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Vortragsankündigung

RANS & LES of Industrial Flows using the Immersed Surface Technology

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Kurzfassung
This talk will center on a fast and versatile grid generation technique for the LES of industrial fluid mechanics problems. The approach known as The Immersed Surfaces Technique (IST) dispenses from the use of conventional structured grids and finite-element unstructured type of grids, in that solid bodies are immersed within a Cartesian grid from a CAD file. The idea (which differs from the Immersed Boundary method of Peskin) is to represent solid walls by a Level Set function representing the exact distance to the surface, which is zero at the surface, positive in the fluid(s) and negative in the solid. The fluid(s) and the solid have their own material properties, based on the Level Set function: density, heat capacity and thermal conductivity,

$$\rho, Cp, \lambda = \rho, Cp, \lambda\big|_L . H(\phi_s) + \rho, Cp, \lambda\big|_S .[1 - H(\phi_s)]$$

where $H(\phi_s)$ is a modified Heaviside function needed to represent the solid surfaces in a smooth way. The technique has the major advantage to solve conjugate heat transfer problems, in that conduction inside the body is directly linked to external fluid convection. In practice, the CAD file of the solid is first immersed into a cubical grid covered by a Cartesian mesh (Fig. 1). The Navier-Stokes equations are modified to account for the presence of the solid level set function. The treatment of viscous shear at the solid surfaces is handled very much the same way as in conventional CFD codes, where the wall normal vector needed to estimate the wall shear ($\tau_w = \mu \partial\vec{u} / \partial\vec{n}$) is obtained from solid level-set function, using $\vec{n} = \nabla.\phi_s$.

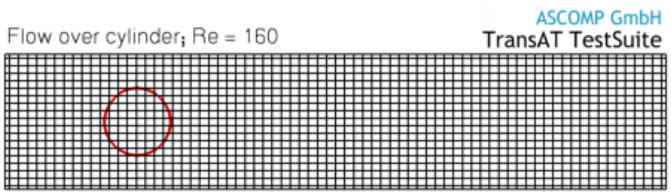

Figure 1: Representation of circular pipes using IST.

The BMR technique (Block Mesh Refinement) was developed to help better solve the boundary layer zone when use is made of the IST technique discussed above. In BMR, more refined sub-blocks are automatically generated around solid surfaces; with dimensions made dependent on the Reynolds number (the sub-block scale should always be set such that it covers the boundary layer thickness). An unlimited number of sub-blocks of different

refinement can be generated, with connectivity between the blocks matching up to 1-to-8 cells. This method can save up to 75% grid cells in 3D, because it prevents clustering structured grids where unnecessary.

The method has been validated for canonical laminar and turbulent flows, and is now under evaluation for its extension to LES. Various examples will be presented; limitations and issues will be discussed as well.

Zeit und Ort:
Montag, 17. November 2008, 14:00 Uhr
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