Enhanced Smoke Wire Technique with Control Dripping Valve in a Small Scaled Quasi-atmospheric Boundary Layer Wind Tunnel

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Abstract In the previous work, fabricated smoke wire technique in an atmospheric boundary layer wind tunnel displayed several flaws during experiment such as manual-dripped solution, leaking problem, utilisation of single heated wire, and an ineffective wire heating system in which the electrical circuit did not operated with desired optimum output to heat the wire efficiently. Therefore, present study fabricates an improved smoke wire technique with a control dripping valve to control the dripped-liquid solution quantity and frequency and aims to perform a qualitative investigation to visualize the flow pattern around a simple two-dimensional rigid body namely rectangular and cylinder. The experiment was conducted in a shorter test section of the quasi-atmospheric boundary layer wind tunnel. The wind tunnel has a working section of 0.3 m height and 0.3 m width with a streamwise length of 1 m. The enhanced fabrication successfully produced a continuous and high-quality smoke lines which utilised 10 lines of nichrome wires in a series circuit compared to a single wire in the previous work. The smoke visualization for the combination of 0.4 mm nichrome wire (type C) with 0.6 mm nozzle size at 25.98 V (3.5 A) was found to be the best condition for a continuous smoke streamline. As a result, from the two-dimensional flow experiment past rigid body, a pair of tip vortex structures, horseshoe vortex, and the downwash flow can be evidently seen.

Keywords Smoke wire technique · Boundary layer wind tunnel · Flow pattern · Qualitative study

1 Introduction

Over a century, wind tunnels have been actively used to investigate aerodynamic responses of aircraft and vehicle [1] which eventually extended to other fields, such

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