



Collaborative Graduate Specialization in Computational Science and Engineering

WEEKLY COLLOQUIUM

Tuesday, 7 March 2006

3:00-3:30 in Goodes 409

Speaker: Frank Secretain, M.Sc.(Eng) Student, Mechanical and Materials Engineering, Queen's University

Title: Integral conservation to discrete computation

Abstract: The general transport equations for fluid mechanics describe all the transport phenomena. Any measurable quantity such as mass, momentum, energy, etc. is conserved using the general transport equations; an example is the Navier-Stokes equations for conservation of momentum. The general transport equations were derived by conserving a quantity over an infinitesimal small control volume in the limit as dx , dy , dz and dt approaches zero.

In computational fluid dynamics (CFD), the equations are discretized using traditional Taylor series methods and solved. For direct numerical simulation (no approximations to the equations) the computational time increases drastically with the Reynolds number due to requirement to resolve the smallest scales of turbulence.

In this presentation a new approach will be demonstrated to derive the equations. I begin with a finite-sized control volume over which integral properties must be conserved and then introduce higher order Taylor series approximations for the transported quantities. Thus, a "new" general transport equation which contains higher order information at each control volume surface was developed. This eliminates the need to accommodate higher order differencing schemes onto what is inherently a second order equation. I will demonstrate, using a simple example, that traditional methods yield higher errors than this new approach.

About the speaker:

Frank is a M.Sc. student in the department of Mechanical and Materials Engineering working under the supervision of Dr. Andrew Pollard. He graduated in 2004 with a B.Sc. in Engineering Physics from Queen's. His research is in computational and experimental fluid mechanics. He is known around the world as a generally all-around great guy, an occasional bully, and an incredibly talented football player.