Special Program in Applied Mathematics and Applied Mechanics

A novel class of plasticity models for granular materials and their application to geophysical problems.

2015 - 05 - 27 (Wed.)
15:00 - 18:00
308, Mathematics Research Center Building (ori. New Math. Bldg.)

Granular materials may exhibit mechanical behaviour which is either solid-like or fluid-like, depending on the loading and environment. For low stress levels the material response is elastic but when the stress level reaches a certain threshold the material flows freely. For problems in which the material does flow freely, it is usual to neglect the elastic strains. A number of different mechanical/mathematical approaches have been made to model such behaviour and we shall consider one particular type of model, namely that of plasticity. Several plasticity models have been proposed, for example we may cite the plastic potential and double-shearing models. In this talk we consider a particular model which is related to, and developed from, both of these models. It is based upon the concept of a yield condition and constitutive equations which incorporate both pressure dependent yield and dilatancy which accompanies shear flows. These concepts are discussed and the equations of the model are presented. The model incorporates a quantity which may be interpreted physically as the average grain spin in a representative volume element of the material and this introduces the idea of a Cosserat continuum in which the Cauchy stress tensor may be non-symmetric and in which couple stresses are present. One interesting possible application of the model is to avalanche flow and we present a preliminary attempt to formulate a boundary value problem which may prove useful in analysing such flows. The equations of the model are presented and explained in the context of this application.

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