE 2009

Computer Science, ranked 4th / 106

AWARDS AND RECOGNITIONS

Gilles Kahn honorary award of the SIF and the Academy of Science in 2015

http://www.societe-informatique-de-france.fr/recherche/prix-de-these-gilles-kahn/

> This prize is given every year to at most the 3 best PhD theses in Computer Science in France and is jointly delivered by the Société Informatique de France (SIF) and the French Academy of Science. The candidates are judged on all aspects of their PhD work, from fundamental contributions to industrial transfers, and from publication impacts to teaching, mentoring, and scientific dissemination activities.

2nd best PhD award from the Fondation Rennes 1 in 2014

https://fondation.univ-rennes1.fr/

> The PhD award from the Fondation Rennes 1 is given every year to 8 outstanding new doctors from the 4 doctoral schools associated with the University of Rennes 1 (2 awards per doctoral school). The candidates are judged on the innovative aspects of their PhD thesis, "innovative" being understood in the sense of impact on socioeconomic development and technology transfers.

C3I Label (Certificat de Compétences en Calcul Intensif) of GENCI

http://www.genci.fr/fr/content/c3i

> The C3I label is delivered by GENCI to doctors who, during their PhD, have developed and applied skills in high performance computing, including optimisation of parallel codes, parallel and distributed algorithms, large-scale data management, etc.

2nd prize at the ACM Student Research Competition at ICS 2011

http://src.acm.org/

> The ACM Student Research Competition is an internationally recognized venue enabling undergraduate and graduate students to experience the research world, share research results and exchange ideas with other students, judges, and conference attendees, rub shoulders with academic and industry luminaries, understand the practical applications of their research, perfect their communication skills, and receive prizes and gain recognition from ACM and the greater computing community.

RESEARCH PROJECTS (past and ongoing)

Joint INRIA/UIUC/ANL/BSC/JSC/RIKEN Laboratory for Extreme Scale Computing

- https://publish.illinois.edu/jointlab-esc/
- Timeframe: 2009 - 2013 under the name "Joint INRIA/UIUC/ANL Laboratory for Petascale Computing" (JLPC), 2013 - present under the current name (JLESC).
- Director: Franck Cappello (ANL, UIUC and INRIA).
- Partner institutions: INRIA, UIUC/NCSA, ANL, BSC, JSC, Riken/AICS

The JLESC is an international, multi-institution collaboration addressing the software challenges for extreme scale computing in the areas of numerical methods for computational science, resilience, data storage, analysis, visualization, and programming models. *My involvement:* I have been involved in the JLPC/JLESC since 2010, and participated in every biannual workshop since 2011. This collaboration gave me the opportunity to complete a 3-month master internship at UIUC in 2010, followed by multiple visits and internships to NCSA and ANL during my PhD. Many of my publications benefited from collaborations within this framework. I am currently the co-lead (with Gabriel Antoniu) of the work-package "I/O traces", which aims to synchronize all participants working on I/O and gather I/O traces from real applications and real platforms, and I/O benchmarks, for the purpose of evaluating solutions proposed in this collaboration.

Preparing for Next Generation Numerical Simulation Platforms: NextGN

- https://publish.illinois.edu/jointlab-esc/puf-nextgn/
- Timeframe: 2013 - present
- Funding: Partner University Fund (http://face-foundation.org/)

This project is jointly organized with the JLESC and gathers the same partners. It aims to develop new research activities and form new generations of researchers for Exascale machines and HPC Clouds. This project organizes a summer school every year on topics related to extreme scale computing. *My involvement:* I was invited to give a lecture titled "An Introduction to HPC Storage and I/O" at the 2nd summer school in Barcelona, Spain, in June 2015.

Compute on Data Path: Combating Data Movement in High-Performance Computing

- http://discl.cs.ttu.edu/cdp/
- Timeframe: 2015 - present
- Funding: NSF

- PIs: Yong Chen (Texas Tech), Rob Ross (ANL), Barbara Chapman (University of Houston), Yonghong Yan (Oakland University)

The goal of this project is to investigate ways of including computation capability on the data path in exascale storage systems, and propose methodologies to reduce data transfer to and from storage, network and memory hierarchy in HPC systems. Partners: Texas Tech, ANL, University of Houston, Oakland University, Northwestern University. *My involvement:* Within this project, we organize biweekly conference calls to report on progress, and I was invited to a physical meeting at Texas Tech in September 2015 to present my work.

