Job Offer

Job Summary

Title, Job Position	**Post-doctorate: modelisation and numerical simulation**
Research Field	Mechanics of structures and solids
Employer	Sorbonne Université
	Institut des sciences du calcul et des données
Location :	Paris, France
Application Deadline / Timezone	05-06-2020 18:00AM Paris (GMT+01 :00)
Salary	depending on skills and experience
Type of Contract	Temporary (fixed term) 12 months
Job Status	Full-time
Envisaged Starting Date	September 2020

Hiring Organisation

Organisation

Sorbonne Université was created on January 1st, 2018 from the merger of Paris-Sorbonne and Pierre and Marie Curie (UPMC) universities. As a public institution, it fulfils the public service calling of French higher education, research and innovation.

Sorbonne University has first-rate potential in the heart of Paris. Sorbonne University has an original organization in three faculties of letters, sciences & engineering and medicine which have an important autonomy. University governance is primarily devoted to promoting the university's strategy, steering, developing partnerships and diversifying resources.

The University's 53,500 students, 3,400 professor-researchers and 3,600 administrative and technical staff members who help it run every day contribute to a University that is diverse, creative, innovative, and with a global outlook.

Organisation Type

Higher Education Institute

Department

Institut des sciences du calcul et des données, FED 3

The institute of computing and data sciences (ISCD (http://iscd.sorbonne-universite.fr/) is dedicated to exploring and developing the potential of computational and data-driven research and training across science, humanities and medicine at Sorbonne Université. Our research teams use the power of algorithms and visualisation to solve problems in biology, chemistry, mathematics, computer science, medicine, and the digital humanities. Our history of supporting collaboration goes back more than 10 years when the institute was created to support areas where methods and means of approaching challenges spilled over the disciplines and were profoundly transforming research.

Offer Description

Description

The research project « Origins of Speech » is focusing on understanding how the capacity of speech emerged in human beings. Recently, the paradigm has radically changed in view of research studies that have shown that several non-human primates seem already anatomically "ready to speak". Hence, contrary to the current opinion, a lower position of the larynx in the vocal apparatus is no longer required to produce the vocalization. A pluridisciplinary team composed of biomechanicians, paleontologists, and mathematicians, from the Grenoble University and the *Muséum national d'Histoire naturelle*, has gathered at the Institute for Computing and Data Sciences (ISCD, Sorbonne Université) to tackle this challenging topic.

This project aims at modelling and numerically reconstructing the soft tissues of the vocal apparatus for application to fossil hominines in which they are not preserved. This work is part of an ongoing exploratory program which showed how it is possible to adapt a reference tongue model (ATLAS) to the geometry of the oral cavity of several fossils, based on skulls of ancient *Homo sapiens* and Neanderthals.

Several questions and difficulties remain open and will constitute the missions of this post-doctoral project as described hereafter.

Main missions :

The post-doc will have a central role in the generation and evaluation of finite element models of the tongue of a fossil man (whose cranial and mandibular geometry is known only) by geometric transformation of an existing reference finite element model (ATLAS) developed in the group from the anatomical characteristics of a living *Homo sapiens* used as a reference.

This work includes a modelling component and a simulation component involving :

- The use, evaluation and improvement of procedures for resetting the finite element meshes already partially developed in the group with the aim of defining reliable models adapted to the cranial structures of other individuals, i.e. by adapting to a certain individual variability (according to gender, geographical origin, etc.).

- Numerical simulation of the consequences of muscle activations on the lingual mobility of the model thus generated. As the model is defined in a hyper-elasticity framework (mechanical and geometric non-linearities) with movements generated over very short activation durations (thus strong influence of the visco-elastic component), it is likely that issues of stability and convergence of the simulations must be addressed.

- The reliability of the numerical predictions will be controlled by (1) finite element mesh discretization error control and (2) quantification of parametric uncertainties. Indeed, many parameters of the model are only partially known or totally unknown and a large number of simulations are necessary to provide elements of answers.

Accompaniment by researchers from the University of Grenoble to:

- Exploit and develop finite element mesh transformation tools by integrating constraints on the quality of the finite element mesh after geometric transformation.

- Implement the active muscle structures (already existing active element model) in the finite element mesh adapted to the selected fossil man (developments on the ANSYS software).

- Simulate the influence of these muscles on lingual mobility by activating muscles in biomechanical models of the tongue.

Accompaniment by researchers from the Sorbonne University to:

- Quantify the parametric uncertainties in the simulations by a non-intrusive approach as follows: build an approximation meta-model from a finite number of simulations using a stochastic collocation approach. The stochastic approximation error is then controlled by solving an optimization problem. This approach has the advantage of also analyzing the sensitivities of the simulations to variations in model parameters. The challenges addressed are both theoretical (due to instationarity) and algorithmic (storage of results in memory, managing the cost in calculation while remaining reliable in predictions). A non-intrusive tool (capable of being applied to other simulation codes) will be developed to address these challenges.

Scientific referents:

- Université de Grenoble - Laboratoire Gipsa-lab : Pascal Perrier

- Université de Grenoble - Laboratoire TIMC-IMAG : Yohan Payan

- Sorbonne Université - laboratoire Jean Le Rond d'Alembert: Anca Belme

- MNHN- UMR 7194, histoire naturelle de l'Homme préhistorique : Amélie Vialet

Contract term
12 months

As part of your duties, you may be required to provide internal training related to your business expertise.

Profile Requirements

Skills / Qualifications
- - Holder of a doctorate in scientific computation/mechanics of structures and solids.

Special requirements
- - Solid knowledge in finite element modeling, numerical simulation, error and uncertainty analysis,
- - Good programming skills (C++ and Matlab).
- - Experience with ANSYS finite element software will be a plus.

Work Location

Institute
Institut des sciences du calcul et des données
Team « Origins of Speech »

Country
France

Location

Sorbonne Université
Campus Pierre et Marie Curie
4, place Jussieu
Paris

How to apply ?

Required Application Materials

1. Cover letter with current and future research interests
2. Most recent curriculum vitae
3. Copy of first author publications
4. Names and contact for three referees

How to submit

Interested candidates should:

- Contact for additional information about the offer:

  Pascal Perrier (Pascal.Perrier@gipsa-lab.grenoble-inp.fr), Yohan Payan (Yohan.Payan@univ-grenoble-alpes.fr), Anca Belme (belme@dalembert.upmc.fr), Amélie Vialet (amelie.vialet@mnhn.fr)

- submit the required application materials to:
  Pascal Frey, Agnieszka Miskiewicz (iscd@sorbonne-universite.fr)
  with the title "ISCD Fellowship Application - #4 ".

Selection Procedure

Selection process

The Institute's selection process is based on an email submission.

Candidates are evaluated by faculty reviewers in their own academic fields and from other disciplines. Reviewers will evaluate candidates according to their academic accomplishments and their potential for research.

The selection process is organized in four stages.

1. Eligibility check: candidate's compliance with the requirements of the offer will be checked on the basis of the information provided by the applicant.

2. Evaluation of CV: applicant's CV and research proposals will be evaluated and ranked according to their merit.

3. Interviews of candidates: **short listed** candidates will be invited for an interview conducted by the selection committee.

4. Final decision: the selected candidate will be proposed the position. A reserve list of candidates may be identified in case of withdrawal of the selected candidate.

Please note that priority in individual applicant selection will be given to first-time fellows.