# Stéphane Lejeunes, PhD, Habil

**Research Engineer at CNRS, Part-time lecturer at Centrale Marseille**
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## Education

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| 2019 | **Habilitation**. *Advanced modeling and numerical simulation for elastomers* https://tel.archives-ouvertes.fr/tel-02115239v1. Aix-Marseille Université. |
| 2006 - 2002 | **PhD Thesis.** *Modeling of laminated elastomer structures with a model reduction method.* http://tel.archives-ouvertes.fr/tel-00090600v1. Université de la Méditérranée. |
| 2002 - 2001 | **Master of Sciences** in solid mechanics (DEA de mécanique). École Supérieure de Mécanique de Marseille. |
| 2001 - 1999 | **Engineer degree**, Centrale Marseille |

## Work experience

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| since 2008 | **Research Engineer** CNRS, laboratoire de mécanique et d'acoustique, LMA UMR-7031. |
| since 2019 | **Part time lecturer** at Centrale Casablanca & Seatech Toulon. |
| since 2010 | **Part time lecturer** at Centrale Marseille |
| 2007 | **Post-Doc** CNRS, laboratoire de mécanique et d'acoustique. |
| 2005 - 2007 | **Teaching assistant**, applied mathematics, Ecole Centrale Marseille |

## Research interests

- **Modeling of elastomers**. key-words: finite-strain, nearly-incompressibility, non-linear viscoelasticity, damping, phenomenological models, fatigue, Payne and Mullins effects, damage, microstructure, homogenization and micro-mechanics.

- **Multi-physics couplings**. key-words: thermo-mechanics, thermo-chemo-mechanics, thermal ageing, thermodynamical framework, variational formulations.

- **Numerical models and methods**. key-words: finite-elements, isogeometric analysis, space-time methods, advanced software concepts.

## Current teaching interests

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| since 2010 | Centrale Marseille: course on the mechanical behavior of materials at finite strain, M2. practice of FE with Abaqus, M2. |
| since 2020 | Seatech Toulon: practical sessions on the simulation of structures with Finite Elements, M1 |
| since 2021 | Centrale Casablanca: course on applied mathematics for engineers, L3 |

## Main professional activities and responsibilities

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| 2018 - 2023 | **Co-head** of the Materials and Structures research group. |
| since 2018 | **Member of the excutive committee** of the LMA. |

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| since 2021 | **Member of COMOP**, operational committee of MISTRAL (joint laboratory CEA-CNRS-ECM). |
| since 2019 | **Scientific expert** for the HCERES (7 committees). |
| since 2007 | **Reviewer** for national funding agency (ANR) and for international journals: Applied Mathematical Modelling, Biomechanics and Modeling in Mechanobiology, Composites Structures, Comptes rendus Mécanique, Continuum Mechanics and Thermodynamics, International Journal of Solids and Structures, Matériaux & Techniques, Mechanics of Materials, Polymer testing, Polymers, Experimental Mechanics, Materials, Journal on Rubber Research, Journal of Industrial Textiles. |
| since 2019 | **Member of habilitation/Phd** thesis juries **Member of juries** for the recruitement of engineers (CNRS) |

## Organization of congress and symposia

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| 2023 | **Member** of the organizing committee of IGA2023, Insa Lyon. |
| 2023 | **Member** of the organizing committee of the Workshop on Soft Material Models, Centrale Casablanca. |
| 2021 | **Member** of the organizing committee of VIGA2021 (online conference). |
| 2020 | **Co-organizer** of minisymposium MS331: Advanced modelling and simulation for polymers, $14^{th}$ WCCM (World Congress in Computational Mechanics), Paris |
| 2017 | **Co-organizer** of WMBR, 1st Europeen Workshop on the modeling of the multi-physcis behavior of rubbers, Marseille |
| 2016 | **Co-organizer** of ELASTO2016: $4^{th}$ national meeting on the experimental characterization of elastomers |
| 2010 | **Member** of the organizing committee, CE2M10 (école d'été CNRS changement d'échelles en mécanique des matériaux) Briançon. |
| 2009 | **Member** of the organizing committee, CFM Marseille |
| 2007 | **Member** of the organizing committee, ECCMR (European Conference on Constitutive Models for Rubber) Paris |

## Master and Doctoral Theses supervised

PhD Theses:

- *Lucas Salmon*, CEA, 2022-2025. "Modeling of the damage in pellet for fast neutron reactor and identification by image analysis".