Data@Exascale associated team between INRIA (KerData team), ANL and NCSA

- http://www.irisa.fr/kerdata/data-at-exascale/
- Timeframe: 2013 - present
- PIs: Gabriel Antoniu (INRIA), Rob Ross (ANL), Marc Snir (UIUC)

Data@Exascale is an associated team between the KerData team from IRISA / INRIA Rennes - Bretagne Atlantique, ANL, and the National Center for Supercomputing Applications (NCSA) at UIUC. Its research topics address the area of large scale data management for post-petascale supercomputers and for clouds. We aim to investigate several open issues related to storage and I/O in HPC, and also in situ data visualization and analysis from large scale simulations. *My involvement:* I contributed to writing the proposal that led to the creation of this associated team. This project provided the funding for me to come at Argonne for a 3-month internship in 2013. It also funded two internships under my supervision (Orcun Yildiz in 2015 and Nathanael Cheriere in 2016). This project led to several of my publications (LDAV 2013, IPDPS 2014, SC 2014, ISAV 2015, IPDPS 2016). It was renewed for three more years in 2016.

Seeding a Franco-Chicago Collaboration in Exascale Storage for Computational Science

- Timeframe: February 2012 - January 2013
- Funding: FACCTS (French And Chicago Collaborating in The Sciences)
- PIs: Gabriel Antoniu (INRIA Rennes), Rob Ross (ANL)

This project aimed at bringing together researchers from INRIA Rennes and Argonne National Laboratory around the challenges related to exascale storage. This 1-year project enabled several visits (including a 3-week visit of myself at Argonne National Laboratory and a 1-week visit of Rob Ross at INRIA Rennes) and allowed us to define the scope and prepare the proposal for the Data@Exascale associated team between the KerData team at INRIA and the team of Rob Ross at Argonne. I contributed to writing the proposal for this collaboration.

RESPONSIBILITIES

Member of Program Committees:
- ACM/IEEE Supercomputing 2017
- IEEE/ACM CCgrid 2017
- EBDMA 2017
- Euro-Par 2017
- ISC 2017 http://isc-hpc.com/isc-2017.html
- IEEE Cluster 2017

- IEEE BigData 2016 http://cci.drexel.edu/bigdata/bigdata2016/
- IEEE/ACM CCgrid 2016 https://ccgrid2016.uniandes.edu.co
- Euro-Par 2016 https://europar2016.inria.fr/

Reviewer: I regularly review papers for the widely referenced conferences and journals of my area (High Performance Computing, Data Storage, Analysis and Visualization): IEEE/ACM SC 2012; EuroPar 2011, 2014, 2015 and 2016; IEEE Cluster 2013 and 2015; ACM HPDC 2015; ACM/IEEE CCgrid 2013 and 2015; IEEE ICPADS 2015; ICPP 2013; ISPDC 2014; NPC 2015; IEEE HPCC 2011; IEEE BigData 2013 and 2016; IEEE TPDS; ACM PARCO.

Session Chair:
- IEEE Cluster 2016, I/O optimization session http://www.ieeecluster2016.org/

SUPERVISION OF RESEARCH ACTIVITIES

Nathanael Cheriere - *Pre-doc from ENS Rennes*

- Co-supervised with Dr. Rob Ross during his internship at Argonne National Laboratory (January to June 2016). *Topic:* **Design and evaluation of MPI collective algorithms for the Dragonfly network topology.**

Nathanael was a 4th year ENS student ("pre-doctoral intern"). I hosted him at Argonne for a 6-month internship in 2016. The goal of this internship was to design and evaluate new topology-aware collective algorithms for the Dragonfly topology using the CODES packet-level network simulator. I was providing day-to-day guidance. The results of this internship have been accepted for a poster publication at ACM/IEEE Supercomputing 2016 and a paper will be submitted to IEEE IPDPS 2017.

Orcun Yildiz - *PhD student from the INRIA KerData team*

- Co-supervised with Dr. Rob Ross during his summer internship at Argonne National Laboratory (June to September 2015). *Topic:* **Investigating the root causes of I/O interference in HPC platforms.**

Orcun is doing a PhD in the KerData team (IRISA/INRIA Rennes) since 2014 under the direction of Shadi Ibrahim and Gabriel Antoniu. I hosted him at Argonne for his summer internship in 2015. The goal of this internship was to investigate the root causes of I/O interference in HPC platforms. This work involved many experiments on the Grid'5000 platform. I was providing day-to-day guidance on the work and we were meeting once a week with Orcun's PhD advisor Shadi Ibrahim on conference calls. The results of this internship have been published at IEEE IPDPS 2016.

Anthony Kougkas - *PhD student from Illinois Institute of Technology*

- Co-supervised with Rob Latham during his summer internship at Argonne National Laboratory (May to August 2015). T*opic:* **Leveraging burst buffers to mitigate cross-application I/O interference.**

Anthony is doing a PhD at IIT under the supervision of Xian-He Sun. I hosted him at Argonne for his summer internship in 2015. The goal of this internship was to design a library implementing an in-memory burst buffer model, and to evaluate several cross-application communication strategies to prevent I/O interference by leveraging this library. I was providing day-to-day guidance during the internship and continued to mentor Anthony remotely afterward to publish our results at IEEE eScience 2016.

