

# JOSEPH BRUNET

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## EDUCATION

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**École des Mines de Saint-Étienne, France**

*Nov 2017 - Mar 2021*

Ph.D. in Biomechanics

**Paris Descartes University, France**

*Sep 2016 - Oct 2017*

Master of Science - MS, Biomedical Engineering - Major in Biomechanics

**École Nationale Supérieure d'Arts et Métiers, France**

*Sep 2014 - Oct 2017*

Master's Degree in Mechanical Engineering

## RESEARCH EXPERIENCE

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**Senior Postdoctoral Research Associate** | University College London (UCL),

*Sep 2022 - Present*

*Funded by the Chan Zuckerberg Initiative*

Senior Research Fellow in ultra-high resolution quasi-dynamic X-ray imaging of human organs and joints using synchrotron tomography

- Visiting scientist at the European Synchrotron Radiation Facility (ESRF)
- Locally lead and co-ordinate the development of the HiP-CT technique at ESRF, performing HiP-CT scans using the latest developments
- Managing other UCL staff and students at ESRF (1 PDRA and, act as local UCL manager for ESRF staff funded by UCL (currently 4 staff))
- Ownership of the local activities of the HiP-CT project at ESRF, coordinating interactions with ESRF Staff, the 8 other Co-Investigator organisations, and the over 30 supporting groups
- Technical leadership. To develop and apply imaging analysis techniques, especially digital volume correlation, to interpret quasi-dynamic biological system behaviour
- Coordinate the local budget of UCL at ESRF for the HiP-CT related projects
- Co-supervision PhD/MSc students, acting as local supervisor whilst they are doing placements at ESRF

**Postdoctoral Research Associate** | University College London (UCL),

*Sep 2021 - Sep 2022*

*Funded by the Chan Zuckerberg Initiative*

Research Fellow in ultra-high resolution quasi-dynamic X-ray imaging of human organs and joints using synchrotron tomography

- Visiting scientist at the European Synchrotron Radiation Facility (ESRF)
- Preparation of biological human and animal samples for quasi-dynamic biological scanning
- Perform Hierarchical Phase-Contrast Tomography (HiP-CT) scans at the European Synchrotron Radiation Facility (ESRF)
- Development of a quasi-dynamic experimental setup to perform in situ testing on coronary stent expansion in a complete heart
- Development and application of imaging analysis techniques, in particular digital volume correlation, to interpret quasi-dynamic biological system behaviour

**PhD Researcher** | École des Mines de Saint-Étienne, France

*Nov 2017 - Sept 2021*

*Funded by the European Research Council*

Advisors: Pierre Badel, Éric Maire

Thesis: Understanding the mechanisms of aortic dissection: finite element modeling and *in situ* experimentation with X-ray tomography

- Collection and manipulation of arterial tissue from pigs and rabbits
- Tensile and peeling tests to assess the elastic and fracture properties of the tissue
- Development of a tension-inflation device fitting inside an X-ray tomography setup and its computer interface
- In situ 3D imaging of the dissection of pressurized arterial segments by X-ray microtomography and synchrotron-based phase-contrast imaging
- Modeling of the observed failure phenomena using the extended finite element method

**Research intern** | Medtronic, France

*Jul 2017 - Nov 2017*

Experimental and numerical study on meshes for abdominal hernia repair

- Uniaxial, biaxial, and indentation tests on different type of textiles
- Modeling the observed mesh behaviors with a nonlinear, anisotropic, plastic model

**M.S. Researcher** | École des Mines de Saint-Étienne, France

*Jan 2017 - Jul 2017*

Advisor: Pierre Badel

Thesis: Investigation of shear delamination during rupture of arterial medial tissue using cohesive numerical model

