Flow Instabilities Associated with a Shock in Two-Dimensional Supersonic Cascade: Part 2 - Numerical Investigation for Inviscid Flow

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1. Introduction

In the first report, unsteady phenomena called "forward traveling fluctuation" was observed in a viscous flow analysis of two-dimensional supersonic cascade flow[1] . Euler calculations were carried out in the present paper to clarify the effect of the viscosity on these phenomena[2].

2. Numerical method

The calculation method is the same as the first report, except for that the flow is inviscid.

The computational grid consists of 71144 nodes. The distance between the blade trailing edge and the outlet boundary was enlarged from viscous calculations in order that the shock from the cascade should not reflect at the outlet boundary.

3. Results and conclusions

Figure 1 shows the performance curves. All of the flows in Fig. 1 became choked by the unique incidence. Unsteady phenomena were observed at operation points with labels A' – Q'. Circumferentially traveling fluctuations were found in the points with circled labels. Except for the operation points A' and E, 'it was found that they correspond to forward traveling fluctuation with oscillating passage shock shown in the first report. It was concluded that the contribution of the viscosity to this fluctuation was little because the occurrence region was enlarged in the present Euler calculations.

Figure 2 shows the static pressure contour at operation point D'. The higher pressure region in the downstream region moves 17% faster than the rotor

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speed. It is easily seen that the contour of the front of this region becomes dense, showing that shock wave is formed at the front. Blade passage shocks merge with the front of the higher pressure region when it approaches, which is different from viscous case.

References

(1) Iwamoto Y., Yokota K. and Tsujimoto Y., *J. GTSJ*, 30-1(2002-1), pp. 55-62, in Japanese.
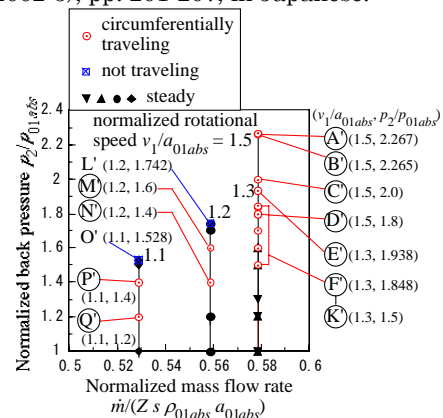(2) Iwamoto Y., Yokota K. and Tsujimoto Y., *J. GTSJ*, 30-3(2002-5), pp. 201-207, in Japanese.

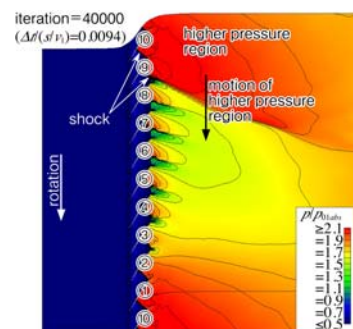**Fig. 1 Performance curves by 10 blades inviscid calculations**

Fig. 2 Static pressure contour observed at operation point D' (increment of p/p_{01abs} = 0.1)