



COLLOQUIUM

Conform artikel 4.6.8 van het SSNS-wb.

Vakgroep: **Technische Stromingsleer**

In het kader van zijn doctoraalopdracht zal

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een voordracht houden getiteld:

Multi-level techniques for advection dominated flows

Datum: vrijdag 15 januari 2010

Tijd: 14:00

Zaal: Zuidhorst 286

Summary:

Computational fluid dynamics (CFD) is a crucial analysis tool in engineering fluid mechanics, as it gives detailed information about a flow and relevant flow parameters, which often cannot be obtained experimentally. CFD computations often involve solving a system of algebraic equations resulting from the approximation of the flow equations in each cell of a grid that covers the computational domain. Accurate solutions require small cell sizes resulting in very large systems of equations, which are very expensive in terms of computer time to solve. Methods based on multi-level techniques have the prospect of very efficiently solving large systems of equations iteratively. These methods make use of simple iterative processes and exploit coarser grids to accelerate convergence of the process on the finer target grid. For some elliptic problems like the ones governed by Laplace's equation, the implementation is straightforward and optimal efficiency is relatively easy to obtain.

However, for systems of equations resulting from the discretization of the equations governing fluid flows, i.e. the Navier Stokes or Euler equations, the standard methodology is often not very efficient, especially when convection dominates the flow. This inefficiency is caused by residual components that are slow to converge on the target grid and cannot be accurately represented on coarser grids. In this case special non-trivial measures need to be taken in the coarsening as well as in the iterative process in order to render the multi-level technique efficient again.

Using the scalar convection-diffusion equation as a model problem in this research, the sources of the loss of efficiency of the standard multi-grid techniques are revealed and remedies are described. These remedies are shown to work for both the standard geometric multi-grid technique as well as for the more general algebraic multi-grid technique.

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