IMPROVED PRESSURE-VELOCITY COUPLED ALGORITHM FOR COMPRESSIBLE FLOW

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In this paper, an improved pressure-velocity coupled computational fluid dynamics algorithm for numerical analysis of compressible flow with the discontinuous phenomena as like shock waves was described.

The pressure-velocity coupled algorithm to analyse at various flow speeds was studied by Drawish[1]. In that paper, they demonstrated that the developed algorithm works well in flow fields at various speeds. The other hand, the pressure-enthalpy coupling scheme for the simulation with high change of enthalpy was performed Emans[2]. This algorithm was adapted to analyse for engine flow problems.

Kraposhin[3] has applied the Kurganov-Tadmor flux splitting scheme, which is mainly used in density-based solvers, to the pressure-based algorithm of OpenFOAM. In that study, they proved that flux splitting schemes are appropriate to interpret the discontinuous flow phenomena as a pressure-based algorithm.

In this study, the Kurganov-Tadmor flux splitting scheme, developed by Kraposhin[3], was applied to a developed coupled algorithms and a verification analysis of compressible flow problems were performed using the developed solver. It was confirmed that the developed solver had the similar analytical ability with that of the other numerical codes through the analysis of the shock wave induced problems in the supersonic flow region. In order to verify the analytical ability for the transonic flow region of the developed solver, the external flow problems were analyzed and compared with results of experiments and other numerical analysis codes. It is confirmed that the analytical ability of developed solver in the high speed flow region such as supersonic and transonic is somewhat improved than the commercial analysis package and is similar to the density based in-house CFD code.
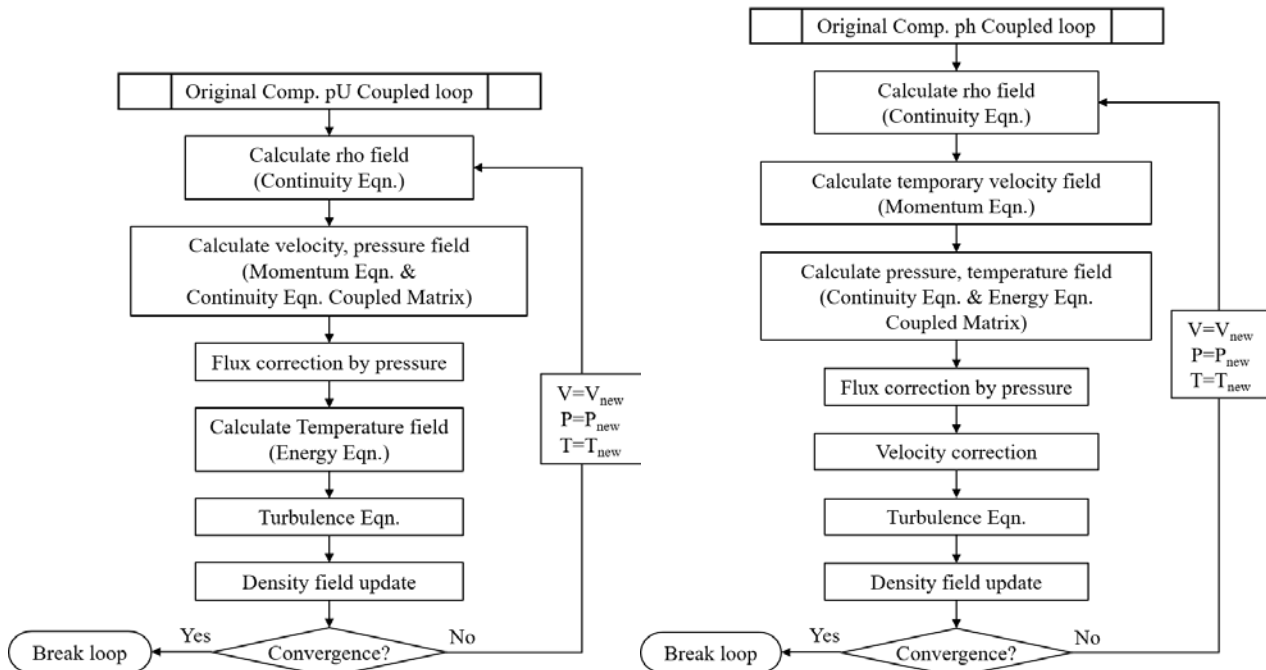

