

## Call for postdoctoral applications in solid mechanics

**Subject:** "Electro-Mechanical modeling of electrical contacts"

**Period:** 12 months

**Laboratories:**

1. [Laboratory of Electrical Engineering \(LGEP\)](#) of [Engineering School of Electricity \(SUPELEC\)](#) (see [@wiki](#))
2. [Material Research Center \(CdM\)](#) of [Engineering School of Mines \(MINES ParisTech\)](#) (see [@wiki](#))

**Location:** Paris region, LGEP at [google.maps](#), CdM at [google.maps](#)

**Keywords:** contact, electrical contact, finite element modeling, surface roughness, plasticity, heat and electric charge diffusion and transfer

**Research project:** PLASTELEC of LaSIPS



## Subject and aims

The aim of this project is to clarify the underlying multiscale physics and mechanics of electrical contact. Specifically, the candidate will study the mechanics of the contact between microscopically rough metallic surfaces and the transfer of heat and electric charge between them. Quasi-static and dynamic problems will be considered to understand the processes leading to degradation of electrical contacts. The candidate will carry out extensive *numerical simulations*, *code development* and *experimental data analysis*.

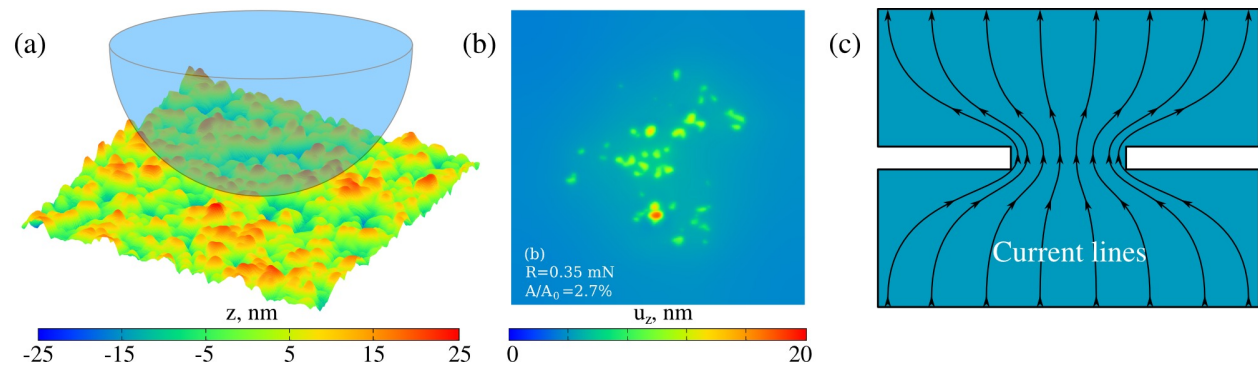


Figure 1: Illustration of simulation scheme: (a) surface topography of a finite element mesh, that is brought in contact with a rigid spherical indenter; (b) finite element simulation of contact, contour plot of the vertical displacement field; (c) scheme of a contour line constriction model that has to be used at contact spots.

## Context

Since many years LGEP investigates the behavior of electrical contacts in the domain of reliability and contact failure, which implies considering wear, fretting, microbreaks and heating. Although significant progress in understanding this topic was made [1], the prediction of contact failure remains a challenging problem. The local micromechanisms need to be investigated to achieve a reliability criterion. The most important mechanisms involved (surface roughness, elasto-viscoplastic material behavior and Joule heating due to electric current) can be considered within a numerical finite-element model, that couples thermal,

electric and mechanical aspects.

Since several years, CdM works on finite element modeling of rough surfaces in contact for elastic and elasto-plastic behavior [2], using either homogeneous material model or models with metallic microstructure [3]. The numerical procedures developed at CdM for contact treatment [4] allows to perform large scale parallel finite element simulations.

This project, supported by the expertise of the laboratories in the field of rough mechanical contact (CdM) and electrical contact (LGEP) will potentially yield breakthrough interdisciplinary results in this field [5]. To accomplish this objective we are looking for *highly motivated and competitive candidates*.

## Details of the project

We will generate a complete mechanical model using elasto-viscoplastic material model (isotropic von Mises plasticity and/or crystal plasticity) combined with a precise geometrical description (multilayered coated material, micro-roughness, crystallographic microstructure). Coating characteristics will be identified by nanoindentation experiments, which will be carried out at CdM. The electrical component will be modeled by a weak coupling of finite element software *Zset* with a multispot electrical model for constriction of current line developed at LGEP [6]. These techniques will be compared by a full scale complete 3D simulation using thermal analogy in *Zset* software. The simulation results will be compared with real experiments carried out at LGEP.

## Requirements

The candidate should have a strong background in solid mechanics and be ready to conduct tribological experiments at LGEP and numerical simulations at CdM. Programming skills are also required (ideally programming experience in C++). The postdoctoral position is open and waits for motivated candidates.

## Contacts

Please submit your candidatures (CV + motivation letter) to people listed below:

- Frédéric Houzé [houze@lgep.supelec.fr](mailto:houze@lgep.supelec.fr)
- Georges Cailletaud [georges.cailletaud@mines-paristech.fr](mailto:georges.cailletaud@mines-paristech.fr)
- Henry Proudhon [henry.proudhon@mines-paristech.fr](mailto:henry.proudhon@mines-paristech.fr)
- Vladislav Yastrebov [vladislav.yastrebov@mines-paristech.fr](mailto:vladislav.yastrebov@mines-paristech.fr)

## References

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