Orcun Yildiz - *M2 student from KTH Royal Institute of Technology*

- Co-supervised with Dr. Shadi Ibrahim during his master internship in the KerData team at IRISA / Inria Rennes (February to July 2014). *Topic*: **Investigating the energy consumption of HPC applications under various I/O management approaches.**

Prior to starting a PhD in the KerData team, Orcun was a master student from KTH enrolled in the European Master in Distributed Computing. I hosted him for his Master internship in the KerData team at INRIA Rennes. The goal of this internship was to leverage the Damaris software that I developed to evaluate the energy consumption of diverse I/O approaches on HPC machines. Under my technical supervision, Orcun provided some contributions to the code of Damaris and conducted extensive evaluations on the Grid'5000 platform. This work led to publications at the DIDC workshop and in the Eslevier FGCS journal. Part of this work is also included in publication to the ACM ToPC journal.

Thomas Bouguet - *M1 student from University of Rennes 1*

- Supervised during his master internship in the KerData team at IRISA / Inria Rennes (May to July 2014). *Topic:* **Developing a web platform for Darshan log analysis.**

Thomas was a first year Master student at Université de Rennes 1. I hosted him in the KerData team for an internship on a subject requiring an engineering profile: the goal of this internship was to leverage the Darshan-Ruby library (http://darshan-ruby.gforge.inria.fr/) to develop a web platform for the online analysis of I/O traces produced by Argonne's Darshan tool. The code of this web platform is available for download on the website of Darshan-Ruby and it inspired some work currently conducted within the NSF "Personalized Benchmarks for HPC Applications" project of Argonne and UIUC.

Catalina Nita - *M1 student from Politehnica University of Bucharest*

- Co-supervised with Dr. Gabriel Antoniu during her master internship in the KerData team at IRISA / Inria Rennes (May to August 2013). *Topic*: **In situ visualization of ensemble simulations.**

Catalina was a first year Master student of University Politechnica of Bucharest. I hosted her in the KerData team for an internship under the joint supervision of Gabriel Antoniu and myself. The goal of this internship was to evaluate the technical feasibility of performing in situ visualization of ensemble simulations (that is, simulations run several times with different input parameters, and whose outputs need to be compared).

Sergiu Vicol - *Bachelor student from the University of Oxford*

- Co-supervised with Gabriel Antoniu during his Bachelor internship in the KerData team at IRISA / Inria Rennes (June - August 2012). *Topic:* **Investigating memory allocation strategies for the Damaris software.**

Sergiu was a first year bachelor student from the University of Oxford. I hosted him for an internship with the goal of proposing more efficient memory management strategies for the Damaris software that I was developing.

TEACHING ACTIVITIES

During my PhD thesis (2011 to 2014), I had a teaching mission at the Ecole Normale Supérieure de Rennes and at INSA Rennes. Prior to this, I was in charge of practical courses of OCaml programming for prepa students at the lycée Chateaubriand in Rennes for two years.

Years	Class	Course	Type and volume
2010 to 2012	Prépa MP, lycée Chateaubriand	Programming in OCaml	TP (2x 28h)
2011 to 2013	1st year INSA	OOP in Java	Courses/TD (2x 28h), TP (2x 14h)
2012 to 2013	1st year ENS Rennes INFO	Programming in OCaml, C, C++	TP (24h)
2013 to 2014	1st year ENS Rennes INFO	Architectures and Systems	TP (24h)
2012 to 2014	1st year ENS Rennes INFO	Initiation to Ruby programming	Courses-TD (3x 12h)
2014	3rd year ENS Rennes MATHS	Initiation to UNIX	TP (2h)
2013	2nd year ENS Rennes INFO	Internship defenses	Jury (3h30)
2013 and 2014	2nd year ENS Rennes INFO	Internship defenses	Jury (2x 3h)

Courses details

OCaml Programming (TP)

> Audience : *classes of MP1 and MP2 at lycée Chateaubriand, Rennes*
>
> Person in charge of the module : *Clément Picard*
>
> Volume : *28h per year, 2 years (2010-2011 and 2011-2012)*

These practical courses aim to initiate students of classes préparatoires MP (2nd year) to programming and basic algorithms in OCaml, targeting the competitions for French grandes écoles. Problems studied go from sorting arrays to more complex algorithms such as automata determinization, manipulation of rational expressions, implementation of tree-based data structures for information storage and retrieval. My goal consisted of helping and supervising students during the sessions, while the exercises were provided by the person in charge of the course.

