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Mechanics of granular and polycrystalline solids



Foreword

The 2013 US–France Symposium was held in Aussois, close to Grenoble, on the topic “Mean-stress-dependent materials, recent advances and applications to natural risks”. This series of workshops is devoted to solid and engineering mechanics. The idea for the 2013 Symposium was to focus on the mechanics of granular and polycrystalline metallic materials with some applications to natural risk modelling. Such applications are of great importance from a fundamental point of view and are critically important in terms of safety for the Rhône-Alpes Région.

Within the past decade, it has become more and more clear that granular geomaterials and polycrystalline metallic materials have several constitutive properties in common such as:

- the dependency of their mechanical behaviour on the mean stress level, particularly when their porosity is becoming important,
- the non-associate character of the plastic flow (plastic strains) that implies the non-symmetry of their constitutive matrices, which in turn gives rise to various specific bifurcations,
- their failure modes characterised most often by shear band formation, sometimes occurring in their hardening plastic regime.

Besides, for these materials, new homogenisation/localisation tools as well as molecular dynamics numerical methods have allowed, rather recently, to bridge the computational scales and develop constitutive models that are micromechanically motivated and more physically based than the classical phenomenological visco-elasto-plasticity framework.

Concerning the natural risks, the involved natural media like snow, fractured rocks, or flowing muds present intricate features due to complex multi-physics couplings and some hydro-mechanical effects, which are still neither fully understood nor properly modelled.

Appropriately, this thematic issue on “Granular and Polycrystalline Solid Mechanics” is constituted by six papers in relation to the first topics evoked above, followed by two papers related to natural risks.

Most of the papers are issued from the research presented at the Symposium and are complemented with other papers that reflect the new directions and trends in mechanics of materials in the American and French communities. Thus, this thematic issue of *Comptes rendus Mecanique* complements and enlarges the scope of the dossier of *Comptes rendus Physique* (“Granular physics”, edited by Alexandre Valance and Michel Louge, which will be published concomitantly), in which diverse aspects of granular mechanics, from static assemblies to flowing suspensions, are considered.

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We are also very grateful to the thirty-two invited lecturers, who have fully contributed to the success of the workshop, and more particularly to the authors of the eight papers of this thematic issue. Last but not least, we would like to express our deepest gratitude to the organisers of the symposium: Bruno Chareyre (Grenoble-INP, 3SR), Frédéric Dufour (Grenoble-INP, 3SR), François Nicot (IRSTEA, ETNA), and Félix Darve (Grenoble-INP, 3SR). Specific thanks are due to Oana Cazacu (University of Florida, REEF) for maintaining dynamic the US–France research network built around the International Center for Applied and Computational Mechanics (ICACM).

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