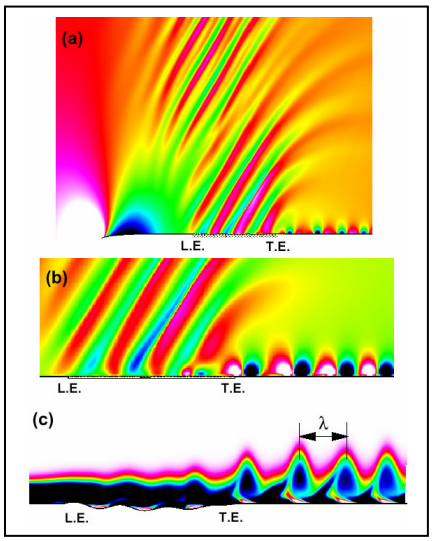
KTH Computational Science & Engineering Seminar

Date: **Wednesday 2005-02-16 kl 15.30 (coffee 15:00)**
Room **PDC seminar room, Teknikringen 14, level 3**

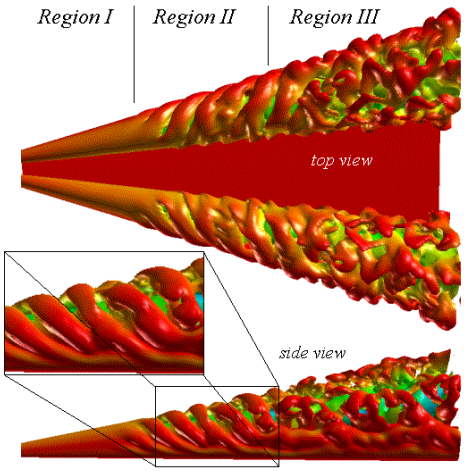
Advances in the Application of Higher-Order Finite-Difference Schemes to Multidisciplinary Simulation on General Geometries

Miguel R. Visbal
Computational Sciences Branch,Air Vehicles Directorate
Air Force Research Laboratory, Wright-Patterson AFB, OH 45433
miguel.visbal@wpafb.af.mil

This presentation will review recent progress achieved in the application of high-order finite difference schemes to the solution of multi-physics conservation laws on stretched, curvilinear, overset and deforming meshes. We focus primarily on 4^{th}- and 6^{th} –order compact schemes coupled with up to 10^{th}-order low-pass spatial Pade-type filters. These spatial algorithms are combined with explicit and implicit time integration methods to examine wave propagation in electromagnetics and acoustics, as well as turbulence and fluid-structure interactions for wall-bounded viscous flows described by the Navier-Stokes equations. It is shown that without the incorporation of the filter, application of the high-order compact scheme to non-smooth collocated meshes results in spurious oscillations which inhibit their applicability. Inclusion of a discriminating low-pass high-order filter restores the advantages of the high-order approach even in the presence of localized grid discontinuities. The filter operator in combination with highly stretched meshes also provides an alternative robust treatment for far field radiation conditions in wave propagation. When three-dimensional curvilinear meshes are employed, the use of standard metric evaluation procedures significantly degrades the accuracy if freestream preservation is violated. To overcome this difficulty, a simple technique is adopted which enforces the geometric conservation law even on highly distorted and deforming curvilinear grids. Development of one-sided high-order filter operators permits the extension of the procedure to multi-domain applications, as required in domain decomposition strategies. Finally, incorporation of high-order interpolation techniques enables the extension of the approach to non-coincident overlap meshes typically encountered in complex geometries. The presentation will describe the various elements of this finite-difference based high-order methodology, and will highlight its accuracy and versatility through applications ranging from acoustic and electromagnetic scattering to Large-Eddy-Simulation (LES) of turbulent flows.



Acoustic radiation and boundary- layer transition over a flexible panel.



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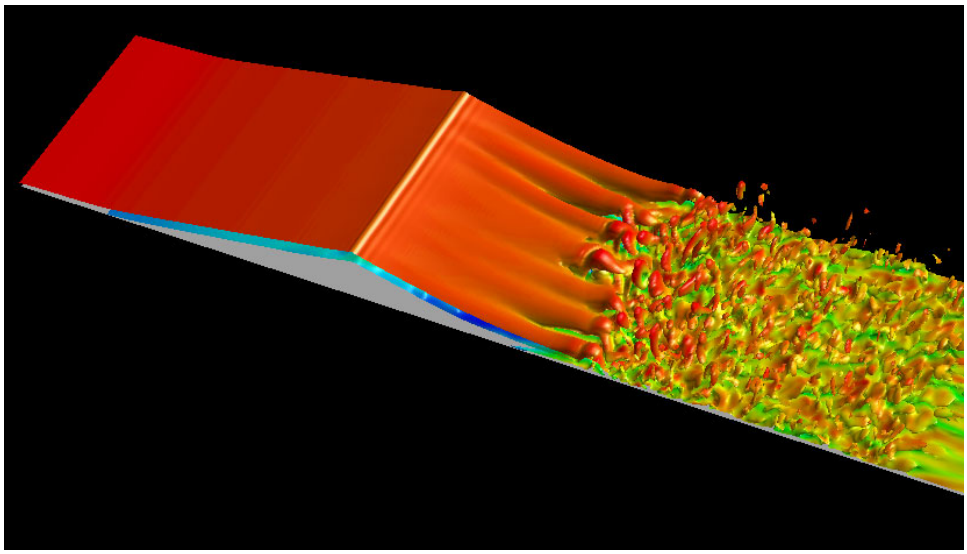

Transitional shock wave / boundary layer interaction generated by an impinging shock at Mach 2