## PUBLICATIONS

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1. **Brunet J.**, A. C. Cook, C. L. Walsh, J. Cranley, P. Tafforeau, K. Engel, C. Berruyer, E. Burke OLeary, A. Bellier, R. Torii, C. Werlein, D. D. Jonigk, M. Ackermann, K. Dollman, P. D. Lee., 2024. Multidimensional Analysis of the Adult Human Heart in Health and Disease using Hierarchical Phase-Contrast Tomography (HiP-CT). *Radiology*. 312, 1. doi: 10.1148/radiol.232731.  
Cover of the July 2024 issue.
2. A. Mirone, **J. Brunet**, R. Boistel, M. Sowinski, C. Berruyer, H. Payno, E. Boller, P. Paleo, C. L. Walsh, P. D. Lee, P. Tafforeau., 2024. Eikonal phase retrieval: Unleashing the fourth generation sources potential for enhanced propagation based tomography on biological samples. Preprint. doi: 10.48550/ARXIV.2311.14745
3. E. Yagis, S. Aslani, Y. Jain, Y. Zhou, S. Rahmani, **J. Brunet**, A. Bellier, C. Werlein, M. Ackermann, D. Jonigk, P. Tafforeau, P. D. Lee, C. Walsh., 2024. Deep Learning for Vascular Segmentation and Applications in Phase Contrast Tomography Imaging. Preprint. doi: 10.48550/ARXIV.2311.13319
4. Xian, R. P., **Brunet J.**, Huang Y., Wagner L. W., Lee D. L., Tafforeau P., and Walsh L. C., 2024. A closer look at high-energy X-ray-induced bubble formation during soft tissue imaging. *Synchrotron Radiation*, 31(3), pp.566-577. doi:10.1107/s160057752400290x. (Co-first author)
5. Ackermann, M., Tafforeau P., **Brunet J.**, Kamp J. C., Werlein C., Khnel M. P., Jacob J. et al., 2023. Comment on: Intrapulmonary shunt and alveolar dead space in a cohort of patients with acute COVID-19 pneumonitis and early recovery. *European Respiratory Journal*, 61(2). doi: 10.1183/13993003.02121-2022
6. **Brunet, J.**, Walsh, C. L., Wagner, W. L., Bellier, A., Werlein, C., Marussi, S., Jonigk, D. D., Verleden, E. S., Ackermann, M., Lee, D. P., Tafforeau, P., 2023. Preparation of large biological samples for high-resolution, hierarchical, multi-modal imaging. *Nature Protocols*, 18, 14411461. doi: 10.1038/s41596-023-00804-z
7. **Brunet, J.**, Pierrat, B., Adrien, J., Maire, E., Lane, B. A., Curt, N., Bravin, A., Laroche, N., Badel, P., 2022. In situ visualization of aortic dissection propagation in notched rabbit aorta using synchrotron X-ray tomography. *Acta Biomaterialia*, 155, pp.449-460. doi: 10.1016/j.actbio.2022.10.060

8. **Brunet, J.**, Pierrat, B., Badel, P., 2021. A parametric study on factors influencing the onset and propagation of aortic dissection using the extended finite element method. *IEEE Transactions on Biomedical Engineering*, 68(10), pp.2918-2929. doi: 10.1109/TBME.2021.3056022
9. **Brunet, J.**, Pierrat, B. and Badel, P., 2021. Review of current advances in the mechanical description and quantification of aortic dissection mechanisms. *IEEE Reviews in Biomedical Engineering*, 14, pp.240-255. doi: 10.1109/RBME.2019.2950140
10. **Brunet, J.**, Pierrat, B., Adrien, J., Maire, E., Curt, N., Badel, P., 2020. A Novel Method for In Vitro 3D Imaging of Dissecting Pressurized Arterial Segments Using X-Ray Microtomography. *Experimental Mechanics Sp Iss: Experimental Advances in Cardiovascular Biomechanics*, 61, pp.147-157. doi: 10.1007/s11340-020-00645-x
11. **Brunet, J.**, Pierrat, B., Adrien, J., Maire, E., Badel, P., 2019. A combined experimental-numerical lamellar-scale approach of tensile rupture in arterial medial tissue using X-ray tomography. *Journal of the mechanical behavior of biomedical materials*, 95, pp.116-123. doi: 10.1016/j.jmbbm.2019.03.028.