- *Sébastien D'Andréa*, CEA, 2020-2023. "Multiphysical modeling of the pellet to cladding interface for transient events in a nuclear reactor".

- *Fabrice Kévine Feutang*, 2020-2023, "Modeling and numerical simulation of the propagation of cracks in elastomers".

- *Youssera El Archi*, Safran, 2019-2022. "Modeling and characterisation of the damping with rubbers in CFRP composites".

- *Flavien Sabourin*, ITER Organization, 2017-2020. "Contribution to the study of the behavior of ITER stainless steel: thermomechanical modeling and numerical simulations".

- *Christelle Saadé*, 2017-2020. "Space-Time Isogeometric analysis for multi-fields problems in mechanics".

- *Komla Dela Ahose*, 2015-2018. "Characterization and modeling of the thermal ageing of elastomers with a multiphysics approach".

- *Alexis Delattre*, Airbus Helicopters, 2011-2014. Sujet: "Characterization and modelling of the hyper-viscoelastic behaviour of a filled rubber in order to simulate elastomer-metal laminated devices and study of fatigue".

- *Thien An N'Guyen Van*, 2009-2012. "On the modeling and the numerical simulation of themo-chemo-mechanical couplings in technical elastomers".

Postdoc:

- *Rami Bouaziz*, 2017-2018. "Modeling of the chemo-physical evolution of a rubber materials under complex thermomechanical loadings".

Master theses:

- *Christelle Saadé* (2017) "Prospective study of a isogeomtric space-time method for linear elasticity and linear viscosity", M2

- *Komla Dela Ahose* (2015) "Thermo-chemo-mechanical ageing in elastomers during fatigue tests", M2

- *Pham Ba Tung* (2014) "A modeling approach for the evolution of physical properties of an elastomer during fatigue tests", M2

- *Farid Khédimi* (2007) "Modeling of steel-elastomers laminated structures with reduced finite elements: the case of curved geometries", M2

- *Pierre-Antoine Bou* (2018, Centrale Marseille) "Validation of a numerical tools for the simulation of technical parts used in helicopter's rotors", M1

- *Louis Papillon* (2016, Centrale Nantes) "Numerical simulation of elastomeric parts for spatial applications", M1

- *Bruno Franke Goularte* (2012, Centrale Marseille) "Characterization and Modelling of LORD's Elastomers used as Lead-Lag Dumpers", M1

- *Gabriel Heguy* (2011, Centrale Marseille) "Numerical determination of the effective permeability of a porous ceramic", M1

# Invited seminars

- Stabilité matérielle et structurelle de lamifiés élastomère-métal, *club des utlisateurs ZeBuLoN (Centre des Matériaux, Mines de Paris, 2006)*

- Développement de Modèles Hyper-visco-plastiques dans ZeBuLoN, *club des utlisateurs ZeBuLoN (Centre des Matériaux, Mines de Paris, 2008)*

- Modélisation du comportement dynamique multi-axial d'élastomères chargés: effet de l'amplitude de chargement et de la température, *Journée du groupe de travail mécanique des polymères Mecamat (ENSAM Paris, 2016).*

- Sur l'approche isogéométrique pour des problèmes multi-physiques/multi-champs: de l'incompressibilité aux couplages thermo-(chimio)-mécaniques. *Séminaire du laboratoire Gabriel Lamé (Tours, 2018).*

- Quelques comportements mécaniques et thermo-mécaniques des élastomères. *Journée du groupe de travail mécanique des polymères Mecamat (Carte Blanche a Noëlle Billon, ENSAM Paris, 2022).*

# List of publications

**Book chapters:**

1. Advances in symbolic and numerical approaches in computational mechanics. D. Eyheramendy, S. Lejeunes, R. Saad, L. Zhang , ©Saxe-Cobourg Publications Chapter 3, 2014, pp. 61-88.

2. Modeling and Simulation with Rubbers. S. Lejeunes, S. Méo, A. Boukamel, D. Eyheramendy, in Rubber Technology, Elsevier (to appear).

