Biomimetic for improvement multiphysics coupling

INSA Lyon

NICOLAS BAUDIN
INTERNSHIPS IN FRANCE INITIATIVE

Name of the hosting institution in France	INSA Lyon
Name of the host laboratory / research team	LGEF
Address	20 Avenue Albert Einstein Gustave Ferrié Building 69621 Villeurbanne Cedex France
Web site	http://lgef.insa-lyon.fr/
Name of the supervisor	Pierre-Jean Cottinet
Function	Associate Professor
Email	pierre-jean.cottinet@insa-lyon.fr

Internship offer

Topic of the internship (title)	Biomimetic for improvement multiphysics coupling			
Proposed dates of the internship*	Start	2020-03-01	End	2021-01-31

* The supervisors have indicated the dates proposed are flexible and are able to be postponed subject to COVID-19 border closures.

Scientific and academic objectives of the internship (detailed description of the internship content, work expected from the intern and expected outcomes):

Abstract After billions of years of evolution on this planet, biological surfaces exhibit almost perfect multifunctional interfaces to adjust to harsh environment. Inspired by naturally fascinating features, people attempt to change a passive surface into a smart structure. The goal of the MS is to explore how additive manufacturing combining with smart materials can generate new class of bioinspired device. Introduction & goal of the MS Many inspirations in biological science world strike exciting opportunities in material science and led to a range of biomimetic and other advanced functional materials for engineering and medical applications. The self-controlled smart behaviour of these systems make their individual functional components sense and process the environment and take necessary actions, similar to a living creature. This smart action is referred to a progressive change of material internal structure and chemical composition at a macroscopic interval of time. The dynamic internal structure results in varying constitutive properties and viewed as an adequate response of the material to external loading (mechanical, magnetic, light, etc.). The slow-rate evolution of constitutive properties of the materials is often affected by non-elastomechanical nature, such as phase transitions, chemical reactions, diffusion and other kinetic processes at the atomic scale.
The main goal of this work is the development of one principally new multi-physics materials able to adapt in different environments Key words: 4D printing, smart material, surface interface, multiphyscis coupling

Expected profile of applicant

Level of study	Master students
Discipline	Material, electrical, mechanical, applied physics
Required qualities, knowledge and skills	We look for an open-minded MS-student, able to work in different fields (material, electrical, mechanical, applied physics) and in a multicultural environment.

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Nicolas Baudin Program: "Internships in France" initiative

Call for applications for a research internship in the laboratory LGEF at INSA Lyon, France

Topic: Biomimetic for improvement multiphysics coupling

Abstract

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Introduction & goal of the MS

Many inspirations in biological science world strike exciting opportunities in material science and led to a range of biomimetic and other advanced functional materials for engineering and medical applications. The self-controlled smart behavior of these systems make their individual functional components sense and process the environment and take necessary actions, similar to a living creature. This smart action is referred to a progressive change of material internal structure and chemical composition at a macroscopic interval of time. The dynamic internal structure results in varying constitutive properties and viewed as an adequate response of the material to external loading (mechanical, magnetic, light, etc.). The slow-rate evolution of constitutive properties of the materials is often affected by non-elastomechanical nature, such as phase transitions, chemical reactions, diffusion and other kinetic processes at the atomic scale. The main goal of this work is the development of one principally new multi-physics materials able to adapt in different environments.

MS profile

We look for an open-minded MS-student, able to work in different fields (material, electrical, mechanical, applied physics) and in a multicultural environment.

Key words: 4D printing, smart material, surface interface, multiphyscis coupling

Period and duration: 6 months (March 2020 – August 2020 or Sept 2020 – Jan 2021 with flexibility)

MS supervisors

Dr. Pierre-Jean COTTINET et Dr. Jean-Fabien CAPSAL
Univ-Lyon- INSA Lyon –LGEF
8 rue de la Physique
69621 VILLEURBANNE – France
Pierre-jean.cottinet@insa-lyon.fr
Jean-fabien.capsal@insa-lyon.fr
http://lgef.insa-lyon.fr/

About LGEF

LGEF (Laboratory of Electrical Engineering and Ferroelectricity) of INSA Lyon (National Institute of Applied Sciences) conducted by a multidisciplinary team of experts. Our laboratory is equipped with a complete library of engineering software and specialized measurement equipment.

LGEF can provide completely customized solutions thanks to "building blocks", involving in new materials or technical concepts that have been tested in the lab and which are particular interest for new applications.

We apply our long experience and technical expertise to the innovation of your products. From electroactive materials to electromechanical devices such as sensor, actuator, μ-generators, we are able to offer different solutions adapted to your application.

The main activities of LGEF concern the multiphysics coupling, particularly the electroactive materials and their applications. The researchers are principally divided into costly related themes, including:

- Electroactive materials: elaboration, constitutive modelling with associated experimentation, especially on ferroelectric ceramic, electroactive polymers loaded with nano-fillers including carbon nano-tube; magnetic particles SiC nano-wires, or all organic composite, piezoelectric paint or ink as well as their multi-scale modeling of the electromechanical behavior.
- Electroactive devices : modelling and application of the multiphysics coupling, mainly between the piezoelectric materials and the electroactive polymers, and development of new approaches based nonlinear treatments of the electrical quantity of the transducers (e.g., piezoelectric or electrostrictive voltage) for:

- Vibration control and damping
- Thermal and mechanical energy harvesting
- Sensor (low cost, printable, flexible, etc.)
- Morphing structure, artificial muscle
- Autonomous wireless device (sensor network, structural health monitoring)
- Electro-caloric coupling for solid state cooling.

About INSA Lyon

INSA Lyon boasts 23 research laboratories, more than 600 researchers and teacher-researchers, 650 PhD students, and over 1,000 industrial contracts with the socio-economic world.

In addition to fundamental studies, a large part of the INSA research is done in close collaboration with companies and authorities. According to these strong involvements, highly relevant researches are performed for solving societal issues and generate non-conventional scientific questions. From this model based on excellence, innovation perspective, and community involvement, INSA Lyon expends its research activities within five main fields:

- Digital Society and Information
- Energy for a Sustainable Development
- Environment: Natural, Industrial, and Urban Environments
- Global Health and Bioengineering
- Transport: Structures, Infrastructures, and Mobilities