

# Lift-enhancing effects of mini flaps at low Reynolds number

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## ABSTRACT

The objective of this study is to evaluate effects of mini flaps on a NACA0012 airfoil at low Reynolds number. Mini flaps are thin and small flat plates attached to trailing edge of the airfoil perpendicularly. All experiments are conducted at the Tohoku-university Basic Aerodynamic Research Tunnel at Reynolds number of 25,000. In addition to force measurements, skin friction distributions were measured by Global Luminescent Oil Film (GLOF), and wake distributions were also measured by hot wire anemometer. Furthermore, flows around the airfoil were visualized by smoke wire method. The results of force measurements say that lift is strongly enhanced by attaching mini flaps, and the rate of lift increment is larger, as flap height becomes higher [Fig.1]. The results of GLOF show that the airfoil with mini flaps have larger separation area on both upper and lower surfaces [Fig.2], and wake distribution measurements indicate that these separations are followed by unsteady phenomena [Fig.3]. Smoke wire method reveals that separation on both upper and lower surfaces truly occurs faster than the one of clean airfoil, and obviously unsteadiness of flow around the airfoil is increased [Fig.4]. Summarizing and analyzing all the results, flow on lower surface separates at the bottom of mini flaps, generating unsteady large vortices. These vortices interfere with the wake of upper flow, making it far more unsteady. Then, separation on upper surface occurs faster, and unsteadiness of flow around the airfoil becomes extremely larger, so lift of the airfoil with mini flaps becomes enhanced.

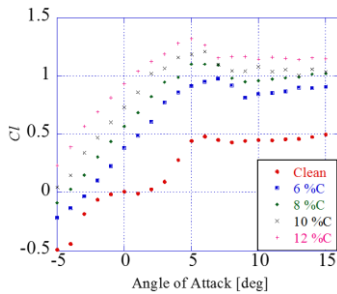


Fig. 1. Lift curve

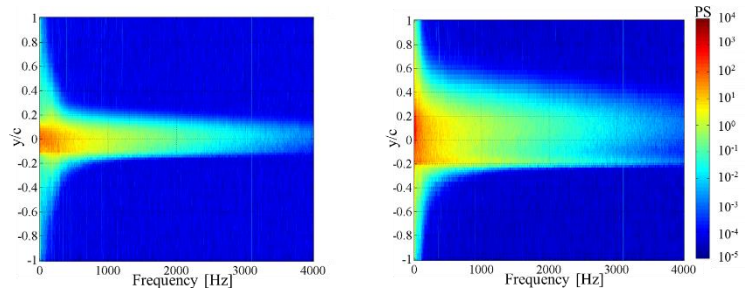


Fig. 3. Power spectrum of wake velocity fluctuation at AoA 6deg  
(Left : Clean airfoil, Right : Airfoil with mini flap)

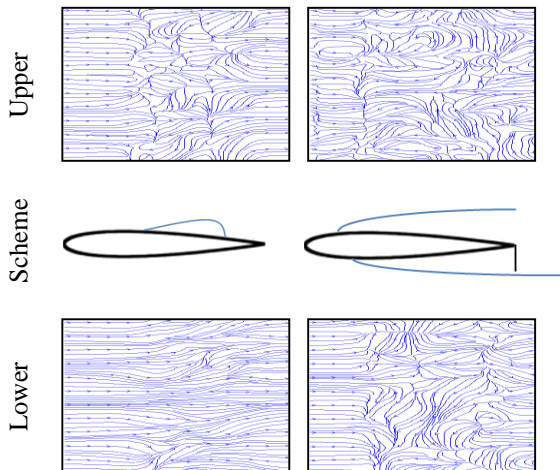


Fig. 2. Visualization of skin friction at AoA 6 deg  
(Left : Clean airfoil, Right : Airfoil with mini flap)

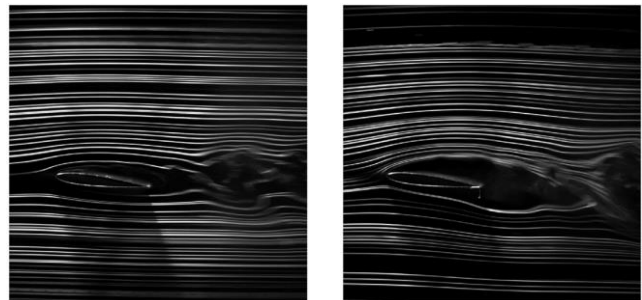


Fig 4. Flow visualization at AoA 6 deg  
(Left : Clean airfoil, Right : Airfoil with mini flap)