

Andrei CONSTANTINESCU

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Professional Experience

CNRS

Laboratoire de Mécanique des Solides

Directeur de Recherches 1^{ère} classe

Directeur de Recherches 2^{ème} classe

Chargé de Recherches

Ecole Polytechnique, Palaiseau, France

since 2015

2005-2015

1995 - 2005

My research activities address a series of problems in solid continuum mechanics. The aim is to provide computationally tractable solutions for engineering problems or fundamental questions based on a solid theoretical framework.

The main topics are:

Inverse problems for linear materials

- *Identification of distributed elastic moduli* from boundary measurements. Discussion of existence and uniqueness of the solution. Numerical solution based on the error on constitutive law.
- *Identification of linear cracks* based on the Reciprocity gap concept. Exact and numerical solutions for acoustics and elastodynamics. Other numerical solutions based on noise projection within the linear sampling method for electric diffusion with measurements from a table top experiment.
- *Reconstruction of residual stresses* from surface X-ray measurements involving matter removal. Closed-form expressions for the exact solution.

Identification problems for nonlinear materials or involving contact

- *Indentation experiments*. Exact expressions of the sensibility problem. Identification of material parameters from artificial and experimental data using the adjoint state and the direct differentiation methods combined with optimization algorithms. Solutions for the thin film multilayer problem based on numeric and symbolic computations.
- *Identification of nonlinear material parameters* for elastoplasticity, poroelasticity, ... for geotechnical applications. Development of the direct differentiation method. Identification of material parameters from artificial and experimental data using experiments on specimens or complete structures.
- *Identification of viscoelastic properties* from DMA and relaxation experiments. Revisiting the classical inversion techniques by proposing a novel technique to determine the precise spectrum of relaxation times.

Lifetime prediction of structures under cyclic loading

- *Thermomechanical fatigue*. Proposed design method based on the interpretation of the cyclic material behaviour. Identification of elastoviscoplastic materials laws adapted to loadings in a wide range of temperatures. Fatigue criteria based on dissipated energy and hydrostatic stress. Applications for cylinderheads and exhaust manifolds (automotive industry) and pipes with highly turbulent flow (nuclear industry). Extensions to variable loading. Model reduction using POD techniques.
- *Fatigue and thermal dissipation*. Multiscale analysis of the relations between shakedown, dissipation and fatigue.
- *Fatigue and stress gradient effects*. Extension of the multiscale Dang Van fatigue criterion for regions with gradient effects. Application to drillstring connexions (oil industry) and fretting fatigue (aerospace industry). Multiscale analysis by numerical homogenisation of the elementary representative volume at the grain scale.
- *Fatigue and mean stress effect*. Multiscale analysis of the effect of mean stress on the evolution of the microstructures (void shape, inclusions, etc.). Homogenisation computations on elementary representative volumes. Models for porous crystal plasticity.
- *Highly filled elastomers* Micromechanisms and macroscopic mechanical behaviour. DMA and relaxation experiments. Uniaxial and biaxial material behavior involving prestrain. Multiscale analysis using physical observations and numerical homogenisation methods at the scale of the fillers. Applications for solid propellant (aerospace industry).

My current research interest are the multiscale exploration of the mechanism underlying damage and fatigue and the extension of these methods to new materials: additive manufactured materials, shape memory alloys, composites exhibiting coupling between mechanical and electromagnetic phenomena, etc.

Education

Université Pierre et Marie Curie <i>Habilitation</i>	Paris, France 2005
Ecole Polytechnique <i>PhD in mechanics</i>	Palaiseau, France 1994
Ecole Polytechnique <i>Master in mechanics</i>	Palaiseau, France 1991
University of Bucharest <i>Bachelor & Master in mathematics-mechanics</i>	Bucharest, Romania 1988

Awards

DGA, France <i>ERE Fellowship, financing of sabbatical stays abroad</i>	France 2015-2016,
Académie des Sciences <i>Doisteau-Emile Blutet Prize</i>	France 2006
ASME Gas Turbine Institute <i>Best paper award</i>	USA 2009
Journal of Fatigue and Fracture of Engineering Materials and Structures <i>Best paper award</i>	2003
Goverment Fellowship <i>Master and PhD studies</i>	France 1990-1994