Object oriented programming in Java

> Audience : 1st *year (L1 level) INSA Rennes engineering school*
>
> Person in charge of the module : *Yann Ricquebourg*
>
> Volume : *28h Courses/TD per year, 14h of TP per year, 2 years (2011-2012 and 2012-2013)*

The objective of these courses was to teach the basics of object-oriented programming (notions of classes, attributes, methods, inheritance, etc.) and their applications in Java. The courses/TD were actual courses based on slides provided by the person in charge of the module, and enriched by exercises on paper proposed either by the person in charge or by myself. The TP consisted of applying the notions studied

during the courses through exercises provided by the person in charge of the module. The student had to send me their code at the end of each session to get a correction the following week.

Programming in OCaml, C, C++

Audience : *1st year (L3 level) ENS Rennes*

Person in charge of the module : *Luc Bougé*

Volume : *24h of TP per year, 1 year (2012-2013)*

The objective of the programming course at ENS is less programming itself than the study of the underlying notions to any programming languages (environment, functional programming, imperative, object-oriented, exceptions, continuations, higher-order functions, etc.). The practical sessions consisted of applying the notions seen during the course in solving typical programming problems (Delaunay triangulation, AVL balancing, ray tracing, etc.). This course contained 4 projects associated with a report and a short oral defense. I wrote most of the subjects used for the TPs and projects. These subjects are still used today by my successors.

Architectures and Systems

Audience : *1st year (L3 level) ENS Rennes*

Person in charge of the module : *Dominique Lavenier*

Volume : *24h of TP per year, 1 year (2013-2014)*

The objectives of this courses were to understand the basics of microprocessor design, from logic gates to the main components of a microprocessor: computation unit, memory, registers, instruction processing, etc. The practical sessions consisted in implementing the architectures seen during the courses on FPGAs. This course ended with a project of an architecture testing the reflexes (delay between a LED turning on and the user pressing a button). For the needs of these practical sessions, I had to adapt the set of exercises used in previous years to the new FPGA devices acquired by ENS.

Initiation to the Ruby language

Audience : *1st year (L3 level) ENS Rennes*

Person in charge of the module : *David Pichardie*

Volume : *12h of courses/TD/TP per year, 3 year (2012, 2013 and 2014)*

This course consists of an initiation to the Ruby language for 1st year students of the INFO department at ENS. It takes place during the first two weeks following the beginning of the classes, in september. It allows students to immerse themselves into a language they usually do not know, work in groups, and get used to how the classes will operate during the year (revolving around research-oriented group projects). In this context, I designed the courses myself, as well as the exercises on machines and the subjects of mini-projects (game of life in 2012, research in a database of texts in 2013, and artificial intelligence for the Awale game in 2014).

Initiation to UNIX

Audience : *"agrégatifs" of the MATHS department of ENS Rennes*

Person in charge : *Thibaut Deheuvels*

Volume : *2h of TP per year, 1 year (2014)*

This course initiates new students arriving in the MATHS department of ENS Rennes to the UNIX environment installed on the machines at ENS. During this TP, we go through the main shell commands (cd, ls, chmod, etc.) as well as SSH/SCP and some other common tools.

KNOWLEDGE DISSEMINATION

In 2014 I was invited to give a lecture titled "An introduction to HPC storage and I/O" at the PUF summer school in Barcelona, Spain.

In 2012, 2013 and 2014 I presented my work to new students entering the Computer Science department of ENS Rennes during their visit of the IRISA/INRIA facilities.

In 2014 I presented my work to master students of University of Rennes 1 during their visit of the IRISA/INRIA facilities. This presentation led Thomas Bouguet to request and come for an internship in the KerData team, under my supervision.

In 2013 I presented my work to students of the classes préparatoires from the lycée Chateaubriand in Rennes, during their visit of the IRISA/INRIA facilities.

SOFTWARE DEVELOPMENT AND TECHNOLOGICAL TRANSFER

Damaris

Description: Damaris is a data-management middleware for high-performance computing simulations. It enables to dedicate some of the cores in each node, or entire nodes, to run data management services, including asynchronous data transformation and storage, and in situ visualization and analysis.

- Website: http://damaris.gforge.inria.fr
- License: LGPL
- First version: 0.1, June 2011. Current version: 1.0.1, October 2015
- Damaris is registered at the Agence pour la Protection des Programmes
- Size and languages: 17711 lines, C++, Fortran, XML
- Number of downloads (all versions): 515 as of October 2016
- Developers: Matthieu Dorier (ENS Rennes, 80% of the code), Orcun Yildiz (INRIA Rennes, 15% of the code), Gabriel Antoniu (INRIA Rennes, 5% of the code)
- Citations of papers related to the software: 87 as of 10/2016 according to Google Scholar

Collaborations: Damaris is at the core of international collaborations between ANL, INRIA, and UIUC, within the frameworks of the Joint Laboratory for Extreme Scale Computing, and the Data@Exascale associated team.

