Benjamin Billot

Postdoc at MIT in medical image computing

Medical Vision Group
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Education

2018 - 2022 **PhD in medical image computing** Centre for Medical Image Computing, University College London, UK
Thesis: Bridging generative models and CNNs for domain-agnostic segmentation of brain MRI
Advisor: Juan Eugenio Iglesias
Thesis committee: John Ashburner (University College London), Ben Glocker (Imperial College London)

2016-2017 **MSc in biomedical engineering** Imperial College London, UK
Thesis: Physics-based generative models in low data regime: segmentation of cortical microscopies.
Advisor: Anil Bharath

2014-2016 **Diplôme d'ingénieur** CentraleSupélec, France
Project: Cancellation of respiratory motions for accurate chest CT reconstruction

Experience

2022 - now **Postdoctoral researcher** Medical Vision Group, Massachusetts Institute of Technology, USA
Equivariant networks and denoising CNNs to decouple spatial and intensity features for motion tracking in fetal MRI
Advisor: Polina Golland

2017-2018 **Intern, AI team** Founders Factory, London, UK
Project: R-CNN for automated navigation of HTML pages
Advisor: Jeff Ng

Summer 2016 **Research assistant** Institute of Psychiatry and neuroscience of Paris, INSERM, France
Project: Physics-based generative models in low data regime: segmentation of cortical microscopies.
Advisors: Therese Jay and Marco Pompili

Summary of publications

10	**Journal articles**	3 as first author, 4 as second author
10	**Conference articles** (with full-length peer-reviewed proceedings)	5 as first author, 1 as second author
1	**Conference abstract**	1 as first author

Honours and awards

2022-2023 **Outstanding reviewer, honourable mentions**
MICCAI 2022, MICCAI 2023

2019-2020 **Short-listed for best paper award**
MIDL 2019, MIDL 2020

2019 **CMIC platform grant**
£4,000 awarded for a 6-month visit at MIT as a PhD student (cancelled due to Covid)

Professional activities

OPEN SOURCE SOFTWARES AND CODE MAINTENANCE

SynthSeg	Domain-agnostic segmentation of brain scans	FreeSurfer GitHub	surfer.nmr.mgh.harvard.edu/fswiki/SynthSeg github.com/BBillot/SynthSeg
SynthSR	Tool to turn any brain scan into a 1mm T1 scan	FreeSurfer GitHub	surfer.nmr.mgh.harvard.edu/fswiki/SynthSR github.com/BBillot/SynthSR
Hypo_seg	Segmentation of the hypothalamic subunits	FreeSurfer GitHub	surfer.nmr.mgh.harvard.edu/fswiki/HypothalamicSubunits github.com/BBillot/hypothalamus_seg

MENTORING

2023 - now **Ramya Muthukrishnan** - PhD student, MIT,
Equivariant networks for robust registration of fetal brain MRI time-series
Co-supervised with Polina Golland

2022 **Jeffrey Pagaduan** – PhD student, Palacky University, Czech Republic
Alteration in Morphology of hypothalamus with mild cognitive impairment (journal paper under review)

2018 – 2019 **Bo hyun Song** - MSc student, UCL, UK
Simulation of histological artefacts in medical images
Co-supervised with Juan Eugenio Iglesias

REVIEWING

Journals IEEE Transactions on Medical Imaging, Medical Image Analysis, IEEE Transactions on Pattern Analysis and Machine Intelligence, NeuroImage, Imaging Neuroscience, Human Brain Mapping, Frontiers in Neuroscience, Neuroradiology, Journal of Neurology, NeuroImage Clinical, Journal of Nuclear Medicine

Conferences MICCAI (2021-2023)
MIDL (2022, 2023)
IPMI (2023)
DGM4H NeurIPS Workshop (2023)

TEACHING

2018 **Introductory Mathematics for Computer Science** (10x1h30) University College London, UK

WORKSHOP ORGANISATION

2023 **Programme chair and organisation committee**
4th Boston Medical Imaging Workshop

PRESS

2023 **Physics world article**
AI creates high-resolution brain images from low-field strength by Cynthia E Keen

SOCIETY MEMBERSHIP

2020 - now **MICCAI member**

Presentations

ORALS AT CONFERENCES

2021 **ISBI 2021** Nice, France (virtual)
Joint segmentation of MS lesions and brain anatomy in brain MRI scans of any contrast and resolution