Visiting Positions

ETH <i>Visiting professor</i>	Zurich, Switzerland 2015–2016
Tokyo Institut of Technology <i>Visiting professor</i>	Tokyo, Japon 2008
PSA Péugeot-Citroen <i>Industrial leave</i>	Vélizy, France 2002
Oxford University <i>Visiting fellow, Royal Society</i>	Oxford, United Kingdom 2002
Cornell University <i>Visiting scientist</i>	Ithaca, NY, USA 1994

Board and management activities

CNRS & Ecole Polytechnique <i>Director of the Laboratoire de Mécanique des Solides</i>	Palaiseau, France starting 01/01/2020
CNRS <i>Chargé de mission, INSIS</i>	Paris, France since 2011-2015

The *chargé de mission* is an expert with the management team of the INSIS-CNRS, i.e. Departement of sciences of engineering and systemes. The work consist of reporting and coordinating the activities in solid mechanics at the national level within the laboratories associated with the CNRS and the work load corresponds to approximatively one day per week.

French National Committee for Mechanics

France

national organisation for IUTAM activities
treasurer

since 2009

Comité National, CNRS

Paris, France

Solid Mechanics (Section 09)

Member

2002 - 2004

The *Comité National*, i.e. national panel of the CNRS, audits and ranks the applicants for positions at the CNRS. It also reviews and reports on various activities of the researchers and laboratories within the CNRS. The work load corresponds to approximatively five weeks a year.

Laboratoire de Mécanique des Solides

Palaiseau, France

CNRS & Ecole Polytechnique

Member of the management committee

since 2010

Research activities

Advisor for PhD thesis

- Sekmen KUBRA, Evolution of viscoelastic properties during UV curing, 2019-2022.
- Nikolai KHAILOV, Fatigue of SLM-printed lattice structures, 2018-2021.
- Filippo AGNELLI, Robust design of 3D printable structures, 2018-2021.
- Camille GUEVENOUX, Repair of parts of aeroengines by additive manufacturing, 2018-2021.
- Yanis BALIT, Fatigue of metal parts produced by additive manufacturing, 2016-2019.
- Stéphane ZANELLA, Fatigue of electronic components, 2015-2018. currently patent engineer, associate, Bandpay & Greuters, France.
- Alexandre JOAN, Fatigue of conductive glues, 2015-2018, currently research engineer, Safran Composites, France.
- Anthony JANIN, Dynamic material behavior of polymeric glues, 2015-2018, currently research engineer, Saint Gobain, France.
- Armel Brice MBIKOP NGASSA, Nonlinear homogenisation of porous materials under cyclic loading, 2012-2015, currently research engineer, Michelin, France.
- Dimitri JALOCHA, Dynamic behaviour of highly filled elastomers, 2012-2015, currently research engineer, Herakles, Safran Group, France
- Gwaenael Houellou, Nonlinear homogenisation for anisothermal cyclic loading, 2013-2015, abandoned PhD, currently High School teacher.
- Stefano BOSIA, On some multi-phase problems in continuum mechanics, 2010-2013 (co-adviser Prof. M.Grasselli, Politecnico di Milano, Italy), currently analyst at GEA Management Consulting, Italy.
- Vivien COURTIER, Model reduction for the lifetime prediction of structures, 2009-2012, currently R & D engineer at SAFRAN-SNECMA, France.
- Shadan TABIBIAN, Thermomechanical Fatigue for aluminum alloys manufactured by a lost foam process. 2008-2011, currently R&D engineer at Medtronic, UK .
- Aurélie AZOUG, Micromechanisms and macroscopic mechanical behaviour of highly filled elastomers, 2007-2010, currently postdoc John Hopkins University, USA.
- Sébastien AMIABLE, Lifetime prediction of structures under thermomechanical loadings, 2003-2005, currently R & D engineer at Airbus Industries.
- Mohamed FERJANI, Fatigue of drillstrings, 2003-2006, currently indenpendent engineering consultant, Belgium.
- Brice LECAMPION, On the Identification of Constitutive laws of deep argillaceous rocks, 2000-2002, professor, EPFL, Lausanne, Switzerland.