Impact: Damaris was evaluated on Blue Waters (Cray XE6, NCSA), Kraken (Cray XT5, NICS), Titan (Cray XK7, ORNL), Intrepid (IBM BlueGene/P, ANL), Grid'5000 (French grid testbed), and Blue Print (Power5 cluster, NCSA), with the CM1 atmospheric simulation and the Nek5000 CFD simulation. Damaris was formally validated for use on NCSA's Blue Waters supercomputer. It

has been used successfully by several researchers from NCSA (Robert Sisneros), University of Wisconsin Madison (Leigh Orf) and the Federal University of Rio Grande do Sul (Francieli Zanon Boiteau).

Damaris is at the core of the research strategy of the KerData team of IRISA and INRIA Rennes. Two PhD students were hired in 2013 and 2014 on topics related to this software: Lokman Rahmani (2013) and Orcun Yildiz (2014).

In 2014, INRIA granted an ADT (Action Developpement Technologique) to the KerData team to hire an engineer for 2 years dedicated to further developing and maintaining Damaris. In 2015, Damaris was officially integrated in the VisIt parallel visualization software starting from its version 2.10.0 as an alternative to its default in situ visualization interface. (https://wci.llnl.gov/simulation/computer-codes/visit/releases/release-notes-2.10.0)

Main peer-reviewed papers resulting from this software: [1], [3], [10], [11], [14], [15], [18]

Omnisc'IO

Description: Omnisc'IO is a middleware integrated in the POSIX and MPI-I/O stacks to transparently observe, model and predict the I/O behavior of any HPC application. It is based on formal grammars and implements a modified version of the Sequitur algorithm. Omnisc'IO has been used on Grid'5000 with the CM1 atmospheric simulation, the LAMMPS molecular dynamics simulation, the GTC fusion simulation and the Nek5000 CFD simulation. Although it has been registered at the Agence pour la Protection des Programmes, the code is not publically available due to ongoing research that make use of it.

- Start of development: January 2014
- Size and language: 4400 lines, C++
- Developers: Matthieu Dorier (ENS Rennes, 100% of the code)

Collaborations: Omnisc'IO is used in research within the contexts of the Joint Laboratory for Extreme Scale Computing, and the Data@Exascale associated team.

Impact: Omnisc'IO is the basis for the implementation of my ongoing project as a postdoctoral appointee at Argonne National Laboratory: IOlogy, an all-in-one approach to I/O tracing, modeling, prediction and extrapolation for HPC applications.

Main peer-reviewed papers resulting from this software: [2], [8]

Darshan-Ruby

Description: Darshan-Ruby is an object-oriented extension to simplify the analysis of ANL's Darshan log files (a tool that traces the I/O of simulations running on supercomputers) using the Ruby language. It was developed to help get a faster insight into the I/O behavior of large-scale applications. Darshan-Ruby efficiently accesses Darshan data without intermediate conversion into text format. It is available as a Ruby Gem package on the official rubygems.org repository (https://rubygems.org/gems/darshan and https://rubygems.org/gems/darshan-ruby) and, as of October 2016, was downloaded about 5000 times. Darshan-Ruby led to the

Darshan-Web project, which proposes a web platform that analyzes traces and provides users with hints on how to improve the I/O performance of their applications.

- Website: https://xgitlab.cels.anl.gov/darshan/darshan-ruby
- License: LGPL
- First version: 1.0.1, September 2013. Current version: 3.0.0, June 2014
- Darshan-Ruby is registered at the Agence pour la Protection des Programmes
- Size and languages: 500 lines, C, Ruby
- Number of downloads (all versions): 5000
- Developers: Matthieu Dorier (ENS Rennes, then ANL, 100% of the code)

This project was not meant for publication, but as a tool to help analyze Darshan logs when interacting with users and administrators or large scale platforms.

Impact: Darshan-Ruby was cited on the website of Darshan (http://www.mcs.anl.gov/research/projects/darshan/).

BBIO (Basic Buffered IO)

Description: BBIO (Basic Buffered IO) is a library that implements a software-defined approach to burst buffers. It capture POSIX I/O functions and redirects them into a user-provided buffer located either in main memory or in a local storage device. BBIO was implemented only for the purpose of evaluating burst-buffer-based approaches to HPC I/O in environments that do not provide actual burst buffers.

- Website: https://bitbucket.org/mdorier/bbio/
- License: no license yet, code under government copyrights, free to use "as is"
- First version: no official release yet
- Size and language: 1480 lines, C
- Developers: Matthieu Dorier (ANL, 50% of the code), Anthony Kougkas (IIT, 50%)

Main peer-reviewed papers resulting from this software: [4]

PUBLICATIONS

Peer-reviewed articles in international journals

[1] **Matthieu Dorier**, Gabriel Antoniu, Franck Cappello, Marc Snir, Robert Sisneros, Orcun Yildiz, Shadi Ibrahim, Tom Peterka, Leigh Orf. *Damaris: Addressing Performance Variability in Data Management for Post-Petascale Simulations.* Submitted to ACM Transactions on Parallel Computing (ToPC). 2016.

