

# GUILLAUME BARNIER

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## SUMMARY

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- > Expert in machine learning, scientific computing for applied mathematics, and optimization of high-dimension nonlinear inverse problems
- > Strong interest and knowledge in reinforcement learning algorithms
- > Excellent high-performance computing (HPC) skills with deep knowledge of graphics processing units (GPU) programming with C++/CUDA (8 years of experience)
- > Won the 2019 “Best Paper Presented by a Student at the Annual Meeting” award from the Society of Exploration Geophysicists (SEG)

## ACADEMIC EXPERIENCE

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Stanford University, Ph.D. in Geophysics (GPA 3.960)	Exp. 2021
Colorado School of Mines, MSc. in Geophysics (GPA 4.000)	2013
Télécom Paris University, MSc. in Electrical Engineering (GPA 3.600)	2007

## MACHINE LEARNING SKILLS

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- > ML coursework: Reinforcement Learning (CS 234), Deep Learning (CS 230), Machine Learning (CS 229),
- > Mathematics coursework: Stochastic Processes (MATH 136), Stochastic Differential Equations (MATH 236)
- > Programming: C++, CUDA, Fortran, pybind11, Unix, MPI, Dask, HTML, CSS
- > Deep Learning Frameworks: Python, NumPy, PyTorch, some use of Keras and TensorFlow

## RESEARCH EXPERIENCE

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### Deep Learning, Computer Vision and Healthcare

- > Stanford Radiology and Neuroimaging Department (Prof. E. Tong) Jan. 2021 – Present
  - Initiated and led a project to predict brain tissue damage for ischemic stroke patients using deep supervised learning based on convolutional neural nets (CNN) and 4D computed tomography perfusion (CTP) data
  - Developed an approach to bypass the use of costly and potentially unreliable commercial software packages
  - Method may have profound impact on stroke imaging by improving diagnostic reliability and making CTP technique more widely available and equitable

### Deep Reinforcement Learning and Computer Vision

- > Personal Project Jan. 2021 – Present
  - Currently implementing and reproducing a model-based reinforcement learning algorithm for Atari proposed by Kaiser et al. (2020)

## Geophysical Seismic Imaging

- > Stanford Exploration Project, Stanford Geophysics (Prof. B. Biondi) 2013 – Present
  - **Research interests:** optimization of large-scale non-convex inverse problems, seismic imaging and velocity-model building algorithms, efficient implementations of numerical schemes with GPUs
  - **Main thesis contributions:**
    - (1) Designed a novel loss function formulation and a robust gradient-descent method to mitigate the presence of spurious local minima in a high-dimension prominent challenging seismology problem referred to as full waveform inversion
    - (2) Developed an industry-quality and efficient GPU numerical implementation of thesis algorithm for 3D field datasets (tens of terabytes of data, billions of unknown parameters)
    - (3) Successfully applied method on a deep-water ocean bottom node acquisition 3D field survey

## Numerical Methods for Wave Propagation

- > Dunham Group, Stanford Geophysics (Prof. E. Dunham) 2015 – 2017
  - Developed an early-warning tsunami modeling and prediction algorithm using a data assimilation technique with Kalman filters
  - Applied method to a 2D tsunami model based on dynamic rupture simulations of the 2011 Tohoku earthquake
  - Accurately reconstructed tsunami wavefield prior to wave arrival at the coast

## INDUSTRY EXPERIENCE

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### Seismic Imaging Research Consultant

- > Self-initiated Industry Partnerships 2018 – 2021
  - Successfully approached and convinced management of three major oil companies to invest in personal imaging algorithm and deployed solution on companies' computing infrastructures

### Seismic Imaging Research Intern

- > BP America - Houston TX, USA Summers 2016 and 2017
  - Deployed Ph.D. algorithm on HPC system and showed value for image quality enhancement in complex geological settings
- > Chevron - San Ramon, CA, USA Jun. 2015 – Sep. 2015
  - Improved and applied a Bayesian uncertainty estimation technique based on the Metropolis-Hastings algorithm for oil reserve quantification
- > Total – Pau, France Jun. 2012 – Sep. 2012
  - Analyzed and identified optimal reservoir-characterization solution (among three software packages) adequate to the team's needs and budget, convinced management committee to follow selection recommendation

### Fixed Income Hedge Fund Structurer

- > J.P. Morgan – London, UK 2007– 2010
  - Provided pricing, trade executions, and financial advice on interest rates derivative products to major investment firms including Pacific Investment Management Company (PIMCO)
  - Took the initiative to develop a novel interest-rate swaps modeling code with improved flexibility and accuracy (compared to available commercial package), which became the team's primary tool for asset pricing

## LANGUAGES

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French/English (bilingual), Spanish (fluent), Hebrew (beginner), Bahasa Indonesia (basics)

## AWARDS AND ACHIEVEMENTS

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### Academics

- > 2019 Award for Best Paper Presented by a Student at the Society of Exploration Geophysicists (SEG)
- > 2013 Colorado School of Mines Mendenhall Award for outstanding academic achievement
- > 2012 Colorado School of Mines Hess Corp Fellowship

