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Ultra-fine roughness effect on a flat plate boundary layer transition[1] AIKO YAKENO, HIROKI TAMEIKE, SHIGERU OBAYASHI, Tohoku University — To reduce the viscous drag around an airfoil, delaying turbulence transition is one of the effective ways. In this study, we analyzed the influence of very small wavy roughness on the two-dimensional boundary layer transition with Direct Numerical Simulation, by resolving each small roughness. First, we found that the transition considerably depended on the streamwise grid resolution. Insufficient resolution in the streamwise direction may mislead to delay the transition. In the study, as many as 400 grid points were used in the boundary layer thickness. Second, it was noted that the transition delayed when the roughness wavelength was longer, even if the roughness height was increased to 1.5 times of the inflow boundary layer thickness. We examined the vortices generated based on the stability analysis. The vortex scales converted as frequencies were compared with the neutral stability curve of the Blasius flow for the Tollmien-Schlichting wave. Almost vortices located in the unstable region and some were shifted in the stable one. The small wavy roughness modified the near-wall pressure distribution. In the long-wavelength case, transition delayed with the background boundary layer modification.

[1]This presentation is based on results obtained from a project commissioned by the New Energy and Industrial Technology Development Organization (NEDO).

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