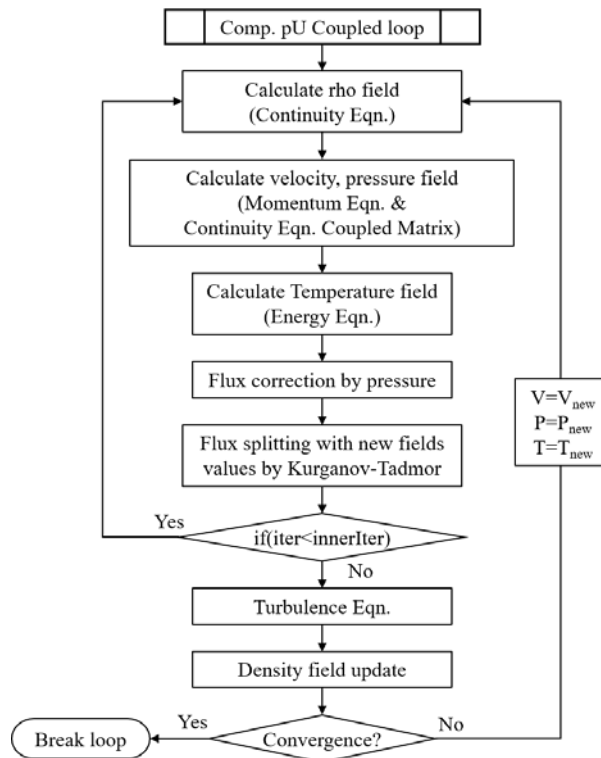**Figure 1: The original algorithms of coupled numerical analysis**

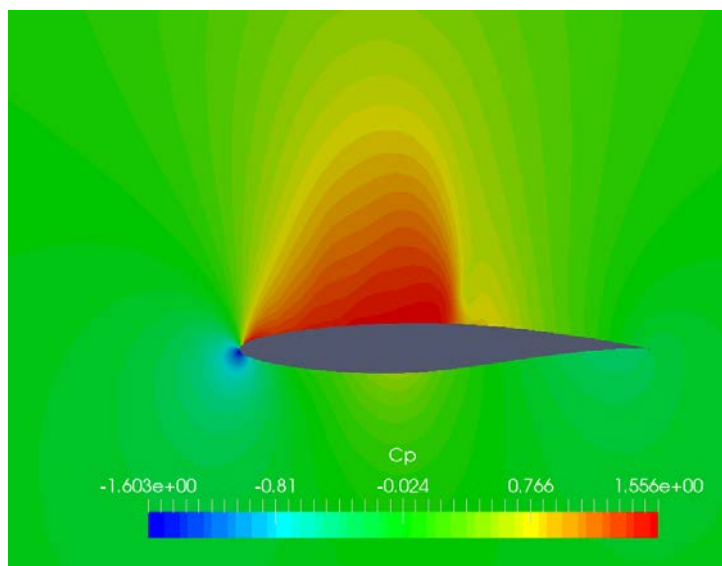**Figure 2: The developed algorithm of coupled numerical analysis**

Figure 3: pressure contour results around RAE 2822

References

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[3] M. Kraposhin, A. Bovtrikova, S. Strijhak, Adaptation of Kurganov-Tadmor Numerical Scheme For Applying in Combination With the PISO Methodin Numerical Simulation of Flows in a Wide Range of Mach Numbers, Procedia Computer Science, Vol. 66, pp. 43-52, 2015.