## A Computational Study on The Characteristics of Asymmetric Vortex and Side Force of Tangent-Ogive-Cylinder Flight Vehicle at Various Angles of Attack

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Flight vehicles such as tangent-ogive-cylinders encounter frequently high angles of attack flight conditions. Under very high angles of attack flight conditions, asymmetric vortices and side force are generated causing unwanted side slip forces and moments, and thus additional yaw control methods may have to be required for stable vehicle operation(1)(2)(3). The flow characteristics of asymmetric vortex and side force of tangent-ogive-cylinder flight vehicle at high angles of attack have been studied by using upwind Navier-Stokes method with the k- $\omega$  turbulence model(4) along with simple laminar-turbulent transition model(5). In this study, the asymmetric vortex and side force were introduced by using artificially different asymmetric turbulent transition location. And the effects of changing angles of attack(Fig. 1) are studied by using the same asymmetric turbulent transition condition and modified condition by streamwise Reynoldes number(6).



Fig.1 Comparison of local side force coefficient distribution

## References

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