1. Flow around a Protoceratopus

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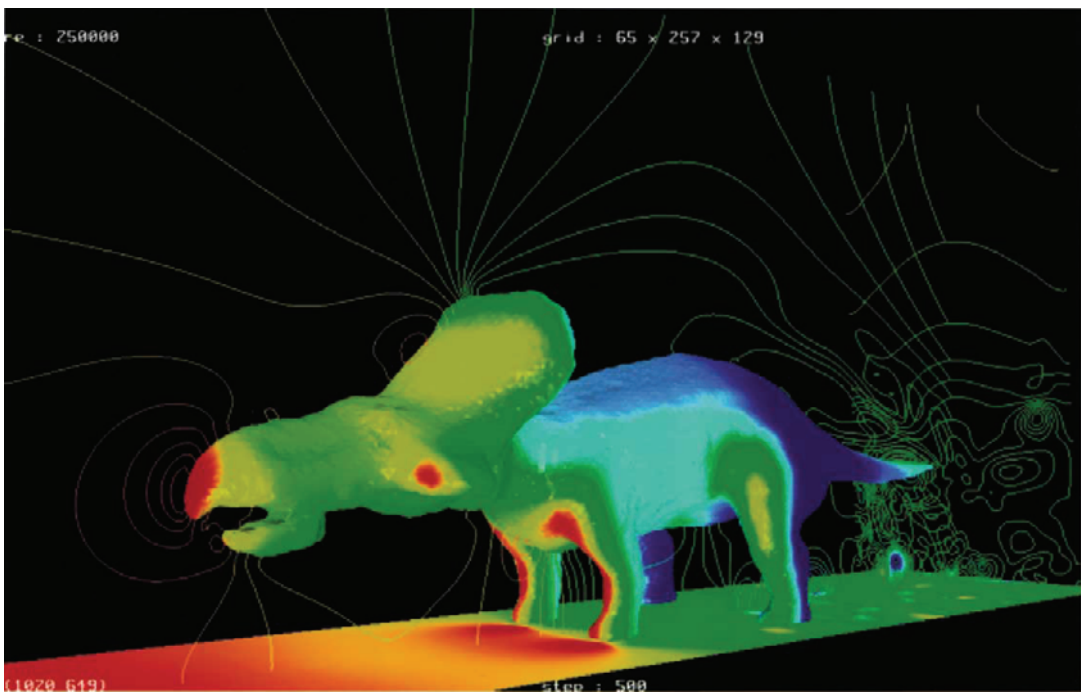

Flow around a complicated shape is very difficult because of the grid generation. In the present approach we used a Cartesian coordinate system with equal spacing for the three directions. Inside the body the velocity components are simply set to be zero. The Navier-Stokes equations are directly solved by a finite-difference method without using any turbulence model at Reynolds number 250 000. The number of the grid points is 64×257×129. The pressure distribution on the surface of the body and the ground is visualized by shading. Also the pressure contour lines in the central plane and in a plane perpendicular to the flow direction are drawn. The computation was performed on DEC alpha based single CPU personal computer ALEPH533.

2. Numerical Simulation of Flowfield around Helicopter Rotor by Moving Overlapped Grid Method

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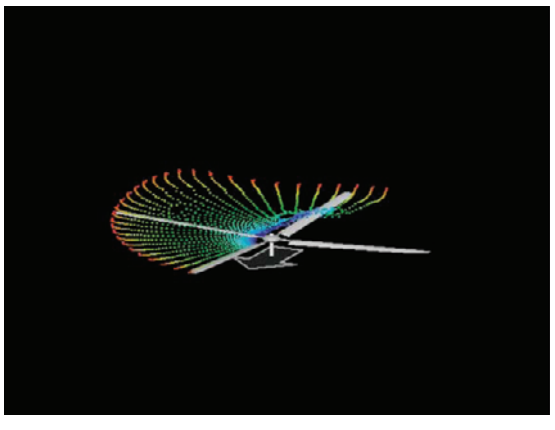

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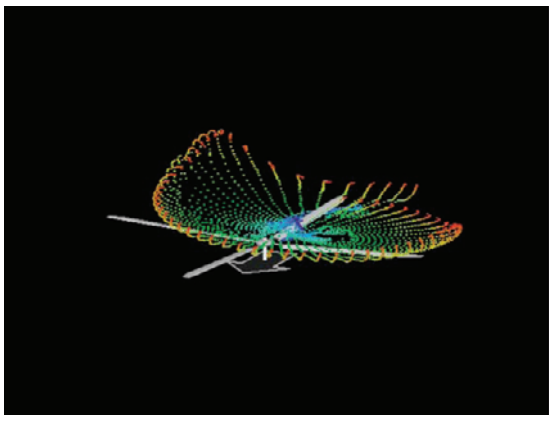

