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Topological Evolution and Nonaffine Mapping in Complex Materials
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Granular media are ubiquitous. Agriculture, mining, structural engineering, even Martian and Lunar exploration require deep understandings of the behaviour of complex materials.

When a physical body is subjected to a force, it deforms. A material's constitutive relation determines how it deforms under a given force (interested students should enrol in *620-342 – Industrial & Applied Mathematics*). While the constitutive relations for fluids and solids are well established, no universally accepted constitutive relation exists for foam and granular matter.

The devil is in the details! The difficulty in modelling this type of media is that the nature of micro-scale particle interactions has measurable macro-scale consequences. Some of these details are necessarily discarded in the analysis that leads to the constitutive relation. The job at hand is to select which details are of importance, and figure out how to get them *back into* the constitutive relation.

I studied *topological* or *nonaffine* rearrangements (i.e. rearrangements which involve changes to the system's contact network) in foam and granular matter. The aim of this study was to develop a formulation of these rearrangement-events which could be used to amend current constitutive relations.

Avenues of inquiry included consideration of the *configuration space* of the assembly (topology), the *statistical mechanics* of particle assemblies (physics) and the *structural stability* of particle arrangements (structural mechanics) – testimony to the multidisciplinary nature of this topic. Continuing work promises to produce a fully working constitutive model for these complex materials.

For more information about the work of the MGM group go to the website:
www.mgm.ms.unimelb.edu.au

I was a part of a team of dedicated and enthusiastic people, involved in active research in a challenging and dynamic discipline. A few weeks of your vacation is a small price to pay for the precious opportunity that a vacation scholarship presents.

As part of my vacation scholarship I had the privilege of attending a conference on granular matter at ANU, Canberra. There I got the chance to rub shoulders with all the big names of the granular matter community. None of this would have been possible had I not participated in the programme.

I highly recommend the vacation scholarship programme. You'll make friends and have fun; all while participating in serious research.

Stephen received an ICE-EM Vacation Scholarship in December 2006.
See http://www.ice-em.org.au/students.html#scholarships2007