1. Title

2. Research Term
FY2002–2003

3. Research Fields
Microgravity Science

4. Research Categories
Germinating Research

5. Research Theme
Numerical Method for Thermal Convection with Nonequilibrium Condensation

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8. Summary of Research

A numerical method for solving thermal convective flows with condensation at low gravity was developed. This is based on the preconditioned flux-splitting scheme and this scheme was applied to the numerical method for solving compressible condensate flows already developed by the author to recreate the present method. Natural convections around a circular cylinder in atmosphere at 1g and low gravity were calculated using the present method. Then, it was found that the condensation which occurs around the cylinder was deeply dependent on the gravitational force. The present method could apply such almost a static field at low gravity without the so-called stiff problem which ordinary compressible flow solvers face if they apply to very slow flows. This work was presented in the 4th ASME-JSME Joint Fluids Engineering Conference, Honolulu on July 2003. At the point of the applicability of the present method to such static fields, it was suggested that the present method could also apply to the calculation of heat conductions in a solid. Consequently, the present method was successfully extended to a method for solving fluid and solid coupling problems. Natural convections around the circular cylinder and the heat conduction in the solid region of the cylinder could be calculated accurately and simultaneously by using the present method. This work will be published in the Int. Journal Heat and Mass transfer. In addition to the above work, the present method was further modified by the equations derived from the Peng-Robinson equation of state(EOS) for solving thermal convective flows in supercritical region. The introduction of the EOS to the present method could enable us to the calculations of not only supercritical water but also supercritical carbon dioxide and supercritical hydrogen. This work will be presented in two international conferences held at Canada and Finland on July 2004. Finally, the present method would be a very useful tool to pre-conduct the experiments on condensations and supercritical fluids in the space laboratory at the ground, because the actual experiments in the space laboratory should be limited by the flight time and the working cost.

9. Publication List


10. URL

http://www.caero.mech.tohoku.ac.jp