[2] **Matthieu Dorier**, Shadi Ibrahim, Gabriel Antoniu, Rob Ross. *Using Formal Grammars to Predict I/O Behaviors in HPC: the Omnisc'IO Approach*. IEEE Transactions on Parallel and Distributed Systems (TPDS), 2015 (https://hal.inria.fr/hal-01238103)

[3] **Matthieu Dorier,** Orcun Yildiz, Shadi Ibrahim, Anne-Cécile Orgerie, Gabriel Antoniu. *On the Energy Footprint of I/O Management in Exascale HPC Systems.* Elsevier Future Generation Computer Systems (FGCS), 2016 (http://www.sciencedirect.com/science/article/pii/S0167739X16300462)

Peer-reviewed articles in international conferences

[4] Anthony Kougkas, **Matthieu Dorier**, Rob Latham, Rob Ross, Xian-He Sun. *Leveraging Burst Buffer Coordination to Prevent I/O Interference*. In proceedings of IEEE International Conference on eScience (eScience '16), Baltimore, October 2016. CORE Rank A.

[5] **Matthieu Dorier**, Misbah Mubarak, Rob Ross, Jianping Kelvin Li, Christopher D. Carothers, Kwan-Liu Ma. *Evaluation of Topology-Aware Broadcast Algorithms for Dragonfly Networks*. In proceedings of IEEE International Conference on Cluster Computing (CLUSTER '16), Taipei, Taiwan, September 2016. CORE Rank A.

[6] **Matthieu Dorier**, Robert Sisneros, Leonardo Bautista Gomez, Tom Peterka, Leigh Orf, Lokman Rahmani, Gabriel Antoniu, Luc Bougé. *Adaptive Performance-Constrained In Situ Visualization of Atmospheric Simulations*. In proceedings of IEEE International Conference on Cluster Computing (CLUSTER '16), Taipei, Taiwan, September 2016. CORE Rank A.

[7] Orcun Yildiz, **Matthieu Dorier**, Shadi Ibrahim, Rob Ross, Gabriel Antoniu. *On the Root Causes of Cross-Application I/O Interference in HPC Storage Systems,* inproceedings of the 2016 IEEE International Parallel & Distributed Processing Symposium (IPDPS '16), Chicago, May 2016. CORE Rank A (acceptance rate 23%) (https://hal.inria.fr/hal-01270630)

[8] **Matthieu Dorier**, Shadi Ibrahim, Gabriel Antoniu, Rob Ross. *Omnisc'IO: A Grammar-Based Approach to Spatial and Temporal I/O Patterns Prediction*, in Proceedings of ACM/IEEE 2014 Supercomputing Conference (SC '14), New Orleans, Nov. 2014. CORE Rank A (acceptance rate 21%) (https://hal.inria.fr/hal-01025670v1)

[9] **Matthieu Dorier**, Gabriel Antoniu, Rob Ross, Dries Kimpe. *CALCioM: Mitigating I/O Interference in HPC Systems through Cross-Application Coordination,* in Proceedings of the 2014 IEEE International Parallel & Distributed Processing Symposium (IPDPS '14), Phoenix, May 2014. CORE Rank A (acceptance rate 21%) (https://hal.inria.fr/hal-00916091v1)

[10] **Matthieu Dorier**, Robert Sisneros, Tom Peterka, Gabriel Antoniu, Dave Semeraro. *Damaris/Viz, a Nonintrusive, Adaptable and User-Friendly In Situ Visualization Framework*, in Proceedings of the 2013 IEEE Symposium on Large Data Analysis and Visualization (LDAV '13), Atlanta, October 2013. (acceptance rate 37%) (https://hal.inria.fr/hal-00859603v1)

[11] **Matthieu Dorier**, Gabriel Antoniu, Franck Cappello, Marc Snir, Leigh Orf. Damaris: How to Efficiently Leverage Multicore Parallelism to Achieve Scalable, Jitter-free I/O, in Proceedings of the 2012 IEEE

International Conference on Cluster Computing (CLUSTER '12), Beijing, September 2012. CORE Rank A (acceptance rate 28%) (https://hal.inria.fr/hal-00715252v1)

[12] Bogdan Nicolae, Diana Moise, Gabriel Antoniu, Luc Bougé, **Matthieu Dorier**. *BlobSeer: Bringing High Throughput under Heavy Concurrency to Hadoop Map/Reduce Applications*, in Proceeding of the 2010 IEEE International Parallel & Distributed Processing Symposium (IPDPS '10), Atlanta, September 2010. CORE Rank A (acceptance rate 24%) (https://hal.inria.fr/inria-00456801)