**Journal articles:**

1. Multiscale simulation and experimental analysis of damping in CFRP structures containing rubber, **Composite Structures**; Y. El Archi, N. Lahellec, S. Lejeunes, A. Jouan, B. Tranquart; 2022

2. Development of a thermo-mechanical behaviour model adapted to the ITER vacuum vessel material, **Fusion Engineering and Design**; F. Sabourin, T. Désoyer, S. Lejeunes, F. Mazerolle, V. Barabash, J.M. Martinez; 2021; vol 173

3. Space-Time Isogeometric Analysis for linear and non-linear elastodynamics, **Computers and Structures**; C. Saadé, S. Lejeunes, D. Eyheramendy, R. Saad; 2021; vol 254

4. Charactarization and Modeling of a filled rubber submitted to thermal aging, **International Journal of Solids and Structures**; R. Bouaziz, K.D. Ahose, S. Lejeunes, D. Eyheramendy, F. Sosson; 2019; vol 169, pp. 122-140

5. Hybrid free energy approach for nearly incompressible behaviors at finite strain, **Continuum Mechanics and Thermodynamics**; S. Lejeunes, D. Eyheramendy; 2018; online first.

6. A constitutive multiphysics modeling for nearly incompressible dissipative materials: application to thermo-chemo-mechanical aging of rubbers, **Mechanic of time dependant materials**; S. Lejeunes, D. Eyheramendy, A. Boukamel, A. Delattre, S. Méo, K.D. Ahose; 2018; vol 22, pp. 51-66

7. A thermodynamical framework for the thermo-chemo-mechanical couplings in soft materials at finite strain. **Mechanics of Materials**; T.A. N'Guyen, S. Lejeunes, D. Eyheramendy, A. Boukamel; 2016; vol 95, pp. 158-171

8. On the dynamical multi-axial behavior of filled rubbers at different temperatures: experimental characterization and constitutive modeling. **International Journal of Solids and Structures**; A. Delattre, S. Lejeunes, F. Lacroix, S. Méo; 2016; vol 90, pp. 178-193

9. On the multiaxial amplitude and frequency dependent behavior of rubber: experiments and constitutive modeling. **Rubber Chemistry and Technology**; A. Delattre, S. Lejeunes, S. Méo, F. Lacroix, C. Richard; 2014; vol 87, pp. 557-578.

10. A micro-mechanically based continuum damage model for fatigue life prediction of filled rubbers. **International Journal of Solids and Structures**; J. Grandcoin, A. Boukamel, S. Lejeunes; 2014; vol 51, pp. 1274-1286

11. Linearized behavior of a dissipative rubber with large static preloads. **Computers and Structures**; S. Lejeunes, T.A. Nguyen Van, A. Boukamel, D. Eyheramendy; 2012; vol 96-97, pp. 46-53

12. Finite element implementation of nearly-incompressible rheological models based on multiplicative decompositions. **Computers and Structures**; S. Lejeunes, A. Boukamel, S. Méo; 2011; vol 89, pp. 411-421

13. Statistical approach for a hyper-visco-plastic model for filled rubber: Experimental characterization and numerical modeling. **European Journal of Mechanics A/Solids**; J.M. Martinez, A. Boukamel, S. Méo, S. Lejeunes; 2011; vol 30, pp. 1028-1039

14. A model reduction technique for laminated solids of revolution with a curved cross-section. **Archive of Applied Mechanics**; S. Lejeunes, A. Boukamel, F. Khedimi; 2010; vol 80, pp. 1085-1102

15. A direct numerical integration scheme for visco-hyperelastic models using radial return relaxation. **European Journal of Computational Mechanics**; S. Lejeunes, S. Méo, A. Boukamel; 2010; vol 19, pp.129-140

16. Méthode de réduction de modèles pour l'analyse de structures composites à matrice élastomérique. **European Journal of Computational Mechanics**; S. Lejeunes, A. Boukamel, B. Cochelin; 2007; vol 16, pp. 795-811

17. Analysis of laminated rubber bearings with a numerical reduction model method. **Archive of Applied Mechanics**; S. Lejeunes, A. Boukamel, B. Cochelin; 2006; vol. 76, pp. 311-326

18. Model reduction method: an application to the buckling analysis of laminated rubber bearings. **Revue Européenne des Eléments Finis**; S. Lejeunes, A. Boukamel, B. Cochelin; 2006; vol. 15, pp. 281-292

**International Conferences:**

1. Modeling the non-linear dynamic behavior of a technical rubber: applications to the vibration of structures subjected to large static preload, 2023, Y. El. Archi, N. Lahellec, S. Lejeunes, A. Jouan, B. Tranquart, *16th International Conference on Advanced Computational Engineering and Experimenting*, Heraklion, Greece, **Invited lecture**

2. A space-time IGA formulation for the dynamic fracture of solids, 2023, F. Feutang, S. Lejeunes, D. Eyheramendy, *11th International Conference on Isogeometric Analysis*, Lyon

