Development of Numerical Tools for Computational AeroAcoustics

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Summary:

The work done in this dissertation was situated in the field of Computational Aero Acoustics. The exponential growth in computational power over the last decade has lead to a growing domain of research where the use of computational fluid dynamics techniques is applied in the field of aero acoustics. Present state-of-the-art methods use a hybrid approach where the calculation of the sound generating process is separated from the calculation of the transport of the sound to the far field. In this work, this hybrid approach was followed and the necessary tools were researched and developed. The main idea was to extend the existing compressible flow solver Euranus towards Large Eddy Simulations for near field noise computation and to develop a code which could compute the sound, based on the LES computation, for an observer far away from the sound source. In this work high order upwind type schemes with low diffusion and dispersion errors were developed and discussed. A new way for optimizing time integration schemes to minimize the total diffusion and dispersion errors was proposed. Two different types of boundary conditions were implemented and tested on their performance in CAA computations. For the far field noise computations, two codes were developed, tested and compared to each other. Finally, all those tools were brought together to perform a LES calculation of a circular cylinder in cross flow, on which an acoustic post processing was done with the developed far field solver.