

Aerodynamic assessment and development of Smokey SAM Prototype (TRL-6)

Nur Azam Abdullah^{1*}, Nor Izzuddin Ismail¹, Muhammad Hanafi Azami¹, Norhuda Hidayah Nordin² and Nor Aiman Sukindar²

¹Department of Mechanical Engineering, Kulliyah of Engineering, International Islamic University Malaysia, Jalan Gombak, 53100, Kuala Lumpur.

²Department of Manufacturing and Material Engineering, Kulliyah of Engineering, International Islamic University Malaysia, Jalan Gombak, 53100, Kuala Lumpur.

Abstract. This paper presents an aerodynamic assessment on the "Smokey Sam Prototype (TRL-6) Start (X)". Initially, the rocket prototype was designed by using OpenRocket open source software, where all of the user's design requirements and objectives are considered. The TRL-6 Smokey Sam Star (X) is expected to fly within 400 m with the operating Mach number 0.2 as a comparable to US GTR-18A. This research evaluates the aerodynamics performance of the design Smokey Sam prototype rocket using a computational fluid dynamics (CFD) approach. The aerodynamics analyses were started with an initial speed of 25 m/s, and the procedures were repeated for 40 m/s and 54.6m/s. For instance, the CFD study assessed the flight performance and stability once launched, such as lift coefficient, drag coefficient and pitching moment. The turbulence model is employing K-omega ($k-\omega$) model to express turbulent properties of flow to a reckoning for history effects like convection and diffusion of turbulent energy. The actual pressure distribution was compared with the conventional rocket material's exact pressure distribution to inspect the best rocket material to sustain the best strength to weight ratio at high-speed trajectory operation. Several observations were made into the modelling process, such as surrounding velocity and pressure. It is found that the flight is in stable mode since the obtained pitching moments are almost zero at all assessed speed. For the flight trajectory validation, the model was printed using a 3D printer and tested experimentally by launching it into the air.

Keyword: Somkey SAM, aerodynamic, CFD, flight performance, trajectory

* Corresponding author: azam@iium.edu.my