3. Space-time isogeometric analysis for the simulation of fracture with gradient damage models, 2022, F.K. Feutang, S. Lejeunes, D. Eyheramendy, *14th International Conference on Computational Structures Technology*, Montpellier

4. Modeling of fuel pellet cladding interface in multiphysics conditions: accounting of mechanical damage and chemical reactions, 2022, S. D'andréa, S. Lejeunes, F. Lebon, V. Blanc and M. Lainé, *ECCOMAS*, Oslo

5. Virtual testing methods of the dynamic behavior of CFRP damped with rubber, 2022, Y. El Archi, N. Lahellec, S. Lejeunes, A. Jouan and B. Tranquart, *Gumference*, Virtual Event

6. On space-time isogeometric analysis for non-linear solid mechanics problems , 2021, F. Feutang, S. Lejeunes, D. Eyheramendy, *VIGA*, Lyon, Virtual Congress

7. Damping in CFRP Structures: Modelling and Comparison of Technological Solutions Using Elastomer, 2021, Y. El Archi, N. Lahellec, S. Lejeunes, A. Jouan and B. Tranquart, *Composites*, Gothenburg, Virtual Congress

8. Space-Time Isogeometric Analysis for Thermomechanics, 2021, C. Saadé, S. Lejeunes, D. Eyheramendy, F. Feuntang, R. Saad, *14th WCCM & ECCOMAS Congress*, Paris, Virtual Congress

9. Multiphysics, 2021, S. Lejeunes, WCCM-ECCOMAS Junior Workshop, **Invited lecture**, Virtual event

10. On space-time methods based on Isogeometric analysis for structures analysis, 2019, S. Lejeunes, D. Eyheramendy, C. Saadé, R. Saad, *16th International Conference on Civil, Structural & Environmental Engineering Computing*, Riva del Garda, **Invited lecture**

11. Isogeometric Analysis for the numerical simulation of rubber structures, S. Lejeunes, D. Eyheramendy, 2019,*European Conference on Constitutive Models for Rubbers XI*, Nantes

12. Modeling and numerical simulation of thermal ageing in a filled rubber, K.D. Ahose, R. Bouaziz, S. Lejeunes, D. Eyheramendy, 2019,*European Conference on Constitutive Models for Rubbers XI*, Nantes

13. On the hybrid free energy for nearly incompressible behaviors, S. Lejeunes, D. Eyheramendy, 2018, *11th International Conference on Advanced Computational Engineering and Experimenting*, Amsterdam, Pays-Bas, **Invited lecture**

14. Isogeometric analysis of coupled thermomechanical problems: Theoretical and implementation aspects, D. Eyheramendy, S. Lejeunes, L. Zhang, 2018, *10th International Conference on Engineering Computational Technology*, Sitges, Espagne

15. Space-time isogeometric solvers for coupled multiphysics: A preliminary study, C. Saadé, S. Lejeunes, D. Eyheramendy, L. Zhang, R. Saad, 2018, *10th International Conference on Engineering Computational Technology*, Sitges, Espagne

16. Thermo-mechanical modeling of the chemo-physical evolution of filled rubbers submitted to severe thermodynamic loadings, R. Bouaziz, S. Lejeunes, D. Eyheramendy, K.D. Ahose , F. Sosson, 2018, *11th International Conference on the Mechanics of Time Dependent Materials*, Milano, Italie

17. Characterization and modeling of the thermal aging in a filled rubber, S. Lejeunes, K.D Ahose, D. Eyheramendy, F. Sosson, 2018, *International Conference on Plasticity, Damage, and Fracture*, San-Juan, Porto-Rico, **Invited lecture**

18. On the relative influence of mechanical and thermal effects on aging of rubber, K.D Ahose, S. Lejeunes, D. Eyheramendy, F. Sosson, 2017, *Worshop on the Multiphysics Behavior of Rubber*, Marseille, France

19. On the isogeometric approach for coupled thermomechanical problems at large strain, L. Zhang, S. Lejeunes, D. Eyheramendy, 2017, *Worshop on the Multiphysics Behavior of Rubber*, Marseille, France

20. An isogeometric approach for coupled thermomechanical problems at large strain, L. Zhang, S. Lejeunes, D. Eyheramendy, 2017, *V International Conference on Isogeometric Analysis*, Pavia, Italie

21. On the thermal aging of a filled butadiene rubber. K.D. Ahose, S. Lejeunes, D. Eyheramendy, F. Sosson, 2017, *European Conference on Constitutive Models for Rubbers X*, Munich, Germany

