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ALLENA Rachele

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Born 09/01/1981
French and italian nationality

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CV

- 2016 Accueil en Délégation CNRS at Institut Jacques Monod
- 2015 Habilitation à Diriger des Recherches at Université Pierre et Marie Curie
- 2011 - ... Assistant Professor at Ecole Nationale Supérieure d'Arts et Métiers Paris
- 2010 - 2011 Post doctoral fellow Marie Curie -INTERPOD at Center for Genomic Regulation Barcelona
- 2009 - 2010 Post doctoral fellow CNRS at Centrale Supélec
- 2009 PhD in Biomechanics at Centrale Supélec
- 2005 M2 in Mechanics at Politecnico di Torino
- 2004 M2 internship at University of Illinois at Chicago
- 2003 Erasmus fellowship at Institut Polytechnique de Grenoble

Research

I am mostly interested in investigating the interactions between cells and their mechanical environment and the consequences such interactions may have not only at the microscale but also at the meso and macroscale. To do so I develop computational multiphysics models which allow to simulate several mechanobiological phenomena such as bone remodelling, single and collective cell migration in different configurations (ie confinement, durotaxis, etc...)

- Computational mechanics
- Mechanobiology
- Bone remodelling
- Cell mechanics
- 2D and 3D cell migration
- Collective cell migration

Scientific supervision

- 1 post doc
- Jamie Frame (2016-2017) - Computational modelling of osseointegration of hydrogel implants

2 on going PhD

- Nicolas Ruyssen (expected 2022)
- Thomas Thenard (expected 2021)

3 PhD

- Solenne Deveraux (2015-2018) - [Modélisation de la mécanique de la cellule et son noyau dans le cadre de la migration confinée](#)
- Mary Schmitt (2012-2015) - [Analyses expérimentales et modélisation numérique de l'ostéogenèse au sein d'un implant poreux en titane.](#)
- Samy Bendaya (2011-2014) - Etude comparative des paramètres pelviens, acétabulaires et fémoraux proximaux des hanches natives asymptomatiques, chez les coxarthroses et après PTH. Analyse par système EOS

11 M2 students

Teaching

I started teaching in 2005 as a Teacher Assistant at the University of Illinois at Chicago, then as a Lecturer from 2006 to 2010 at Centrale Supélec and since 2011 as Assistant Professor at the Ecole Nationale Supérieure d'Arts et Métiers de Paris. I have been teaching both in english and french at different levels (Licence, M1, M2) for lectures, tutorials and practical works. Here is a list of the main courses I have provided so far:

- Cell mechanics, adhesions and motility (lectures)
- Mechanical behaviour of biological tissues (lectures and practical works)
- Finite Elements (lectures and tutorials)
- Mechanics (lectures and tutorials)
- Differential Equations (lectures and tutorials)
- Numerical Analysis (tutorials)
- Statistics (tutorials)
- MicroElectroMechanical Systems (tutorials)
- Cell and Tissue Engineering (practical works)
- Bioinstrumentation (practical works)

Funding

- 2018 - 2022 Prime d'Encadrement Doctoral et de Recherche
- 2013 - 2017 Prime d'Excellence Scientifique
- 2016 'Coup de Pouce' of the Fédération Francilienne de Mécanique (50 k€)
- 2015 Fellowship of the Isaac Newton Institute for Mathematical Sciences (3 k€)
- 2015 Fellowship of the Gruppo Nazionale per la Fisica Matematica (3 k€)

Responsibilities

- 2018 - ... Secretary of the Politecnico di Torino Alumni in Paris Association
- 2017 - ... Co-chair of the Biomécanique axis of the Fédération Francilienne de Mécanique
- 2013 - ... Co-chair of the Biomaterials and Biodevices track of the [BioMedical Engineering Track](#)
- 2012 - 2015 Chair of the Unité d'Enseignement d'Expertise de Bioingénierie

