



# 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    **Data Scientist**    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

12	<b>Journal articles</b>	3 as first author, 4 as second author
10	<b>Conference articles</b> (with peer-reviewed proceedings)	5 as first author, 1 as second author
1	<b>Conference abstract</b>	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

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### SOFTWARE RELEASE, CODE MAINTENANCE, AND ACTIVE SUPPORT

<b>SynthSeg</b>	Domain-agnostic segmentation of brain scans	FreeSurfer <a href="https://surfer.nmr.mgh.harvard.edu/fswiki/SynthSeg">surfer.nmr.mgh.harvard.edu/fswiki/SynthSeg</a> GitHub <a href="https://github.com/BBillot/SynthSeg">github.com/BBillot/SynthSeg</a> Matlab <a href="https://mathworks.com/products/matlab.html">mathworks.com/products/matlab.html</a> TorchIO <a href="https://torchio.readthedocs.io">torchio.readthedocs.io</a>
<b>SynthSR</b>	Tool to turn any brain scan into a 1mm T1 scan	FreeSurfer <a href="https://surfer.nmr.mgh.harvard.edu/fswiki/SynthSR">surfer.nmr.mgh.harvard.edu/fswiki/SynthSR</a> GitHub <a href="https://github.com/BBillot/SynthSR">github.com/BBillot/SynthSR</a>
<b>Hypo_seg</b>	Segmentation of the hypothalamic subunits	FreeSurfer <a href="https://surfer.nmr.mgh.harvard.edu/fswiki/HypothalamicSubunits">surfer.nmr.mgh.harvard.edu/fswiki/HypothalamicSubunits</a> GitHub <a href="https://github.com/BBillot/hypothalamus_seg">github.com/BBillot/hypothalamus_seg</a>

### MENTORING

2023 - now	<b>Ramya Muthukrishnan</b> - PhD student, MIT, Equivariant networks for robust registration of fetal brain MRI time-series Co-supervised with Polina Golland
2022	<b>Jeffrey Pagaduan</b> – PhD student, Palacky University, Czech Republic Alteration in Morphology of hypothalamus with mild cognitive impairment (journal paper under review)
2018 – 2019	<b>Bo hyun Song</b> - MSc student, UCL, UK Simulation of histological artefacts in medical images Co-supervised with Juan Eugenio Iglesias

### REVIEWING

<b>Journals</b>	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
<b>Conferences</b>	MICCAI (2021-2023), MIDL (2022, 2023), IPMI (2023), DGM4H NeurIPS Workshop (2023)

### TEACHING

2018	<b>Introductory Mathematics for Computer Science</b> (10x1h30)	University College London, UK
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### WORKSHOP ORGANISATION

2023	<b>Programme chair and organisation committee</b> 4th Boston Medical Imaging Workshop
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### PRESS

2023	<b>PhysicsWorld press release</b> <i>AI creates high-resolution brain images from low-field strength</i> by Cynthia E Keen
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### SOCIETY MEMBERSHIP

2020 - now	<b>MICCAI member</b>
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## Invited Presentations

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2023-2024	<b>Domain agnostic brain MRI segmentation and equivariant networks for 3D motion tracking</b> ARAMIS lab seminars IMAGES seminars (Télécom Paris) EPIONE seminars (INRIA) MICS seminars (CentraleSupélec)	Paris, France (virtual) Paris, France Nice, France Paris, France
2023	<b>SynthSeg+: robust segmentation of heterogeneous clinical brain MRI scans</b> Martinos center lab seminars LEMoN group lab seminars	Boston, USA (virtual) Boston, USA
2021	<b>SynthSeg: domain-agnostic segmentation of brain MRI</b> Biomedical imaging and analysis seminars (MIT) CMIC-WEISS seminars	Boston, USA (virtual) London, UK (virtual)
2020	<b>Partial volume segmentation of brain MRI scans of any resolution and contrast</b> LCN group seminars	Boston, USA (virtual)
2020	<b>A learning strategy for contrast-agnostic MRI segmentation</b> UCL/King's College/Imperial College bio-imaging symposium CMIC-WEISS seminars	London, UK (virtual) London, UK

## Publications

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### 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)

*Brain Growth Charts for Quantitative Analysis of Pediatric Brain MRI Scans with Limited Imaging Pathology*

J. Schabdach, J. Schmitt, S. Sotardi, A. Vossough, S. Andronikou, T. Roberts, H. Huang, V. Padmanabhan, A. Ortiz-Rosa, M. Gardner, S. Covitz, S. Bedford, A. Mandal, B. Chaiyachati, S. White, E. Bullmore, R. Bethlehem, R.

Shinohara, **B. Billot**, J. Iglesias, S. Ghosh, R. Gur, T. Satterthwaite, D. Roalf, J. Seidlitz, A. Alexander-Bloch

Radiology (2023)

*Machine learning of dissection photographs and surface scanning for quantitative 3D neuropathology*

H. Gazula, H. Tregidgo, **B. Billot**, Y. Balbastre, J. William-Ramirez, R. Herisse, L. Deden-Binder, A. Casamitjana, E. Melief, C. Latimer, M. Kilgore, M. Montine, E. Robinson, E. Blackburn, M. Marshall, T. Connors, D. Oakley, M.

Frosch, Sean I. Young, K. Van Leemput, A. Dalca, B. Fischl, C. Mac Donald, C. Keene, B. Hyman, and J. E. Iglesias

eLife (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)

## 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-fielded 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 (2017)

**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 2017