

Stéphane Lejeunes, PhD, Habil

Research Engineer at CNRS, Part-time lecturer at Centrale Marseille

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Education

- 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 Méditerranée.
- 2002 - 2001 **Master of Sciences** in solid mechanics (DEA de mécanique). École Supérieure de Mécanique de Marseille.
- 2001 - 1999 **Engineer degree**, Ecole Supérieure d'Ingénieurs de Marseille

Work experience

- since 2008 **Research Engineer** CNRS, laboratoire de mécanique et d'acoustique, LMA UMR-7031.
- 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

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

Main professional activities

- since 2021 **Member of COMOP**, operational committee of MISTRAL (joint laboratory CEA-CNRS-ECM).
- since 2018 **Co-head** of the Materials and Structures research group.
- since 2018 **Member of the executive committee** of the LMA.

since 2019 **Scientific expert** for the HCERES.

2021 **Member** of the organizing committee of VIGA2021 (an ECCOMAS conference), Lyon.

2020 **Co-organizer** of minisymposium MS331: Advanced modelling and simulation for polymers, 14th WCCM (World Congress in Computational Mechanics), Paris

2017 **Co-organizer** of WMBR, 1st European Workshop on the modeling of the multi-physics behavior of rubbers, Marseille

2016 **Co-organizer** of ELASTO2016: 4th 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

since 2007 **Reviewer** 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, Mechanics of Materials, Polymer testing, Experimental Mechanics, Materials, Journal on Rubber Research.

Master and Doctoral Theses supervised

PhD Theses:

- *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 Aho*, 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 thermo-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 isogeometric 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 utilisateurs ZeBuLoN (Centre des Matériaux, Mines de Paris, 2006)*
- Développement de Modèles Hyper-visco-plastiques dans ZeBuLoN, *club des utilisateurs 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)*.

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. 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. Maze-rolle, V. Barabash, J.M. Martinez; 2021; vol 173
2. Space-Time Isogeometric Analysis for linear and non-linear elastodynamics, **Computers and Structures**; C. Saadé, S. Lejeunes, D. Eyheramendy, R. Saad; 2021; vol 254
3. Characterization 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
4. Hybrid free energy approach for nearly incompressible behaviors at finite strain, **Continuum Mechanics and Thermodynamics**; S. Lejeunes, D. Eyheramendy; 2018; online first.
5. 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
6. 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
7. 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
8. 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.
9. 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
10. 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
11. 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
12. 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
13. 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
14. 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

15. 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
16. 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
17. 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. On space-time isogeometric analysis for non-linear solid mechanics problems , 2021, F. Feutang, S. Lejeunes, D. Eyheramendy, *VIGA*, Lyon, Virtual Congress
2. 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
3. Space-Time Isogeometric Analysis for Thermomechanics, 2021, C. Saadé, S. Lejeunes, D. Eyheramendy, F. Feutang, R. Saad, *14th WCCM & ECCOMAS Congress*, Paris, Virtual Congress
4. Multiphysics, 2021, S. Lejeunes, WCCM-ECCOMAS Junior Workshop, **Invited lecture**, Virtual event
5. 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**
6. Isogeometric Analysis for the numerical simulation of rubber structures, S. Lejeunes, D. Eyheramendy, 2019, *European Conference on Constitutive Models for Rubbers XI*, Nantes
7. 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
8. 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**
9. 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, **Keynote lecture (co-auteur)**
10. 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
11. 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. Sossou, 2018, *11th International Conference on the Mechanics of Time Dependent Materials*, Milano, Italie

12. 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**
13. On the relative influence of mechanical and thermal effects on aging of rubber, K.D Ahose, S. Lejeunes, D. Eyheramendy, F. Sosson, 2017, *Workshop on the Multiphysics Behavior of Rubber*, Marseille, France
14. On the isogeometric approach for coupled thermomechanical problems at large strain, L. Zhang, S. Lejeunes, D. Eyheramendy, 2017, *Workshop on the Multiphysics Behavior of Rubber*, Marseille, France
15. 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
16. 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
17. 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**
18. 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
19. 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
20. An isogeometric analysis investigation for multiphysics formulations at large strains. L. Zhang, S. Lejeunes, D. Eyheramendy, 2016, *ECCOMAS*, Hersonissos , Grèce.
21. 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
22. 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
23. 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
24. 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
25. A finite strain thermo-chemo-mechanical coupled model for filled rubber. T.A. Nguyen, S. Lejeunes, D. Eyheramendy, A. Boukamel, 2012, *ECCOMAS*, Vienne, Autriche

26. 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.
27. 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
28. 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
29. 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
30. 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
31. 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, Homogenisation 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