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by geometric domain-of-dependence requirements. Thus high-order Hermite methods maximize the computation-to-communication ratio and therefore they admit highly efficient implementations on multicore processors. In this talk we focus on the application of Hermite methods to simulate unsteady compressible flows. Examples will include the direct simulation of the aeroacoustics of a low Reynolds number subsonic jet, as well as studies of more basic sound radiating flows. The latter will illustrate the coupling of Hermite methods with more standard discontinuous Galerkin discretizations to handle physical boundaries.

**10:40–11:00 Break**

**11:00**

**4aHT5. Effect of Riemann flux solver on the accuracy of spectral difference method for CAA problems.** Junhui Gao, Xiaodong Li (Beihang University, Beijing, China, gaojhui@buaa.edu.cn), and Qiqi Wang (Massachusetts Institute of Technology, Cambridge, MA 02139, U.S.A.)

The spectral difference (SD) method is a new high-order method for unstructured grids proposed recently by Liu et al. (2006). In this paper, a two dimensional computation aeroacoustics (CAA) tool based on SD method is developed. Five Riemann solvers are implemented in the current code, including Roe scheme, advection upstream splitting method (AUSM), flux-vector-splitting scheme, Rusanov scheme, convective upwind and split pressure (CUSP) scheme. A comparison of these Riemann solvers is carried out with three CAA workshop benchmark problems. The relative error of each solver in simulating of entropy, vorticity and acoustic waves is presented. The accuracy of the SD method with each Riemann solver is obtained. It is found that the usually used Rusanov scheme is less accurate than other solvers. AUSM and CUSP schemes are more accurate than others in simulating acoustic waves. Meanwhile, the effect of mesh quality on the accuracy of SD method is investigated. Gaussian distributed random error is superimposed on a base mesh to change the mesh quality. The accuracy of each solver on the skewed mesh is presented and compared with the results on base mesh. It is shown that mesh quality has little effect on the accuracy of SD method if the mesh resolution is sufficient.

**11:20**

**4aHT6. Assessment of nonlinear perfectly matched layer boundary conditions for CAA benchmark problems.** Dakai Lin (Beijing Aeronautical Science & Technology Research Institute of COMAC, lindakai@comac.cc), Xiaodong Li (School of Jet Propulsion, Beihang University, China), and Fang Q. Hu (Department of Mathematics and Statistics, Old Dominion University)

Non-Reflecting Boundary Conditions (NRBCs) are very crucial for accurate numerical simulation of aeroacoustic problems. This paper aims to assess the performances of recently developed nonlinear Perfectly Matched Layer (PML) NRBCs by several Computational Aeroacoustics (CAA) benchmark problems through the comparison with the linearized PML, the characteristic and the asymptotic NRBCs. Numerical results show that the performances of the nonlinear PML NRBCs are tantamount to each other, and there is no substantial difference. But for strongly nonlinear cases, the error caused by using nonlinear PML NRBC is 1~2 orders of magnitude smaller than the one caused by using the linearized PML NRBC. Thus, using nonlinear PML is necessary in strong nonlinear aeroacoustic problems. Numerical tests also demonstrate that the nonlinear PML NRBCs outperform the characteristic NRBCs significantly, and have better performances than the asymptotic NRBCs.

**11:40**

**4aHT7. Control of edge-scattering noise via permeable surfaces.** Young J. Moon, Ikhyun Bai, and Seungtae Hwang (Korea University, School of Mechanical Engineering, Seoul 136-701, Korea, yjmoon@korea.ac.kr)

The edge-scattering noise generation mechanism is first studied, in line with the existing thoeries of Howe, Amiet, and others. Then the edge-scattering noise is controlled by attempting various permeable edges such as porous surfaces and slitted edges. The basic underlying mechanism of noise reduction is to be understood, examining the three-dimensional scattering of a line-vortex embedded in the laminar boundary layer over the flat plate with the porous and slitted trailing-edges. More realistic investigations will follow by the large-edge simulation (LES) of a turbulent boundary layer over the flat plate, solving the filtered, three-dimensional, compressible Navier-Stokes equations with the six-order compact finite-difference scheme and the four-stage Runge-Kutta method.

**12:00**

**4aHT8. Control of weak perturbations.** J. E. Ffowcs Williams (Emmanuel College, University of Cambridge, Cambridge CB2 3AP, U.K, jef1000@cam.ac.uk), and L. Huang (Dept of Mechanical Engineering, University of Hong Kong, China)

We define sound as being a weak perturbation in the properties of material consistent with the Navier-Stokes and continuity equations. Lighthill's pioneering paper on aerodynamic noise gives an exact theory that enables interesting connections to be made between flow and sound. Aerodynamic noise being caused by quadrupoles is a good point of view, but what caused the quadrupoles? Were they possibly initiated by sound? Conclusions deduced from such a theory are not necessarily helpful, but they are true and might be very helpful indeed. The linear perturbations we call sound obey linear rules and it can be suppressed by anti-sound, a subject now becoming both practical and useful. The same must apply to any weak perturbation of a dynamic system perturbed from rest. Some perturbations are unstable and grow exponentially in their early weak state. They might be eliminated altogether by suppressing their linear form. The Rijke tube experiment shows that to be practical and shows also the close similarity that exists between acoustics and control theory. The lecture will give more examples of that type and suggest others that have yet to be demonstrated.