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Numerical Simulation of Landing Aircraft Dynamics

Zdravko Terze[1,*], Milan Vrdoljak[1], Hinko Wolf[2], Tomislav Mešinović[1]

[1] Department of Aeronautical Engineering, F. Mech. Eng. Naval Arch., University of Zagreb, Croatia
[2] Department of Applied Mechanics, F. Mech. Eng. Naval Arch., University of Zagreb, Croatia

Abstract. Numerical simulation procedures for landing dynamics of large transport aircraft are shortly presented. Developed numerical procedures allow for determination of dynamic response of landing aircraft for different flight and touch-down parameters. Non-linear dynamical model of landing aircraft, which serves as a basis for computational procedures, is synthesised by modelling of aircraft structural subsystems using multibody dynamics approach. Dynamical model with variable kinematical structure includes discontinuous dynamics of landing gear oleopneumatic shock-absorber with friction and hydraulic/thermodynamic processes. Non-linear tire contact dynamics and unilateral dynamics of nose gear elastic leg assembly is modelled as well. The longitudinal and lateral aerodynamic loads are estimated by considering aircraft various system configurations (landing gears in "up" and "down" position, different control surfaces in active/inactive modes). Mathematical model is derived as differential-algebraic (DAE) system. The developed numerical tools are modularly shaped and efficient numerical integration methods, as well as original procedures for MBS constraint stabilization, are applied for dynamical response determination. On the basis of the presented model, dynamic simulations of landing cases of large transport aircraft were performed for different initial descent velocities and lateral wind conditions.

Key words: *Dynamics of landing aircraft, Aircraft multibody model, Non-linear landing gear dynamics, Shock absorber model.*

1. Introduction

During landing and taxi, a transport aircraft landing gear and parts of an airframe can be exposed to high dynamical loading. In the extreme situations even damages and loss of the stability of an airplane may be expected. During

*Correspondence to: Faculty of Mechanical Eng. and Naval Arch., Department of Aeronautical Engineering, Ivana Lučića 5, HR-10002 Zagreb, Croatia, zdravko.terze@fsb.hr, web page: http://www.fsb.hr/aero.