## INVITED TALKS

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1. "Creating The Human Organ Atlas with HiP-CT" Invitation for oral presentation at the **Big Data and Big Science** workshop organized by University of the Witwatersrand, Johannesburg, South-Africa. Date: May 8th, 2024
2. "Human Organ Atlas project : High-resolution imaging of whole human organs and application on COVID-19" Invitation for oral presentation at the **XXVimes Jours Francophones de Virologie**, Brussels, Belgium. Date: April 11th, 2024
3. "In situ quantification of the mechanical behavior of arteries using synchrotron X-ray tomography" Invitation for oral presentation at the **GDR Matriaux Fibreux - Caractrisation, modlisation et optimisation (GDR CNRS FIBMAT)**, Lyon, France. Date: December 1st, 2023
4. "Hierarchical Phase-Contrast Tomography for High-Resolution imaging of Ex Vivo Whole Adult Human Heart in Health and Disease" Oral presentation delivered at the **BioMedEng23**, Swansea University, Swansea, UK. Date: September 14th, 2022
5. "BM18, the new ESRF-EBS beamline for multiresolution phase-contrast tomography on large samples : past, present and future" Invitation for key-lecture presentation at the "High-resolution imaging in correlative workflows" workshop organized by Zeiss given at the **Technical University of Munich**, Munich, Germany. Date: July 3rd, 2023
6. "X-ray imaging at BM18 - Human Organ atlas project" Seminar given at **Ecole des Mines de Saint-Etienne**, Saint-Etienne, France. Date: July 3rd, 2023
7. "Imaging of whole human organs using Hierarchical Phase-Contrast Tomography (HiP-CT)" Invitation for oral presentation at the **6th Annual Workshop on Advances in X-ray imaging**, Harwell, UK. Date: June 22nd, 2023
8. "Human Organ Atlas project: Whole Human Organs Imaged in Synchrotrons" Invitation for oral presentation at workshop ("**3D image analysis From Foundation to Vision**") at the Center for Quantification of Imaging Data from MAX IV (QIM), Copenhagen, Denmark. Date: March 10th, 2023

9. "Imaging of whole human organs using Hierarchical Phase-Contrast Tomography (HiP-CT)" Oral presentation delivered at the ImagingBioPro Network Workshop (Leveraging Next-Gen Multiscale Imaging at Central Facilities for Biomedical Engineering Research) at the **BioMedEng22**, University College London, London. Date: September 9th, 2022
10. "In situ quantification of the mechanical behavior of coronary arteries during angioplasty using synchrotron X-ray tomography in intact porcine hearts" Oral presentation delivered at the **BioMedEng22**, University College London, London. Date: September 9th, 2022
11. "Imaging of whole human organs using Hierarchical Phase-Contrast Tomography (HiP-CT)" Seminar given at **Witwatersrand University**, Johannesburg, South Africa. Date: September 6th, 2022
12. "High-resolution imaging of the whole human heart using synchrotron x-ray tomography" Oral presentation delivered at the **5th International Conference on Tomography of Materials and Structures (ICTMS)**, Grenoble, France. Date: July 25th, 2022
13. "3D characterization of crack propagation during the onset of a dissection using X-ray microtomography on pressurized aortic segments" Oral presentation delivered at the **26th Congress of the European Society of Biomechanics**, Online. Date: July 13th, 2021
14. "Hierarchical imaging of complete human organs, how the EBS changed the game" Oral presentation at the **Science Day Symposium**, ESRF, France. Date: March 21st, 2022
15. "Investigation of notch propagation in an in-vitro dissection model using X-ray microtomography" Oral presentation delivered at the **45th Congress of the Societe de Biomecanique**, Online. Date: October 27th, 2020
16. "A numerical design of the experiment approach to understand aortic dissection onset and propagation" Oral presentation delivered at the **44th Congress of the Societe de Biomecanique**, Poitiers, France. Date: October 29th, 2019
17. "Chairman of the session 'Macro-scale biofluids'" **44th Congress of the Societe de Biomecanique**, University of Poitiers, France. Date: October 28th, 2019
18. "A new approach combining experiment and numerical simulation using a cohesive interface to model tensile failure in arterial medial tissue at the meso-scale" Poster presentation delivered at the **8th World Congress of Biomechanics**, Dublin, Ireland. Date: July 9th, 2018
19. "Characterization and modeling of rupture in arterial medial tissue under tension from in situ experiments with X-ray tomography" Oral presentation delivered at the **15th International Symposium on Computer Methods in Biomechanics and Biomedical Engineering**, Lisbon, Portugal. Date: March 28th, 2018