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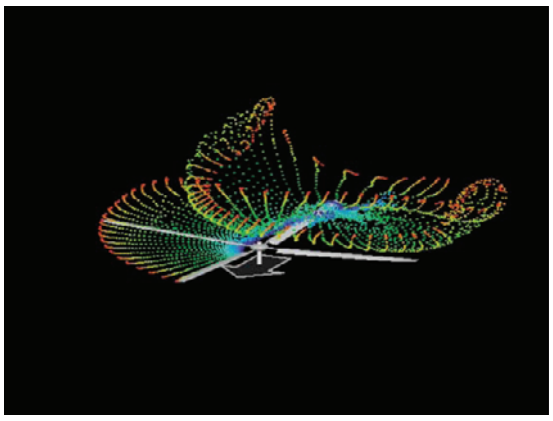

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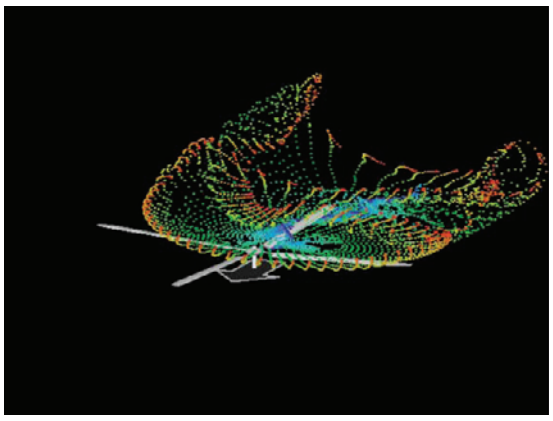

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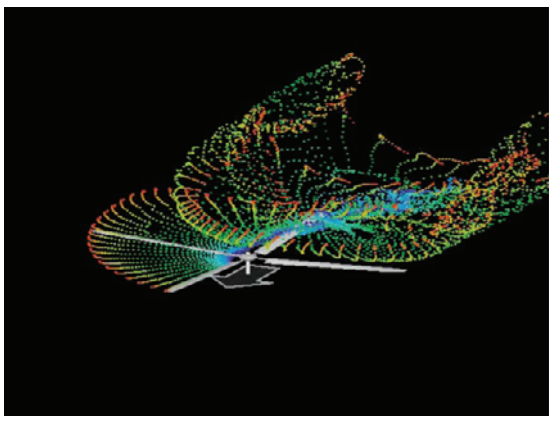

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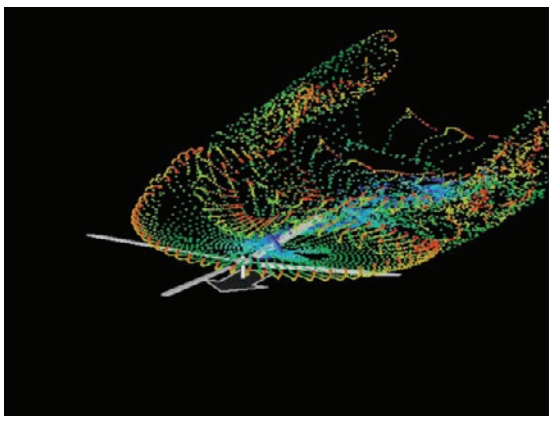

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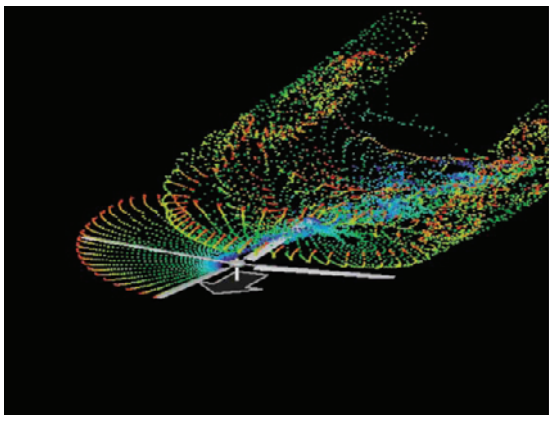

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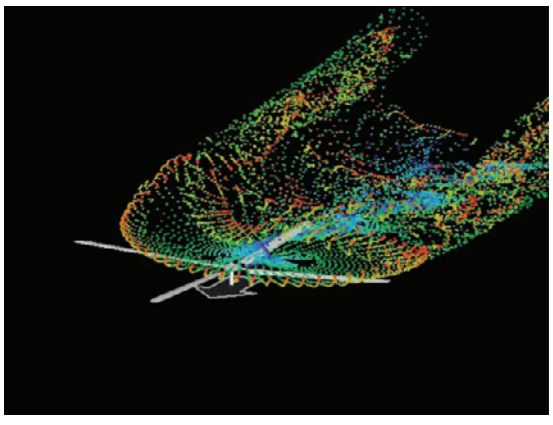

2.8

The flowfield around a 4-bladed helicopter rotor in a descending flight condition is simulated by an unsteady Euler code and visualized by particle trace in these figures. The phenomenon of roll-up is clearly observed. The Euler code employs a moving overlapped grid method in order to accurately capture the complicated flowfield around a helicopter rotor. The total number of grid points is about 5,320,000. This calculation is performed on a parallel vector super computer, Numerical Wind Tunnel (NWT), in NAL. The CPU time for three rotor revolutions is about 50 hours by using 24 processing elements.