Jacques Bourg

| @ | | Antony, 92160 FR

Summary

Experienced data scientist with extensive experience doing data analysis, mathematical modeling, simulations, machine learning and signal and image processing. I am autonomous, able to dig into a scientific bibliography, conceive algorithms and elaborate concise presentations.

Professional experiences

Computer vision engineer / image analyst Paris, FR

Institut Pasteur *Since 11/ 2024*

- Implementation of image processing pipelines to quantify spatially RNA expression by fluorescence (FISH). Collaborations: Nedelec lab: HOX expression patterns . SANOFI: LNP vaccines.
- **Keywords**: Python, Napari. Image processing. Deep learning. Omics. Fluorescence imaging.

Data scientist (senior) Paris, FR

Depixus SAS *10/ 2021 - 08/ 2024*

- Implementation of new functionalities in a proprietary software of industrial quality in Python. Unitary tests. Code reviews.
- Development of a library in Python for data analysis of magnetic tweezers experiments (∼4000 lines of code). Documentation in Sphinx.
- Propose and led a project on experiment optimization (probabilistic and chemical modeling), in order to maximize the experiment time and the concentration of the reagents, in force cycle experiments. Verified models with an experimentalist.
- Developed graphical user interfaces allowing to make simulations of my models. Deployment on an internal server. Python : Panel and Holoviews ; Julia and Makie. Linux : screen.
- Design, implement and coordinate a benchmarking change point detection methods (∼3600 lines of code, unitary tests, Gitlab) . Integration of a state of the art library (Ruptures). Conception of signal processing algorithms: drift removal, and noisy trials detection, for quality control. Used in production for drug testing.
- Elaboration of functional block diagrams of the instrument.
- Computer vision project on detection and localization of landmarks on a cartridge (F1-score = 0.9). Pipeline conception, algorithm development and benchmarking.
- Conception of an algorithm to analyse the strips width, as the camera moves stepwise, in order to determine the focal point. Used in the firsts prototypes of the machine Magna. Collaboration with a physicist and an instrumentation engineer to understand and improve the signal. Elaboration of experimental protocols to verify the algorithms.
- Computer vision project: registration of cartridge's canal and bubble segmentation.
- Experiment optimization: measure of single-molecule interactions (chemical constants). Determine the number of measures needed to obtain a given precision and the experiment time. Compute the time needed to attain the permanent regime, in order to measure the interaction strength. Continuous time Markov process. Realization of an autoencoder in Pytorch to infer the states (high or low) present in the signal.

Postdoctoral researcher Paris, FR

CNRS and Pasteur Institute, Audition Institute. *2017 – 2021*

- Mathematical models of learning of a behavioral task of auditory discrimination. Measure, analysis and modeling of different areas of auditory system. **Keywords**: Two photon microscopy, data analysis, software.

Teaching Paris and Orsay, FR

Paris Diderot and Paris Sud University. *2018 – 2021*

- 'Neuron biophysics' and 'Perception and sensory coding', (8h/year) to physics masters students and medical students from INSERM school.

Doctoral researcher Lisbon, PT

Champalimaud neuroscience programme. *2012 – 2017*

- Statistical analysis of electro-physiological data from auditory cortex during desynchronized state. Modeling of the activity using linear dynamical systems theory (normal and non-normal dynamics). Developed a technique to assess the statistical significance of principal components. **Keywords**: biophysical modeling, PCA, Fourier, analysis, electrophysiological signals, Matlab.

Research engineer in signal processing Saclay, FR

Commissariat à l´ énergie atomique et aux énergies alternatives (CEA). *2010 – 2011*

- Early recognition of explosive compounds using recursive least squares. **Keywords**: Matlab, Graphical user interfaces, handling databases, Kalman filtering.

Intern in image processing Curitiba, BR

Universidade Tecnológica Federal do Paraná *2010 (6 months)*

- Elaboration of an image segmentation pipeline using Mean-Shift clustering.

Training

PhD in data analysis and modeling: "Amplification in cortical networks" Lisbon, PT

Universidade Nova de Lisboa, Champalimaud Neuroscience Programme *2009 – 2010*

Research master degree: signal and image processing Lyon, FR

INSA Lyon, UCBL Lyon 1, Centrale Lyon *2009 – 2010*

Electrical engineering. Lyon, FR

INSA Lyon. *2005 – 2010*

Scientific publications and dissertations

Amplification in cortical networks. Jacques Bourg. Universidade Nova de Lisboa. [1]

Multilaminar networks of cortical neurons integrate common inputs from sensory thalamus. N. Morgensten, **J. Bourg**, L. Petreanu. **Nature Neuroscience.** [2]

Cortical recruitment determines learning dynamics and strategy. S. Ceballo* , **J. Bourg***, A. Kempf* et al. (*co-first author). **Nature Communications**. [3]

Targeted Cortical Manipulation of Auditory Perception. S. Ceballo, Z. Piwkowska, **J. Bourg** et al. **Neuron**. [4]

Combinatorial identities using Bernoulli graphs. **J. Bourg**. **ArXiv**. [5]

A spatial code for temporal information is necessary for efficient sensory learning. S. Bagur*, **J. Bourg*** et al. (*co-first author) **Science Advances**. [6]

Technical Skills

Languages: Python, Matlab, SQL, Julia.
Developer Tools: GitLab, Conda, Visual Studio Code.
Standard libraries: Pandas, NumPy, Matplotlib, Scipy, Scikit-Learn, Pytorch, Open CV, Sphinx, Panel, Holoviews, SnakeViz, Multiprocessing, Napari.

Other

Languages: French, Spanish (mother tongues), English (fluent), Portuguese (fluent).
Scientific and technical interests: Machine learning, image and signal processing, algorithmics, neuroscience, molecular biology, mathematics, bio-medical industry.
Selected talks and posters at international conferences : 2019, 2014: Society for Neurosciences, Washington DC, Chicago (USA). 2019: Advances for auditory neuroscience, Chicago (USA). 2018: GDR Neural Net, Strasbourg. 2016, 2022: Cosyne, Salt Lake City (USA).