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LEADING EDGE

Leading Edge, supported by the Society for Engineering in Agriculture and the Australian Centre for Precision Agriculture, provides a local and worldwide window on engineering and PA research.

Plotting particles blowing in the wind

The flight paths of particles blowing in the wind can now be predicted to improve materials handling processes in agriculture, mining and materials processing.

While design engineers and students are the main targets for this digitised revelation of the aerial movements of various particulate materials, this open-access computer program will help growers appreciate the complexities of grain, fibre and cane cleaning.

University of Melbourne agricultural engineer Ross Macmillan has harnessed the analytical power of modern computers crunching clever new analogues to predict how particles will move in various media such as air or other fluids.

"The study of the interaction of particles moving relative to fluids has had a long history and has led to many useful operations particularly in modern agriculture," Ross said. "Of special interest is the trajectory of particles and crop components but, until recently, it has not been possible to easily predict these."

The recent publication of Ross's Trajectory Plotting System, and an associated monograph giving examples of its application will help to satisfy this need.

"This new technology should find ready application in education, research and design in the agricultural engineering industries," Ross said.

Common occurrence but little understood

Particle movement in a fluid is a common occurrence. Many natural processes such as seeds blowing in the wind, raindrops falling to the earth and sand grains carried in a stream involve these complex but often unappreciated interactions.

Many modern machine operations in agriculture also involve the relative movement of particles in a fluid and require a detailed understanding if the machines are to be designed on a more analytical basis.

Many research engineers developed simple programs to predict particle trajectories in special situations. But it wasn't until 2006 that Ross perfected his computer program to predict accurately how particles will behave travelling in different media under varying conditions.

When small, solid particles are involved, the interest is usually in predicting their trajectory. Here particles are totally 'free' to move and rotate as a result of the gravity and the fluid drag forces and generally do so with a complex motion.

"But the common practical application in agriculture usually only requires the prediction of particle motion and the trajectory at the macro-level," Ross explained.

Current work

Ross' interest in fluid particle mechanics – and in particular the prediction of particle trajectories – arose out of the need to develop suitable course materials for training professional agricultural engineering students.

It was also driven by a certain frustration with the fact that existing methods were largely limited to the use of terminal velocity as a basis for separation processes. ■

WHAT IS THE TPS?

TPS is a computer program which calculates and plots the trajectories for up to 10 particles projected at any angle (or dropped) in any fluid with a velocity at any angle.

The particle is specified by its equivalent diameter and mass and the fluid by its density and viscosity. The drag force is calculated on the basis of the velocity of the particle relative to the fluid which is calculated by the program for each minute time step.

Further details on the use of the program are available from the User Manual and the associated monograph.

The TPS provides a readily available but powerful tool to aid in the design of new machines and insights into their operation.

Ross Macmillan offers a consultancy service for those who need help in using the program. For further information contact Ross at r.macmillan@devtech.unimelb.edu.au or access the free program downloads.

The trajectory plotting system: http://eprints.unimelb.edu.au/archive/00001513/ An associated 156pp monograph http://eprints.unimelb.edu.au/archive/00001514/ Both can be downloaded free of charge.