dune, while the migration speed is always an unsteady quantity controlled by wind speed and diameter of sand particles, which is still not clear. Considering the limitations of existing dune field model, this work reports on a three-dimension model with several modifications involved: (1) Inspired by the field measurements of Finkel (1959) and Sauermann et.al (2000) in Peru and Morocco, we introduce the relationship between dune height and windward slope angle; (2) According to Lancaster's conclusion (1995) that wind speed-up factor changes with windward slope angle and dune height, we put forward a logarithm relation between wind speed-up factor α and the dune height; and (3) We take account of the effect of wind acceleration process on formation and evolution of dune field not only in determining the transport length L_{ij}^{t} but also the thickness h_{ij}^{t} of sand slabs. Such modification is proved to be significant in simulating the realistic character of wind-formed features. Moreover, the evolution process of dune field in different desert region is proved to have obvious discrepancy.

W-2E-3. EFFECTS OF AEROSOL SIZE AND DEFORMATION ON CLOUD FORMATION IN THE ATMOSPHERE

N. DEVARAJU and N. RUDRAIAH, *UGC-Centre for Advanced Studies in Fluid Mechanics, Bangalore University, India,* There is a growing concern that human activities may alter the climate by releasing a large amount of soot and other pollutants into the atmosphere in the form of ultra fine dust particles which are suspended in the atmosphere called aerosols. Atmospheric aerosols play the important role in the atmospheric processes of favoring cloud formation and also negatively linked to a number of undesirable phenomena ranging from visibility reduction to adverse effects on human body depending on their size due to coagulation. The coagulation causes aerosol hit each other leading either to stick each other resulting in increase in size and decrease in number or collide each other, leading to the formation of tiny particles resulting in decrease in size and increase in number but in both the cases mass concentration remains the same. Knowing the complexity of aerosols due to coagulation, their favorable or unfavorable effects and the desire to control atmospheric aerosol, the study dispersion of aerosols is crucial. This is done in this paper considering large size aerosols as the mixture of agglomeration and coalescence in the atmosphere and modeled them as fluid saturated sparsely packed porous media. Using this assumption and considering aerosols as deformable the required basic equations are derived incorporating advection and diffusion using mixture theory and Saffman dusty fluid model. The solutions of the basic equations are obtained using regular perturbation technique together with Saffman slip condition on velocity and the permeable condition on concentration. The Taylor dispersion coefficient D_r is obtained and is computed for different values of dimensionless number $R_i (i = 1,2,3)$ and the results are tabulated. From this table we conclude that D_r decreases with an increase in R_4 where R_4 has the dimension reciprocal of Reynolds number.

W-2E-4. A NUMERICAL SIMULATION OF DUST DEVIL AND ELECTRIC FIELD IN IT

N. HUANG, G. W. YUE, X. J. ZHENG, *Key Laboratory of Mechanics on Western Disaster and Environment, Lanzhou University, China,* On a hot and dry day in arid regions, it's common to see swirls of dust race across the landscape. The strong electric field of dust devils may be a possible nuisance or hazard to future human explorers on the surface of planets (Farrell et al., 2004), and therefore it is important to study electric field of field dust devils. Because it is difficult to get the detailed information of the electric field in dust devils through measurement, the simulation becomes an effective way to study the electric field of field dust devils. In this paper, based on the surface energy-balance equation and atmospheric movement equations, and Coulomb's law, the whole process of dust devil development and the electric field in dust devil is numerically simulated, then the simulated results of electric field are discussed and compared with field measurements. It is found that the simulated electric field agrees well with the measured result when the charge-mass ratio of sand grains with diameters of 0.15mm、0.2mm and 0.25mm are taken as $-120\mu C/kg$、$60\mu C/kg$ and $57\mu C/kg$, respectively. The results also show that for electric field in dust devil, it needs about 80s from the moment when some sand particles begin to be lifted off from bed (t=0) to the stage that the value of electric field becomes relatively stable. The absolute value of electric field at a given height always increases as the radius decreases and it will reach a maximum value at the center of dust devil. The absolute value of electric field in dust devil increases first and reaches a maximum at the height of 20m and then decreases with height.