- Laetitia VERGER, Thermomechanical behaviour of aluminium cylinderheads, 1998-2001, currently R & D engineer at PSA Peugeot-Citroen, France.
- Nicolas TARDIEU, Characterisation of the properties of the nuclear fuel pellets, 1997-2000, currently R & D engineer at Electricite de France.
- Eric CHARKALUK, Thermomechanical behaviour of automotive parts, 1996-1999, currently directeur de recherches at CNRS, France.

Advisor for Postdoctoral research

- Grigor NIKA, Mathematical modelling of polymeric lattice structures, 2015.
- Luka PAVIC, Cyclic behavior of CNT sensors, 2015.
- Raphael GUERCHAI, Fretting fatigue modelling, 2014-2015.
- Giulia SCALET, Fretting fatigue modelling, 2015.
- An Danh NGUYEN, Lifetime prediction for aerospace parts under fretting fatigue, 2007-2008, currently researcher at RTWH, Aachen, Germany.
- Laila FLANDI, Lifetime prediction for aerospace parts under fretting fatigue, 2004-2005, currently R & D engineer at Electricite de France.

Principal investigator

for collaborative work with industry:

- *France*: Air liquide, EdF, GDFSuez, PSA Peugeot-Citroen, CEA (Commissariat à l'Énergie Atomique), IFPEN (Institut français du Pétrole), SAFRAN-SNECMA, SAFRAN-Herakles, Schlumberger, SAFRAN-Composite.
- *Germany*: MTU, BMW.
- *Japan*: Nippon Steel and Sumito Metal Company.

for national government funded projects

- *ANR program*: Evocrit, FastFM, Indiana, MechNanoTruss (France-Switzerland), UVLightComposites (France-Germany)
- *SESAME2014*.

Other activities

- engineering consultant: GdF 2003-2009, SAFRAN-Herakles 2008-2009
- international mobility projects: Portugal 1998, Italy 2014
- organisation of conferences: Colloque National en calcul des Structures, France, 1999, *Euromech 505: Multiscale Effects in fatigue of metals, France, 2010, Stability and Nonlinearity in Solid Mechanics, Paris, 2010*.
- reporting for *PhD* and *habilitation committees* approximately three and one per year respectively.
- reviewer for : *Journal of Mechanics and Physics of Solids, International Journal of Solids and Structures, International Journal of Fatigue, Fatigue and Fracture of Engineering Materials and Structures, Inverse Problems, European Journal of Mechanics A, Compte Rendus Académie des Sciences, International Journal of Inverse Problems in Engineering, Wear, Fuel,*
- reviewer for the *ANR program*.
- editor for special issues of the *Journal of Mechanics Materials and Structures*.

Teaching Experience

ENPC

Associate Professor

Lectures on *Fatigue of structures* combining tutorial and project classes.

Paris, France

since 2016

ETH

Invited professor

Zurich, Suisse

2015-2016

During my stay, I taught lectures on *Nonlinear problems in elasticity* using analytic and symbolic computations with Mathematica.

Ecole Polytechnique

Associate Professor (part time)

Palaiseau, France

2003-2015

My activities involve teaching lectures and tutorials, project classes or steering research projects and internships both at the graduate and undergraduate level. The actual subjects lectured are *Continuum Mechanics and Elasticity, Inverse Problems, Numerical Methods, and Fatigue*.

ENSTA

Assistant Professor (part time)

Paris, France

1996-2003

My first teaching tutorials were in *Continuum Mechanics, Linear Thermoelasticity, Rods and slender structures, Fatigue of materials and structures*. I was then promoted responsible for the lectures and tutorials in *Linear Thermoelasticity*

Tokyo Institute of Technology

visiting professor

Tokyo, Japan

2008

During my stay, I taught lectures on *Continuum Mechanics* and *Inverse Problems* both of them based on numeric and symbolic computations using the Mathematica software.

Collège de Polytechnique

continuum education for engineers

Paris, France

since 1999

The lectures on *Fatigue of metallic structures* are intended for engineers in various industries and provide a rapid and upto date insight on the materials and computational foundations of the lifetime prediction of structures

CISM summer school

Parameter Identification of Materials and Structures

Udine, Italy

2003

CNRS summer school

Identification Procedures using Full-Field Measurements

France

2011,2013

Language skills

- lecturing proficiency: french, english, german, romanian,
- conversational proficiency: italian