### Trail-running

- > 2018 First place overall, Spartan Race Diablo Grande Super Open
- > 2018 First place overall, Inside Trail Pacifica Foothills Trail Half Marathon
- > 2015 First place overall, Mount Diablo Coastal Trail Runs Half Marathon

## PUBLICATIONS

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- E. Biondi, G. Barnier, R. G. Clapp, F. Picetti, S. Farris, An object-oriented optimization framework for large-scale inverse problems: Computers & Geosciences (accepted).
- Barnier, G. and Biondi, E., 2020. Full waveform inversion by model extension using a model-space multi-scale approach. In SEG Technical Program Expanded Abstracts 2020 (pp. 646-650). Society of Exploration Geophysicists.
- Biondi, E. and Barnier, G., 2020. Elastic-parameter estimation by combining full-waveform inversion by model extension and target-oriented elastic inversion. In SEG Technical Program Expanded Abstracts 2020 (pp. 735-739). Society of Exploration Geophysicists
- Barnier, G., Biondi, E. and Clapp, R., 2019. Waveform inversion by model reduction using spline interpolation. In SEG Technical Program Expanded Abstracts 2019 (pp. 1400-1404). Society of Exploration Geophysicists. **Won award for Best Paper Presented by a Student.**
- Yang, Y., Dunham, E.M., Barnier, G. and Almquist, M., 2019. Tsunami wavefield reconstruction and forecasting using the ensemble Kalman filter. Geophysical Research Letters, 46(2), pp.853-860.
- Barnier, G., Biondi, E. and Biondi, B., 2018. Full waveform inversion by model extension. In SEG Technical Program Expanded Abstracts 2018 (pp. 1183-1187). Society of Exploration Geophysicist.
- Biondi, E., Biondi, B. and Barnier, G., 2018. Target-oriented elastic full-waveform inversion through extended-migration redatuming. In SEG Technical Program Expanded Abstracts 2018 (pp. 1228-1232). Society of Exploration Geophysicists.
- Barnier, G., Biondi, E. and Biondi, B., 2018, June. A Modified Approach for Tomographic Full Waveform Inversion Using Variable Projection. In 80th EAGE Conference and Exhibition 2018 (Vol. 2018, No. 1, pp. 1-5). European Association of Geoscientists & Engineers.
- G. Barnier, E. Biondi, and B. Biondi, 2017, A modified approach to tomographic full-waveform inversion: SIAM Imaging Symposium, Rice University, Houston.
- Biondi, E., Barnier, G. and Biondi, B., 2017. Preconditioned elastic full-waveform inversion with approximated Hessian. In SEG Technical Program Expanded Abstracts 2017 (pp. 1654-1658). Society of Exploration Geophysicists.
- Barnier, G. and Dunham, E.M., 2016, December. Tsunami Modeling and Prediction Using a Data Assimilation Technique with Kalman Filters. In AGU Fall Meeting Abstracts (Vol. 2016, pp. NH41A-1754).

- Revil, A., Barnier, G., Sava, P.C., Jardani, A. and Kulesa, B., 2014, December. Seismoelectric coupling in partially water-saturated porous media: From the theory to the detection of saturation fronts. In AGU Fall Meeting Abstracts (Vol. 2014, pp. NS31D-06).
- Revil, A., Barnier, G., Karaoulis, M., Sava, P., Jardani, A. and Kulesa, B., 2014. Seismoelectric coupling in unsaturated porous media: theory, petrophysics, and saturation front localization using an electroacoustic approach. *Geophysical Journal International*, 196(2), pp.867-884.
- Barnier, G., 2013. Detecting electrical and hydraulic heterogeneities using seismic focusing and seismoelectric conversions (MSc. dissertation, Colorado School of Mines).

## **INVITED CONFERENCE PRESENTATIONS**

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- "Full waveform inversion by model extension using a model-space multi-scale approach" at the 89th SEG Annual meeting 2020, invited speaker at the post-convention workshop "Low-frequency FWI: How low do we need to go?" (Houston, USA).
- "Extended imaging for robust velocity-model building and elastic target-oriented full-waveform inversion", invited speaker at the 8th Chevron FWI workshop 2019 (Houston, USA).
- "Exploiting the entire data bandwidth by extended imaging for avoiding cycle skipping and elastic target-oriented inversion" at the 88th SEG Annual meeting 2019, invited speaker at the post-convention workshop "Value of High-frequency FWI Models" (San Antonio, USA).
- "Full Waveform Inversion by Model Extension", invited speaker at the 2019 SIAM Conference on Mathematical and Computational issue in the Geosciences (Houston, USA).
- "Effects of top-salt picking inaccuracies on subsalt image quality" at the 85th SEG Annual meeting 2015, invited speaker at the post-convention workshop "Challenges and Opportunities in Subsalt Imaging" (New Orleans, USA).