

Jean-Baptiste Keck

Computer science engineer, PhD in applied mathematics



Contact

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Professional webpage:



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- **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 techniques. 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 software 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 conjunction with OpenGL for rendering.
- 02–04 2015 **Medical imaging software development** Internship, Imactis, Grenoble, France
Contributed to improve the start-up product written in C++ by developing alternative medical imaging viewing techniques to visualize the path of a curved needle in a pre-operative 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 flocks 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 algae. 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.

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