Jean-Baptiste Keck

Computer science engineer, PhD in applied mathematics

Contact

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Languages

French mother tongue
English TOEIC 910
German B1 level

Programming

Linux environment
Python, C/C++
CUDA, OpenCL
MPI, OpenMP

Tools

Vim, CMake, Git
Docker, CI/CD,
Amazon EC2

Software

Maple, Matlab, Scilab
Gimp, Inkscape, IPE
Blender, LuxRender

Objective

I am currently working at the Jean Kuntzmann laboratory as postdoctoral researcher. My fields of interest are numerical simulation, imaging and more broadly any domain that targets high-performance computing, especially distributed computing on GPU accelerators and other coprocessors. I am also interested in the dimensioning and setup of compute clusters.

Interests

GPGPU, HPC, scientific modelling, numerical simulation, computational fluid dynamics, imaging, optimization, optimal transport, data science, wavelets, non-imaging optics.

Education

2015-2019   **PhD Thesis in Applied Mathematics** Jean Kuntzmann laboratory, Grenoble, France
Numerical modelling and High Performance Computing for sediment flows
Supervisors: Georges-Henri Cottet, Iraj Mortazavi and Christophe Picard.
🏆 Numerical Simulation Trophy 2019 awarded by Usine Nouvelle.
📜 High Performance Computing Certificate (C3I) issued by GENCI.

2014-2015   **Master of Science in Industrial and Applied Mathematics**
Grenoble-Alpes University, UFR IM²AG, Grenoble, France
Specialization in mathematical modelling and scientific computing.

2012-2015   **Superior National School of Applied Mathematics and Computer Science**
Grenoble Institute of Technology - Ensimag, Grenoble, France
Three years of studies in applied mathematics and computer science leading to a master degree. Specialization in modelling, imaging and simulation.

2010–2012   **Classes Préparatoires aux Grandes Écoles** Lycée Kléber, Strasbourg, France
Preparation for national competitive entrance exams leading to French "grandes écoles". Specialization in mathematics, physics and engineering.

Experience

2020-2021   **Postdoctoral research** Jean Kuntzmann laboratory, Grenoble, France
Research and development for the design of optical components (mirrors and lenses) in nonimaging optics setups. Implementation of a numerical optimizer that solves optical inverse problems using optimal transport and automatic differentiation. Distributed multi-GPU implementation using Python and Torch to solve large problems.

2015-2019   **Doctoral research** Jean Kuntzmann laboratory, Grenoble, France
Numerical modelling and high performance computing for sediment flows. Development of a high-performance scientific library in Python, OpenCL and C++ dedicated to hybrid distributed computing in fluid dynamics. Performed 2D and 3D DNS simulations of Navier-Stokes and coupling with sediment transport. The numerical solver is based on semi-Lagrangian, spectral and finite differences methods and performs on-the-fly OpenCL code generation and compilation from symbolic expressions. Automatic performance tuning of the generated code depending on target hardware architecture.

2018-2019   **Teaching assistant**   Grenoble Institute of Technology - Ensimag, Grenoble, France
Academic teaching assistant in charge of teaching Ensimag engineering students as well as MSIAM international master students. Topics: introduction to Unix, numerical methods, image processing, `C++` programming and high performance computing.

2016-2018   **Consulting expertise**   Ingéliance, Bordeaux, France
Training and support for a company specialized in numerical simulation. Training of engineers in the concepts of parallelism, coprocessors and distributed computing. Support for the administration of the compute cluster, advisor for hardware and sofware upgrades; also performed system benchmark. Duration of the mission: 32 days / year.

04–10 2015   **Volcanic lava simulation and rendering**   Master Thesis, LJK/INRIA labs, France
The goal of the internship was to simulate, process and adapt simulation data in order to propose a graphical representation of an effusive eruption on the Piton de la Fournaise volcano. Simulation of eruption scenarios on complex terrain topographies by using the C++ finite element based numerical solver Rheolef. Use of a viscoplastic complex fluid model taking into account height-averaged thermal effects. Performed dynamic texture generation in CUDA in conjuction with OpenGL for rendering.

02–04 2015   **Medical imaging software development**   Internship, Imactis, Grenoble, Franche
Contributed to improve the start-up product written in C++ by developing alternative medial imaging viewing techniques to visualize the path of a curved needle in a preoperative 3D CT scan. Real-time feedback of the biopsy needle curvature and display of the sections of its anticipated trajectory on the `Imactis CT-Navigation system`.

01-02 2015   **Scattered data interpolation using wavelet trees**   Wavelet projet, Ensimag
Implemented incremental signal approximation from scattered point data by using Deslauriers-Dubuc interpolating wavelet trees in C++. The goal was to obtain a numerical interpolation method such that approximation error locally only depends on local sample density.

