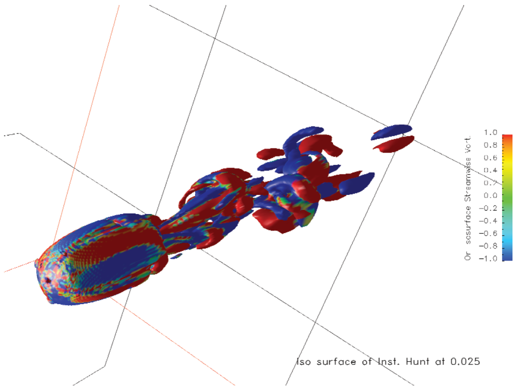
TURBULENT FLOWS SIMULATION

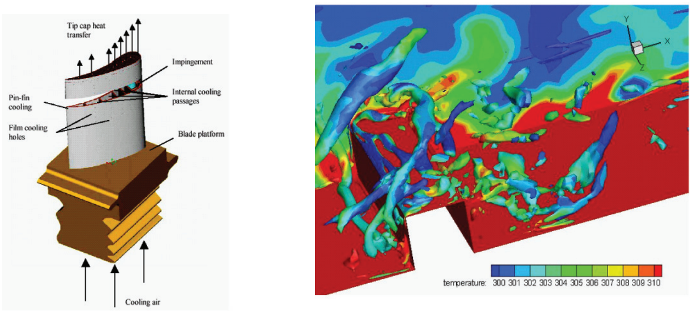
Numerical simulation is the most powerful tool available to investigate the fundamental aspects of turbulence, such as the coherent structures (Direct Numerical Simulation: DNS, Large-Eddy Simulation: LES) and study practical applications such as atmospheric flows, pollutant dispersal, flow around bluff bodies, heat transfer, industrial processes and aeroacoustics (LES; Reynolds-Averaged Navier-Stokes: RANS). Both aspects are explored at the VKI, applying in-house codes, commercial and open source general flow solvers.



Visualization of coherent structures in turbulent flow around a sphere. Re=3,700 (blue-red is the sign of the streamwise vorticity. MIOMA in-house code)

HEAT TRANSFER IN INTERNAL FLOWS

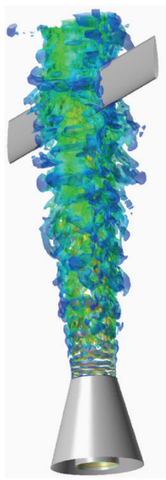
The understanding of turbulent heat transfer and of the action of turbulence promoters is indispensable to design efficient cooling systems, such as the ribbed ducts for internal cooling of turbine blades.



Visualization of the interaction of coherent structures and temperature field in ribbed duct. Re=40,000. LES (fluent 6.3)

AEROACOUSTICS

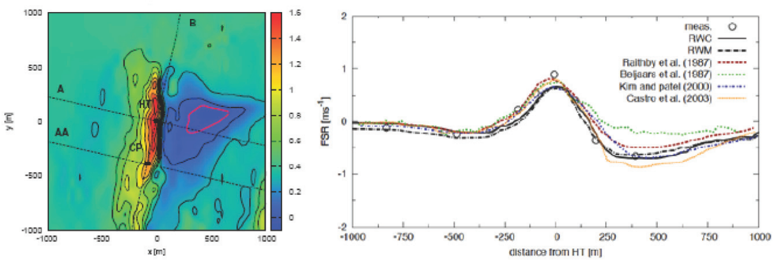
In aeroacoustics, the sources of sound should be computed accurately, reproducing most of the energy content of the turbulent flow to obtain a correct sound prediction. Therefore, LES based methods imposed themselves as reliable and powerful tools for hybrid methods, separating the sources of sound computation from the sound propagation itself.



Instantaneous flow field for the study ofjet-airfoil leading edge noise. Coherent structures colored by velocity magnitude (OpenFoam)

ATMOSPHERIC FLOWS

The simulation of the atmospheric boundary layer is indispensable to evaluate the effect of wind on buildings, pollutant dispersal and location of wind farms.



Simulation of flow over Askervein hill. Left: wall shear stress; right: fractional speed-up ratio. RANS (OpenFoam)

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