The 10th TSME International Conference on Mechanical Engineering
10th – 13rd December 2019
Pattaya, Thailand

Aerodynamics, Stability and Control Analysis of Tactical Solar Power UAV

K Jane-wit[1,*], J Wanchai[2], and K Jiravud[3]

[1,2,3]Department of Aeronautical Engineering Navaminda Kasatriyadhiraj Royal Air Force Academy, 171/1 Phaholyothin Rd, Saimai District, 10220, Bangkok, Thailand

* Corresponding Author: janewit_kamp@rtaf.mi.th, +662-534-8057, +662-534-8057

Abstract. A solar power Unmanned Aerial Vehicle (UAV) is capable of harvesting energy from the sun to enhance its endurance or flying in the sky longer than solely battery power UAV. Moreover, this type of UAV is a dual technology, which can be used in both military and civilian domains. Therefore, the tactical solar power UAV was conceptually designed in order to perform intelligence, surveillance, and reconnaissance (ISR) missions at low altitude. This paper addresses the fundamental aerodynamics, stability and control analysis, which utilized in the preliminary design phase. The aerodynamic characteristics of the UAV are obtained from both Computational Fluid Dynamics (CFD) analysis and wind-tunnel testing at the Reynolds number from $1x10^5$ – $4.5x10^5$ according to designed airspeed. The fundamental aerodynamics coefficient consists of C_L, C_D, and C_m versus angle of attack curves, respectively. The stability and control analysis was carried out based on small disturbance theory and XFLR5. The results show that the tactical solar power UAV provides high aerodynamic efficiency when flying at a 4-degree angle of attack corresponding to the lift-to-drag ratio equal to 20.05. The results also show that it possesses positive static and dynamic stability in the designed cruise flight condition.

Keywords: Aerodynamics, Stability and Control, Solar Power UAV