22. Constitutive modeling of a thermal aging behavior due to cyclic mechanical loadings with a multiphysics approach, S. Lejeunes, D. Eyheramendy, A. Boukamel, K.D. Ahose, 2017, *11th International Conference on Advanced Computational Engineering and Experimenting*, Vienna, Austria, **Invited Lecture**

23. A constitutive multiphysics modeling for dissipative materials that can undergo chemical reaction: application to the thermo-chemo-mechanical aging of rubbers. S. Lejeunes, D. Eyheramendy, A. Boukamel, T.A. N Guyen, K.D. Ahose, 2016, *10th International Conference on Mechanics of Time Dependent Materials*, Paris, France

24. On the constitutive modeling of a filled rubber: frequency, temperature and amplitude effects. A. Delattre, S. Lejeunes, S. Méo, F. Lacroix, 2016, *10th International Conference on Mechanics of Time Dependent Materials*, Paris, France

25. An isogeometric analysis investigation for multiphysics formulations at large strains. L. Zhang, S. Lejeunes, D. Eyheramendy, 2016, *ECCOMAS*, Hersonissos , Grèce.

26. Dynamical multi-axial behavior of filled elastomers. Numerical modelisation of elastomer-metal laminate. A. Delattre, S. Lejeunes, F. Lacroix, S. Méo, 2015, *Elastomers*, Tours, France

27. Advances in symbolic and numerical approaches in computational mechanics. D. Eyheramendy, S. Lejeunes, R. Saad, L. Zhang, 2014, *12th International Conference on Computational Structures Technology and 9th International Conference on Engineering Computational Technology*, Naples, Italy

28. Constitutive modelling of the dynamical properties of a filled rubber and simulation of laminated devices with a specific FEM tool. A. Delattre , S. Lejeunes, S. Méo, F. Lacroix, 2014, *RubberCon*, Manchester

29. Experimental and constitutive modeling of a filled rubber with emphasis on the dynamical properties. A. Delattre, S. Méo, F. Lacroix, C. Richard, S. Lejeunes, 2013, *European Conference on Constitutive Models for Rubbers IX*, San Sebastian, Espagne

30. A finite strain thermo-chemo-mechanical coupled model for filled rubber. T.A. Nguyen, S. Lejeunes, D. Eyheramendy, A. Boukamel, 2012, *ECCOMAS*, Vienne, Autriche

31. A Finite Strain Thermo-Chemo-Mechanical Coupled Model for Filled Rubber. T.A. Nguyen, S. Lejeunes, D. Eyheramendy, A. Boukamel, 2012, *8th International Conference on Engineering Computational Technology*, Dubrovnik, Croatie.

32. A thermo-chemo-mechanical coupled formulation, application to filled rubber. T.A. NGuyen, S. Lejeunes, D. Eyheramendy, A. Boukamel, 2011, *European Conference on Constitutive Models for Rubbers VIII*, Dublin, Irlande

33. Un schéma direct d'intégration numérique de modèles visco-hyperélastiques par relaxation radiale. A. Boukamel, S. Lejeunes, S. Meo, 2009, *Congrès International Conception et Modélisation des Systèmes Mécaniques CMSM'2009*, Hammamet, Tunisie

34. Constitutive and numerical modeling of the fatigue behavior of a filled rubber J. Grandcoin, A. Boukamel, S. Lejeunes, 2009, *European Conference on Constitutive Models for Rubbers VII*, Dresden, Allemagne

35. FE-implementation of a statistical hyper-visco-plastic model. A. Boukamel, S. Méo, S. Lejeunes, 2007, *European Conference on Constitutive Models for Rubbers V*, Paris, France

36. Model reduction methods for composites structures with elastomeric matrix. S. Lejeunes, A. Boukamel, B. Cochelin, 2005, *European Conference on Constitutive Models for Rubbers IV*, Stockholm, Suède

**Software production:**

1. Homtools, Homogeneisation toolbox for Abaqus, S. Lejeunes, S. Bourgeois, 2010,licenced under Cecill C , http://homtools.lma.cnrs-mrs.fr/

2. PredimLam, Pre-dimensioning of laminated steel-rubber structures, S. Lejeunes, A. Boukamel, A. Delattre, 2007, licenced for Airbus Helicopters

3. FEMJava, A multi-physics workframe for mechanics with FE and IGA written in Java, D. Eyheramendy, S. Lejeunes (main authors), to be distributed with an open-source licence