Peer-reviewed articles in international workshops

[13] Robert Latham, **Matthieu Dorier**, Robert Ross. *Get Out of the Way! Applying Compression to Internal Data Structures*, in Proceedings of the PDSW-DISC 2016 workshop (held in conjunction with SC 2016)

[14] **Matthieu Dorier,** Matthieu Dreher, Tom Peterka, Justin M. Wozniak, Gabriel Antoniu, Bruno Raffin. *Lessons Learned from Building In Situ Coupling Frameworks*, in Proceedings of the First workshop on In Situ Infrastructures for Enabling Extreme-scale Analysis and Visualization (ISAV '15) (held in conjunction with SC 2015) (https://hal.inria.fr/hal-01224846)

[15] Orçun Yildiz, **Matthieu Dorier**, Shadi Ibrahim, Gabriel Antoniu. *A Performance and Energy Analysis of I/O Management Approaches for Exascale Systems*, in Proceedings of the Sixth International Workshop on Data Intensive Distributed Computing (DIDC '14) (held in conjunction with HPDC 2014) (https://hal.inria.fr/hal-01076522v1)

Posters in international conferences

[16] Nathanael Cheriere, **Matthieu Dorier**, Rob Ross, Shadi Ibrahim. *Design and Evaluation of Topology-aware Scatter and AllGather Algorithms for Dragonfly Networks*. IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC '16), Salt-Lake City, November 2016.

[17] Dong Dai, Robert Ross, Dounia Khaldi, Yonghong Yan, **Matthieu Dorier**, Neda Tavakoli, Yong Chen. *A Cross-Layer Solution in Scientific Workflow System for Tackling Data Movement Challenge*. IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC '16), Salt-Lake City, November 2016.

[18] **Matthieu Dorier**, advised by G. Antoniu. *Efficient I/O using Dedicated Cores in Large-Scale HPC Simulations*. PhD forum of the 2013 IEEE International Parallel & Distributed Processing Symposium (IPDPS '13), Boston, May 2013 (https://hal.inria.fr/hal-00831296v1)

[19] **Matthieu Dorier**. *Damaris - Using Dedicated I/O Cores for Scalable Post-petascale HPC Simulations*, 2011 ACM/SIGARCH International Conference on Supercomputing (ICS '11), Tucson, April 2011. **2nd prize at the ACM Student Research Competition**. (https://hal.inria.fr/hal-00639157v1)

Research reports

[20] **Matthieu Dorier**, Shadi Ibrahim, Gabriel Antoniu, Rob Ross. On the Use of Formal Grammars to Predict HPC I/O Behaviors. 2015. RR-8725 (https://hal.inria.fr/hal-01149941v2)

[21] **Matthieu Dorier**, Robert Sisneros, Tom Peterka, Gabriel Antoniu, Dave Semeraro. A Nonintrusive, Adaptable and User-Friendly In Situ Visualization Framework. 2013. RR-8314 (https://hal.inria.fr/hal-00831265)

[22] **Matthieu Dorier**, Gabriel Antoniu, Franck Cappello, Marc Snir, Leigh Orf. Damaris: Leveraging Multicore Parallelism to Mask I/O Jitter. 2012. RR-7706 (https://hal.inria.fr/inria-00614597v3)

[23] **Matthieu Dorier,** Robert Sisneros, Leonardo Bautista Gomez, Tom Peterka, Leigh Orf, Rob Ross, Lokman Rahmani, Gabriel Antoniu, Luc Bougé. *Performance-Constrained In Situ Visualization of Atmospheric Simulations*. RR-8855 (https://hal.inria.fr/hal-01273718)

Theses

[24] *Addressing the Challenges of I/O Variability in Post-Petascale HPC Simulations*. PhD thesis Defended on December 9th, 2014 at INRIA Rennes (https://hal.inria.fr/tel-01099105v1)

[25] *On the Bene t of Dedicating Cores to Mask I/O Jitter in HPC Simulations*. Master thesis. Research internship conducted in 2011 at IRISA/INRIA Rennes, in the KerData Team, supervised by Gabriel Antoniu (https://hal.inria.fr/hal-00668136v1)

[26] *BlobSeerFS : un système de fichiers pour le calcul hautes performances sous Hadoop MapReduce*. Bachelor thesis. Internship conducted in 2009 at IRISA/INRIA Rennes, in the KerData Team, supervised by Luc Bougé.

Talks

In 2016
[Invited talk] Addressing the Challenges of I/O Variability in Post-Petascale HPC Simulations. Gilles Kahn Award ceremony of the Societé Informatique de France (Strasbourg, France, January 2016).

[Invited talk] Evaluation of Topology-Aware Broadcast Algorithms for Dragonfly Networks. Fifth workshop of the JLESC (Lyon, France, July 2016).