## GRANTS

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- 2024 Human Organ Atlas Hub (HOAHub) £1,000,000 worth of beamtime, Co-investigator
- 2024 HiP-CT beamtime MD-1252 and MD-1290 (12 beamtimes) £1,000,000 worth of beamtime Co-investigator
- 2023 Human Organ Atlas Hub (HOAHub) £1,000,000 worth of beamtime, Co-investigator
- Sept 2022 April 2023 Proof of Concept Awards (PoCAs) delivered by ImagingBioPro Network. £25,000 PI

- 2023 HiP-CT beamtime MD-1252 and MD-1290 (12 beamtimes) £1,000,000 worth of beamtime Co-investigator
- 2020 - ESRF Beamtime LS-2904 - £80,000 PI

## TEACHING EXPERIENCE

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<b>Co-Supervisor of 6 MS students, ESRF/UCL</b>	<i>2021 - 2023</i>
Projects: Mechanical testing / Image processing and analysis / Deep learning	
<b>Provide training to PhD students and Post docs at ESRF</b>	<i>2021 - 2023</i>
Subjects: sample preparation, scan acquisition, image reconstruction	
<b>Supervisor of 2 MS students, École des Mines de Saint-Étienne</b>	<i>2018 - 2020</i>
Industrial and research projects	
<b>Teaching Assistant, École des Mines de Saint-Étienne (140 hours)</b>	<i>2018 - 2020</i>
Courses: Experimental mechanics, Finite element method	
<b>Tutor for students in difficulty, Saint-Exupery middle school, Macon</b>	<i>2015 - 2016</i>
Courses: Mathematics and Physics	

## AWARDS

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<b>Travel Grants for Invited Talks</b> (6 - equivalent to approx. £3600)	<i>2018 - 2024</i>
Awarded travel grants to present research at international conferences or workshops	
<b>1st prize poster competition</b> (£300). CiET Mid-term review, University College London. March, 2024	
<b>Camille Mathieu Award</b> (5000€). Handitecam, Arts et Mtiers. December, 2017	

## INSTITUTIONAL CITIZENSHIP

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<b>UCL representative at at ESRF</b>	<i>2018 - 2020</i>
Locally lead and coordinate research activities, provide assistance to new staff for settling in, facilitate collaboration between UCL and ESRF teams, and ensured smooth operational workflows.	
<b>Responsible for health and safety compliance of the project at ESRF</b>	<i>2018 - 2020</i>
Handling human organ samples, dealing with substances like ethanol, formalin, and the inherent risks of X-ray radiation	
<b>Guest Lecturer in Engineering Schools</b>	<i>2022 - 2024</i>
Delivered presentations on current research and academic opportunities in the sciences to undergraduate engineering students. Aims to inspire students to consider careers in academia.	
<b>PhD student representative</b>	<i>2018 - 2020</i>
Board of the Doctoral School of Science, Engineering and Health of the University of Lyon	
<b>PhD student representative</b>	<i>2018 - 2020</i>
Board of SAINBIOSE laboratory (INSERM)	
<b>President of the Saint-Étienne Doctoral Students' Club</b>	<i>2018 - 2019</i>

## REFERENCES

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Peter Lee, Prof  
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