First principle analysis of Coandă Micro Air Vehicle aerodynamic forces for preliminary sizing

ABSTRACT

Purpose – The purpose of this paper is to reformulate the governing equations incorporating major variables and parameters for the design a Micro Air Vehicle (MAV), to meet the desired mission and design requirements. Design/methodology/approach – Mathematical models for various spherical and cylindrical Coanda˘ MAV configurations were rederived from first principles, and the performance measures were defined. To verify the theoretical prediction to a certain extent, a computational fluid dynamic (CFD) simulation for a Coanda˘ MAV generic models was performed. Findings – The major variables and parameters of Coanda˘ MAV have been formulated into practical guidelines, which relate the lift (or thrust) produced for certain input variables, particularly the Coanda˘ MAV jet momentum coefficient. The influences of the geometrical parameters are elaborated. Research limitations/implications – The present analysis on Coanda˘ jet-configured MAV is focused on the lift generation due to the Coanda˘ jet effect through a meticulous analysis. The effects of viscosity, the Coanda˘ jet thickness, the radius of curvature of the surface and the stability of Coanda˘ jet are not considered and will be the subject of the following work. Practical implications – The results obtained can be used for sizing in the preliminary design of Coanda˘ MAVs. Originality/value – Physical and mathematical models were developed which can describe the physical phenomena of the flow field near the Coanda˘ MAV surfaces influenced by Coanda˘ jet sheets and for obtaining a relationship between relevant variables and parameters to the lift of practical interest.