[Conference talk] Evaluation of Topology-Aware Broadcast Algorithms for Dragonfly Networks. IEEE Cluster 2016 (Taipei, Taiwan, September 2016).

[Conference talk] Adaptive Performance-Constrained In Situ Visualization of Atmospheric Simulations. IEEE Cluster 2016 (Taipei, Taiwan, September 2016).

In 2015
[Invited talk] Performance-Constrained In Situ Visualization of Atmospheric Simulations. Fourth workshop of the JLESC (Bonn, Germany, November 2015).

[Invited talk] How predictable are HPC applications, and why should we care? Bird of a Feather on Analyzing Parallel I/O (SC 2015, Austin, TX, USA).

[Workshop talk] Lessons Learned from Building In Situ Coupling Frameworks. ISAV 2015 (SC 15, Austin, TX, USA).

[Invited talk] An Introduction to HPC Storage and I/O. Second summer school of the JLESC/PUF (Barcelona, June 2015).

In 2014

[PhD defense] Addressing the Challenges of I/O Variability in Post-Petascale HPC Simulations. Defended on December 9th, 2014 at INRIA Rennes.

[Conference talk] Omnisc'IO: A Grammar-Based Approach to Spatial and Temporal I/O Patterns Prediction, ACM/IEEE 2014 Supercomputing Conference (SC '14), New Orleans, Nov. 2014.

[Conference talk] CALCioM: Mitigating I/O Interference in HPC Systems through Cross-Application Coordination, IEEE International Parallel & Distributed Processing Symposium (IPDPS '14), Phoenix, AZ, May 2014.

[Invited talk] Omnisc'IO: A Grammar-Based Approach to Spatial and Temporal I/O Patterns Prediction, Eleventh workshop of the JLPC, Sophia-Antipolis, France, June 2014.

[Invited talk] Damaris: Data Management for Scientific Simulations on Post-Petascale Supercomputers, Seminar at Inria Grenoble, invited by Bruno Raffin, June 2014.

In 2013

[PhD forum] Efficient I/O using Dedicated Cores in Large-Scale HPC Simulations, IPDPS 2013, Boston, May 2013.

[Invited talk] From Damaris to CALCioM: Mitigating I/O Interference in HPC Systems. Tenth workshop of the JLPC, Urbana-Champaign, IL, November 2013.

[Invited talk] In Situ Data Analysis and Visualization: Results with Damaris and Application to Ensemble Simulations, Ninth workshop of the JLPC, Lyon, France, June 2013.

[Internal talk] CALCioM: a Holistic, Machine-Wide Approach to I/O Management, Internal presentation for the MCS division at Argonne National Laboratory, August 2013.

[Internal talk] Dealing with Big Data on post-petascale machines: the Damaris approach, Inria D1 department seminar, Rennes, February 2013.

In 2012

[Conference talk] Damaris: How to Efficiently Leverage Multicore Parallelism to Achieve Scalable, Jitter-free I/O, IEEE CLUSTER 2012, Beijing, China, September 2012.

[Invited talk] I/O and in-situ visualization: recent results with the Damaris approach, Eighth workshop of the JLPC Argonne, IL, November 2012.

[Invited talk] Dealing with Big Data on post-petascale machines: the Damaris approach, Assises du Big Data (Club des Responsables Infrastructures et Production), Paris, October 2012.

[Invited talk] In-Situ Interactive Visualization of HPC Simulations with Damaris, Seventh workshop of the JLPC Rennes, France, June 2012

[Invited talk] Data Management for Scientific Simulations on Next-Generation Supercomputers, Ecole Normale Supérieure de Rennes, Alumni Gathering, Rennes, France, January 2012.

[Invited talk] Data management for scientific simulations on next-generation supercomputers, Internal meeting of the PRAC teams, NCSA, Urbana, IL, July 2013.

In 2011

[Conference talk] (ACM SRC) Damaris - Using Dedicated I/O Cores for Scalable Post-petascale HPC Simulations, International Conference on Supercomputing (ICS), Tucson, AZ, April 2011.

[Defense] Toward new I/O Approaches for Scalable Post-petascale HPC Simulations, Master defense, University of Rennes 1, June 2011.

[Invited talk] Update on Damaris: How CM1 Scales Linearly up to (Almost) 10K Cores And What Comes Next, Sixth workshop of the JLPC, Urbana, IL, November 2011.

[Invited talk] Damaris: Leveraging Multicore Parallelism to Mask I/O Jitter, Fifth workshop of the JLPC, Grenoble, France, June 2011.

[Invited talk] Vers de nouvelles approches pour les entrées/sorties en calcul haute performance, Ecole Normale Supérieure de Rennes, Alumni Gathering, Rennes, France, May 2011.

[Invited talk] Damaris: Leveraging Multicore Parallelism to Mask I/O Jitter, Evaluation of the JLPC, Paris, France, June 2011.