01-02 2015   **High performance particle flocking**   HPC and GPU project, Ensimag
High performance simulation of boids by using efficient spatial data structures such as octrees. Implementation of hybrid MPI and CUDA parallelism in C++ able to handle the simulation of the flocking behaviour of birds.

10–11 2014   **Pollution visualization**   Scientific visualization project, Ensimag
Interpolation of scattered air pollution concentration data in the Grenoble region and visualization in google-earth. Generation of level lines by a marching squares algorithm. Use of DevIL and Eigen libraries as well as Keyhole Markup Language (KML).

06-07 2014   **Real time electrophysiological simulation**   Speciality project, Ensimag
Simulation and real-time visualization of cardiac cells on GPU. Use of finite differences on Cartesian grids. Performed domain splitting to obtain a multi-GPU solver. This project was carried out in C++ with the OpenCL and OpenGL standards and Qt4.

02-06 2014   **3D medical image reconstruction**   TIMC-IMAG laboratory, Grenoble, France
Efficient reconstruction of an isotropic 3D volume from localized 2D ultrasound images. The main objective was the rapid reconstruction of the volume, for a clinical application, with the help of GPU hardware acceleration. Performed a multi-GPU implementation of reconstruction algorithms such as Pixel Nearest Neighbor (PNN) volume filling in C++ and CUDA.

02–05 2014   **3D Graphics - Submarine scene generation**   3D graphics project, Ensimag
Generation and rendering of an underwater scene whose elements are either physically simulated or procedurally generated. All the underwater physics is simulated in CUDA, the scene includes a particle system to generate the bubbles that rise to the surface and mass-spring systems to animate algaes. The surface of the water is animated on CPU by using a spectral method. Ocean floor and caves are procedurally generated at each iteration using a marching cube and texture generation algorithm implemented in OpenGL shaders.

Peer-reviewed journal articles

Feb. 2021   **Double-diffusive sedimentation at high Schmidt numbers**
Jean-Baptiste Keck, Georges-Henri Cottet, Eckart Meiburg, Iraj Mortazavi, Christophe Picard
Physical Review Fluids, 2021, vol. 6, no 2, p. L022301 (impact factor 2.5)

Jan. 2021   **Morphological bases of phytoplankton energy management and physiological responses unveiled by 3D subcellular imaging**
Clarisse Uwizeye, Johan Decelle, Pierre-Henri Jouneau, Serena Flori, **Jean-Baptiste Keck**, Benoit Gallet, Davide Dal Bo, Christine Moriscot, Claire Seydoux, Fabien Chevalier, Nicole L. Schieber, Rachel Templin, Guillaume Allorent, Florence Courtois, Gilles Curien, Yannick Schwab, Guy Schoehn, Samuel C. Zeeman, Denis Falconet, Giovanni Finazzi
Nature communications, 2021, vol. 12, no 1, p. 1-12 (impact factor 12.1)

Conferences

Jul. 2019   **International Congress on Industrial and Applied Mathematics**
Conference talk, ICIAM 2019, Valencia, Spain

Dec. 2018   **High Performance Computing Center Day**
Conference talk, CCRT 2018, CEA, Bruyères-le-Châtel, France

Oct. 2018   **International Conference on Vortex Flow Mechanics**
Conference talk, ICVFM 2018, Xi'an, China

Sep. 2018   **Ingéliance's 20th Anniversary Ceremony**
Poster presentation, Bordeaux, France

Oct. 2017   **Tec21 Winter school: multiscale approaches in fluid mechanics**
Poster presentation, Grenoble, France

Academic teaching

2018-2019	**Numerical methods**	48h - 1A Ensimag, Grenoble, France
2018-2019	**Introduction to Unix**	15h - 1A Ensimag, Grenoble, France
2018-2019	**C++ programming**	32h - 2A Ensimag, Grenoble, France
2018-2019	**Image processing**	15h - 2A Ensimag, Grenoble, France
2018-2019	**Algorithms and software tools**	36h - M1 MSIAM, UFR IM²AG, Grenoble, France
2018-2019	**High Performance Computing**	36h - M1 MSIAM, UFR IM²AG, Grenoble, France

Company teaching

2017-2018	**Using the the HySoP library**	Ingéliance, Bordeaux, France
2017-2018	**Introduction to the MPI standard**	Ingéliance, Bordeaux, France
2016-2017	**Introduction to coprocessors**	Ingéliance, Bordeaux, France
2016-2017	**Parallelism: culture and new technologies**	Ingéliance, Bordeaux, France