2020 **MICCAI 2020** Lima, Peru (virtual)
Partial volume segmentation of brain MRI scans of any resolution and contrast

2020 **MIDL 2020** Montreal, Canada (virtual)
A learning strategy for contrast-agnostic MRI segmentation

2016 **Human brain project 4th summer school** Obergurgl, Austria
Physics-based generative models in low data regime: application to segmentation of cortical microscopies

INVITED PRESENTATIONS AT WORKSHOPS

2020 **UCL/King's College/Imperial College bio-imaging symposium** London, UK
A learning strategy for contrast-agnostic segmentation of brain MRI scans

INVITED PRESENTATIONS AT SEMINARS

2023 **ARAMIS lab seminars** Paris, France (virtual)
Domain-agnostic brain MRI segmentation and equivariant networks for registration of fetal MRI time-series

2023 **Martinos center lab seminars** Boston, USA (virtual)
SynthSeg$^+$: robust segmentation of heterogeneous clinical brain MRI scans

2023 **LEMoN group lab seminars** Boston, USA
Robust segmentation of heterogeneous clinical brain MRI scans

2022 **CMIC-WEISS seminars** London, UK (virtual)
SynthSeg: domain randomisation for segmentation of brain MRI of any contrast and resolution

2021 **Biomedical imaging and analysis seminars (MIT)** Boston, USA (virtual)
SynthSeg: domain randomisation for segmentation of brain MRI of any contrast and resolution

2020 **LCN group seminars** Boston, USA (virtual)
Partial volume segmentation of brain MRI scans of any resolution and contrast

2020 **CMIC-WEISS seminars** London, UK (virtual)
A learning strategy for contrast-agnostic MRI segmentation

Publications

JOURNAL PAPERS

Robust machine learning segmentation for large-scale analysis of heterogeneous clinical brain MRI datasets
B. Billot, C. Magdamo, Y. Cheng, S. E. Arnold, S. Das, J. E. Iglesias
PNAS: *Proceedings of the National Academy of Sciences* (2023)

Linking brain structure, cognition, and sleep: insights from clinical data
R. Wei, W. Ganglberger, H. Sun, P. Hadar, R. L. Gollub, S. Pieper, **B. Billot**, R. Au, J. E. Iglesias, S. S. Cash, S. Kim, C. Shin, B. Westover, R. J. Thomas
Sleep (2023)

SynthSR: a public AI tool to turn heterogeneous clinical brain scans into high-resolution T1-weighted images for 3D morphometry
J. E. Iglesias, **B. Billot**, Y. Balbastre, C. Magdamo, S. E. Arnold, S. Das, B. L. Edlow, D. Alexander, P. Golland, B. Fischl
Science Advances (2023)

SynthSeg: segmentation of brain MRI scans of any contrast and resolution without retraining
B. Billot, D. N. Greve, O. Puonti, A. Thielscher, K. Van Leemput, B. Fischl, A. V. Dalca, J. E. Iglesias
Medical Image Analysis (2023)

Quantitative brain morphometry of portable low-field-strength MRI using super-resolution machine learning
J. E. Iglesias, R. Schleicher, S. Laguna, **B. Billot**, P. Schaefer, B. McKaig, J. N. Goldstein, K. N. Sheth, M. S. Rosen, W. T. Kimberly
Radiology (2022)

In vivo hypothalamic regional volumetry across the frontotemporal dementia spectrum
N. L. Shapiro, E. G. Todd, **B. Billot**, D. M. Cash, J. E. Iglesias, J. D. Warren, J. D. Rohrer, M. Bocchetta
NeuroImage Clinical (2022)

A deep learning toolbox for automatic segmentation of subcortical limbic structures from MRI images
D. N. Greve, **B. Billot**, D. Cordero, A. Hoopes, M. Hoffmann, A. V. Dalca, B. Fischl, J. E. Iglesias, J. C. Augustinack
NeuroImage (2021)

SynthMorph: learning contrast-invariant registration without acquired images
M. Hoffmann, **B. Billot**, D. N. Greve, J. E. Iglesias, B. Fischl, A. V. Dalca
IEEE Transactions on Medical Imaging (2021)

Joint super-resolution and synthesis of 1mm isotropic MPRAGE volumes from clinical MRI exams with scans of different orientation, resolution and contrast
J. E. Iglesias, **B. Billot**, Y. Balbastre, A. Tabari, J. Conklin, R. G. Gonzalez, D. Alexander, P. Golland, B. L. Edlow, Bruce Fischl, ADNI
NeuroImage (2021)