Papers

1. **R. Allena**, C. Cluzel [Computational implementation of non-uniform orthotropic directions in the femoral diaphysis based on cortical bone microstructure to build a constitutive model](#), (2021)
2. T. Thenard, A. Catapano, **R. Allena**, M. El May, N. Saintier, M. Mesnard [Topography and wettability characterization of surfaces manufactured by SLM and treated by chemical etching](#), (2020)
3. T. Thenard, A. Catapano, M. Mesnard et **R. Allena** [A Cellular Potts energy-based approach to analyse the influence of the surface topography on single cell motility](#), (2020)
4. D. George, **R. Allena**, C. Bourzac, S. Pallu, M. Bensidhoum, H. Portieret Y. Rémond [How mechanobiological modelling of cellular activities can predict bone density evolution?](#), (2020)
5. D. George, **R. Allena**, C. Bourzac, S. Pallu, M. Bensidhoum, H. Portieret Y. Rémond [A new comprehensive approach for bone remodeling under medium and high mechanical load based on cellular activity](#), (2020)
6. S. Mondésert-Deveraux, D. Aubry, **R. Allena** [In silico approach to quantify nucleus self-deformation on micropillared substrates](#), (2019)
7. D. George, **R. Allena**, Y. Rémond [Integrating molecular and cellular kinetics into a coupled continuum mechanobiological stimulus for bone reconstruction](#), (2019)
8. J. Frame, P.-Y. Rohan, L. Corté, **R. Allena** [A mechano-biological model of multi-tissue evolution in bone](#), (2019)
9. P. Davidson, G. Fedorchack, S. Mondésert-Deveraux, E. Bell, P. Isermann, D. Aubry, **R. Allena**, J. Lammerding [High-throughput microfluidic micropipette aspiration device to probe time-scale dependent nuclear mechanics in intact cells](#), (2019)
10. **R. Allena**, C. Cluzel [Heterogeneous directions of orthotropy in three-dimensional structures: finite element description based on diffusion equations](#), (2018)
11. D. George, **R. Allena**, Y. Rémond [A multiphysics stimulus for continuum mechanics bone remodeling](#), (2018)
12. C. Cluzel, **R. Allena** [A general method for the determination of the local orthotropic directions of heterogeneous materials: application to bone structures using CT images](#), (2018)
13. **R. Allena** [The discriminant role of mechanics during cell migration](#), (2018)
14. D. George, **R. Allena**, Y. Rémond [Cell nutrients and motility for mechanobiological bone remodeling in the context of orthodontic periodontal ligament deformation](#), (2018)
15. J. Frame, P.-Y. Rohan, L. Corté, **R. Allena** [Optimal bone structure is dependent on the interplay between mechanics and cellular activities](#), (2018)
16. S. Mondésert-Deveraux, **R. Allena**, D. Aubry [A coupled friction-poroelasticity model of chimneying shows that confined cells can mechanically migrate without adhesions](#), (2018)
17. S. Mondésert-Deveraux, **R. Allena**, D. Aubry [A numerical model suggests the interplay between nuclear plasticity and stiffness during a perfusion assay](#), (2017)
18. J. Frame, P.-Y. Rohan, L. Corté, **R. Allena** [Mechanobiological stimuli for bone remodeling: mechanical energy, cell nutrients and mobility](#), (2017)

19. S. Bendaya, C. Anglin, J.-Y. Lazennec, **R. Allena**, P. Thoumie, W. Skalli [Good vs poor results after total hip arthroplasty: an analysis method using implant and anatomic parameters with the EOS imaging system](#), (2016)
20. **R. Allena**, M. Scianna, L. Preziosi [A Cellular Potts Model of single cell migration in presence of durotaxis](#), (2016)
21. M. Schmitt, **R. Allena**, T. Schouman, S. Frasca, J.-M. Collombet, P. Rouch [Diffusion model to describe osteogenesis within a porous titanium scaffold](#), (2016)
22. **R. Allena**, H. Thiam, M. Piel, D. Aubry [A mechanical model to investigate the role of the nucleus during confined cell migration](#), (2015)
23. S. Mondésert-Deveraux, **R. Allena**, D. Aubry [Viscoelastoplastic model of cell nucleus under compression](#), (2015)
24. **R. Allena** [Computational modelling of cell mechanics: from osteogenesis down to collective and single cell migration](#), (2015)
25. D. Aubry, M. Gupta, B. Ladoux, **R. Allena** [Mechanical link between durotaxis, cell polarity and anisotropy during cell migration](#), (2015)
26. S. Bendaya, J.-Y. Lazennec, C. Anglin, **R. Allena**, N. Sellam, P. Thoumie, W. Skalli [Healthy vs. osteoarthritic hips: A comparison of hip, pelvis and femoral parameters and relationships using the EOS® system](#), (2015)
27. C. Cluzel, **R. Allena** [Modelling of anisotropic cortical bone based on degradation mechanism](#), (2015)
28. D. Aubry, H. Thiam, M. Piel, **R. Allena** [A computational mechanics approach to assess the link between cell morphology and forces during confined migration](#), (2015)
29. **R. Allena**, P. K. Maini [Reaction–diffusion finite element model of lateral line primordium migration to explore cell leadership](#), (2014)
30. **R. Allena**, C. Cluzel [Identification of anisotropic tensile strength of cortical bone using Brazilian test](#), (2014)
31. **R. Allena** [Mechanical modelling of confined cell migration across constricted-curved micro-channels](#), (2014)
32. **R. Allena**, D. Aubry, J. Sharpe [On the mechanical interplay between intra-and inter-synchronization during collective cell migration: a numerical investigation](#), (2013)
33. M. Schmitt, P. Rouch, Y. Tillier, T. Schouman, **R. Allena** [Diffusion–reaction model to describe osteogenesis within a titanium scaffold](#), (2013)
34. **R. Allena**, J. Muñoz, D. Aubry [Diffusion-reaction model for Drosophila embryo development](#), (2013)
35. **R. Allena** [Cell migration with multiple pseudopodia: temporal and spatial sensing models](#), (2013)
36. **R. Allena**, D. Aubry [A purely mechanical model to explore amoeboid cell migration](#), (2012)
37. **R. Allena**, D. Aubry [‘Run-and-tumble’ or ‘look-and-run’? A mechanical model to explore the behavior of a migrating amoeboid cell](#), (2012)
38. **R. Allena**, D. Aubry [An extensive numerical simulation of the cephalic furrow formation in Drosophila embryo](#), (2012)
39. **R. Allena**, D. Aubry [Coupling ALE Technique and Harmonic Parametrization to Describe Concurrent and Successive Elementary Cell Deformations](#), (2011)
40. **R. Allena**, D. Aubry [A novel technique to parametrize shell-like deformations inside biological membranes](#), (2011)
41. **R. Allena**, A.-S. Mouronval, D. Aubry [Simulation of multiple morphogenetic movements in the Drosophila embryo by a single 3D finite element model](#), (2011)
42. **R. Allena** [Numerical simulation of morphogenetic movements in Drosophila embryo](#), (2009)

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