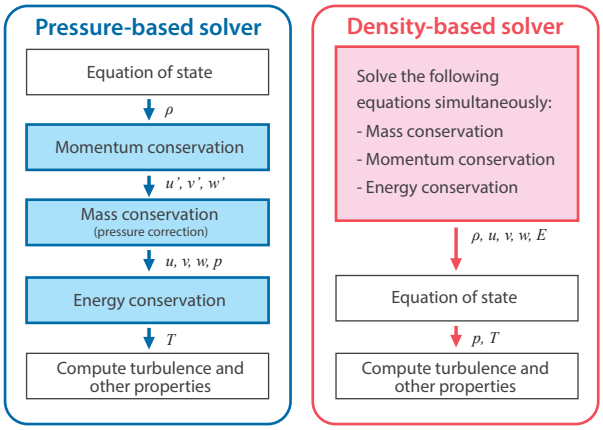
Density-Based Solver

scFLOW Function

Conducting highly stable and accurate analyses of high speed compressible flow using scFLOW

What is Density-Based Solver?



Compressible fluid can be analyzed using pressure-based solver or density-based solver. Former approach solves mass, momentum, and energy conservation equations separately and is suitable for analyzing flow field of relatively slow flows. Latter approach solves above-mentioned equations simultaneously, and is suitable for analyzing flow field of transonic or supersonic flows.

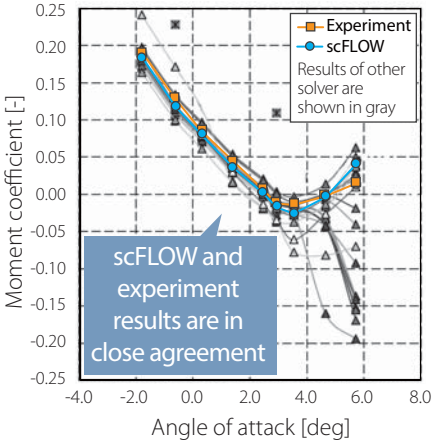
Density-based solver of scFLOW, in which newly invented Rotated-RHLL Approximate Rieman Solver is applied, can stably and accurately simulate shock waves and expansion waves, which are identified in high speed compressible flows.

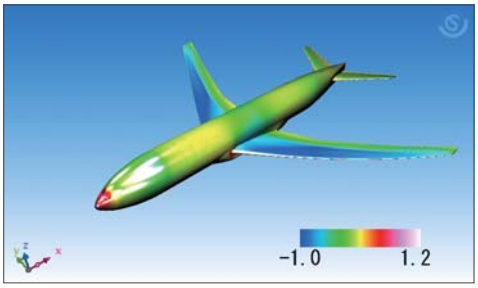
Application examples

Analyses of transonic flow around airplane*1

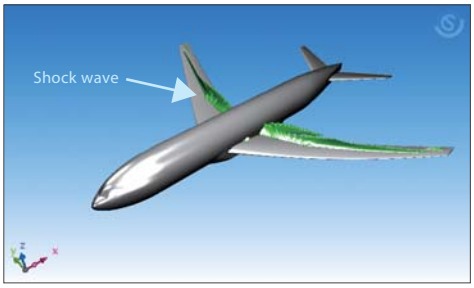
*1 Reference: AIAA2016-1780, JAXA-SP-17-001

*2 Reference: Bazhenova, T. V. et al., "Unsteady interactions of shock waves," Prog. Aerospace Sci., 1984.





Pressure coefficient

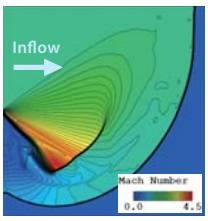


Shock wave function

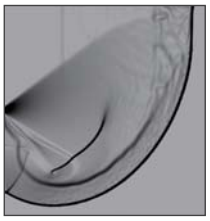
Flow around airplane flying at Mach number of 0.8 was analyzed. Changes in the calculated moment coefficient caused by changes in angles of attack were in close agreement with results of wind tunnel experiment. Shock wave appears on the wing surface in the case of high angle of attack.

Analysis of shock wave diffraction

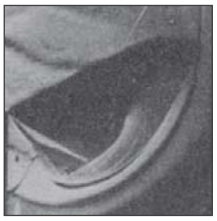
scFLOW Analysis Results



Distribution of Mach number



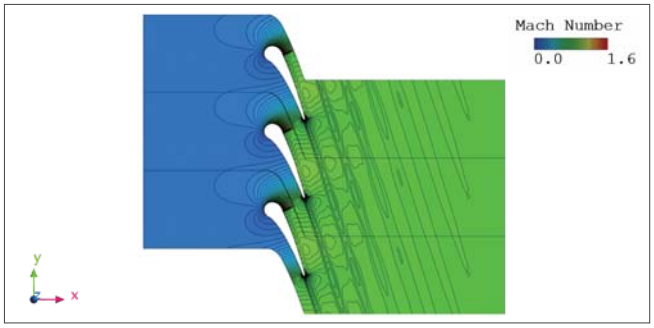
Pseudo Schlieren



Schlieren photograph (experiment *2)

Diffraction of shock wave was analyzed. Shock wave comes from left side half up. Color shades visualized using pseudo Schlieren variable was in close agreement with Schlieren photograph on right. Overall, shock wave phenomenon was simulated accurately.

Analysis of blade cascade



A flow passing through blade cascade was analyzed. Shock waves appear on blade surfaces. Analysis was performed for one entire blade and periodic boundary conditions were applied.

Notes

Density-based solver of scFLOW enables users to simulate high speed compressible flows for various applications because this solver can be used with many physical functions, such as moving objects and thermal analysis of solid objects etc.