Automated segmentation of the hypothalamus and associated subunits in brain MRI
B. Billot, M. Bocchetta, E. Todd, A. V. Dalca, J. D. Rohrer, J. E. Iglesias
NeuroImage (2020)

FULLY PEER-REVIEWED CONFERENCE PROCEEDINGS

AnyStar: domain randomized universal star-convex 3D instance segmentation
N. Dey, M. Abulnaga, **B. Billot**, E. Abaci Turk, P. E. Grant, A. V. Dalca, P. Golland
WCACV: *Winter Conference on Applications of Computer Vision* (2024)
Early accept

Domain-agnostic segmentation of thalamic nuclei from joint structural and diffusion MRI
H. Tregidgo, S. Soskic, M. D. Olchanyi, J. Althonayan, **B. Billot**, C. Maffei, P. Golland, A. Yendiki, D. C. Alexander, M. Bocchetta, J. D. Rohrer, J. E. Iglesias
MICCAI: *Medical Image Computing and Computer-Assisted Intervention* (2023)
Early accept

Equivariant and denoising CNNs to decouple intensity and spatial features for motion tracking in fetal brain MRI
B. Billot, D. Moyer, N. Karani, M. Hoffmann, E. Abaci Turk, E. Grant, P. Golland
MIDL: *Medical Image with Deep Learning* (2023), short paper track

Robust segmentation of brain MRI in the wild with hierarchical CNNs and no retraining
B. Billot, C. Magdamo, S. E. Arnold, S. Das, J. E. Iglesias
MICCAI: *Medical Image Computing and Computer-Assisted Intervention* (2022)

Super-resolution of portable low-filed MRI in real scenarios: integration with denoising and domain adaptation
S. Laguna, R. Schleicher, **B. Billot**, P. Schaefer, B. McKaig, J. N. Goldstein, K. N. Sheth, M. S. Rosen, W. T. Kimberly, J. E. Iglesias
MIDL: *Medical Image with Deep Learning* (2022), short paper track

Joint segmentation of multiple sclerosis lesions and brain anatomy in MRI scans of any contrast and resolution
B. Billot, S. Cerri. K. Van Leemput, A. V. Dalca, J. E. Iglesias
ISBI: *International Symposium on Biomedical Imaging* (2021)
Oral presentation

Learning MRI contrast-agnostic registration
M. Hoffmann, **B. Billot**, J. E. Iglesias, B. Fischl, A. V. Dalca
ISBI: *International Symposium on Biomedical Imaging* (2021)
Oral presentation

Partial volume segmentation of brain MRI scans of any contrast and resolution
B. Billot, E. Robinson, A. V. Dalca, J. E. Iglesias
MICCAI: *Medical Image Computing and Computer-Assisted Intervention* (2020)
Oral presentation, early accept

A learning strategy for contrast-agnostic MRI segmentation
B. Billot, D. N. Greve, K. Van Leemput, B. Fischl, A. V. Dalca, J. E. Iglesias
MIDL: *Medical Image with Deep Learning* (2020)
Short-listed for best paper award, oral presentation

Image synthesis with a convolutional capsule generative adversarial network
C. Bass, T. Dai, **B. Billot**, K. Arulkumaran, A. Creswell, C. Clopath, V. De Paola, A. A. Bharath
MIDL: *Medical Image with Deep Learning* (2019)
Short-listed for best paper award, oral presentation

Deep reinforcement learning for subpixel neural tracking
T. Dai, M. Dubois, K. Arulkumaran, J. Campbell, C. Bass, **B. Billot**, F. Uslu, V. De Paola, C. Clopath, A. A. Bharath
MIDL: *Medical Image with Deep Learning* (2019)
Spotlight

CONFERENCE ABSTRACTS

Physics-based generative models in low data regime: application to segmentation of cortical microscopies
B. Billot, C. Bass, A. A. Bharath
Human brain project 4th summer school, Obergurgl, Austria
Oral presentation

THESES

Benjamin Billot
Bridging generative models and convolutional neural networks for domain-agnostic segmentation of brain MRI
Ph.D. Thesis, University College London, September 2022

Benjamin Billot
Physics-based generative models in low data regime: application to segmentation of cortical microscopies
MSc Thesis, Imperial College London, September 2016