10:40-12:00 (Room106)

Granular Flows

Session Chair : Prof. K. Hirata, Doshisha Univ/Japan

W-2F-1. NONLINEAR STABILITY OF GRANULAR SHEAR FLOW: LANDAU EQUATION AND SHEAR-BANDING

Priyanka SHUKLA, *Engineering Mechanics Unit, Jawaharlal Nehru Centre for Advanced Scientific Research, India,* Meheboob ALAM, *Engineering Mechanics Unit, Jawaharlal Nehru Centre for Advanced Scientific Research, India*, Starting from the continuum equations of rapid granular flows, we derived Landau equation for the plane Couette flow using both the amplitude-expansion method and the center-manifold reduction. Our amplitude `order-parameter' equation describes the onset and the subsequent dynamics of shear-band formation near the critical point. To find the actual behavior of flow due to finite-amplitude disturbances, we need to calculate Landau coefficient which can be expressed in terms of a suitable inner-product of the nonlinear terms and the eigenfunctions of the related adjoint problem. The numerical results on Landau coefficients suggest that there is a sub-critical *finite-amplitude* instability for dilute flows even though the dilute flow is stable according to the linear stability theory. This result is in agreement with previous molecular dynamics simulations of granular Couette flow as well as with the direct solution of nonlinear continuum equations. The scaling of equilibrium amplitudes with different control parameters as well as the effects of mean-flow distortion will be discussed.

W-2F-2. LARGE-SCALE STRUCTURES AND FLUCTUATIONS IN 3D GRANULAR POISEUILLE FLOW

Ashish MALIK and Meheboob ALAM, *Engineering Mechanics Unit, Jawaharlal Nehru Centre for Advanced Scientific Research, India,* Various macro- and micro-structural features of a gravity driven three-dimensional (3D) granular Poiseuille flow are studied in the rapid flow regime using event-driven simulation. A monodisperse system of rough, inelastic hard spheres interacting via hard core potential is considered. The collisions are assumed to be binary and instantaneous in which only momentum is conserved but the energy is non-conserved quantity. The wall-particle interactions are modeled using same collision dynamics as for particle-particle interaction. The structure formation in the form of large-scale density waves takes place under certain conditions. These density waves are affected by various parameters like the volume fraction, the coefficient of restitution and the aspect ratio of the simulation domain. In particular, these structures are driven by inelastic collisions of particles and hence these are dissipation-induced structures.

W-2F-3. INFERENCE OF FACTOR OF TRANSPORTATION EFFICIENCY IMPROVEMENT BY ROTARY FEEDER IN PLUG CONVEYING

K. KOFU, M. OCHI and M. TAKEI, *Department of Mechanical Engineering, College of Science & Technology, Nihon University, Japan,* In plug conveying system, it is desired that the transportation efficiency is improved. Then a rotary feeder is often used these days. However, the reason of the transportation efficiency improvement has not been clarified. Therefore this reason has been investigated experimentally. Two kinds of pipe diameters, i.e., 38 and 50 mm, were used. The pipe line length was about 11.4 m. Four kinds of particle-air mixing devices were used, and feeders were changed to a rotary feeder and a vessel in each experimental condition. As a result, there is no improvement of transportation efficiency by the rotary feeder in all experimental conditions, because there is little difference between the largest particle mass flow rate by the rotary feeder and that by the vessel. However, the deviation of plug length and velocity in a rotary feeder is smaller than that in a vessel under all experimental conditions. This is assumed as the improvement reason. In short, the number of incorporated plugs during transportation in a rotary feeder is smaller than that in a vessel. In this case, plug length are short, large air mass flow rate is not required to transport particles in a rotary feeder and transportation efficiency becomes large. It is thought there is no improvement because the total pipe length is short and combinations of plugs are seldom used in this study. Additionally, it is said that the effect by pipe diameter and volume of particle-air mixing device on transportation efficiency improvement is small. Some experimental conditions show that particle mass flow rate is not dependent on the number of vane rotation of a rotary feeder. This reason is also considered from the result of the particle velocity measured by the high speed camera and PIV in the particle-air mixing device. Particles in the upper part move smoothly in spite of the experimental conditions and kinds of particle-air mixing device, although it