

Accepted Manuscript

Unsteady aerodynamic effects in landing operation of transport aircraft and controllability with fuzzy-logic dynamic inversion

C. Edward Lan, Ray C. Chang

PII: S1270-9638(16)30661-7
DOI: <https://doi.org/10.1016/j.ast.2018.04.032>
Reference: AESCTE 4537

To appear in: *Aerospace Science and Technology*

Received date: 14 September 2016
Revised date: 2 April 2018
Accepted date: 18 April 2018

Please cite this article in press as: C. Edward Lan, R.C. Chang, Unsteady aerodynamic effects in landing operation of transport aircraft and controllability with fuzzy-logic dynamic inversion, *Aerosp. Sci. Technol.* (2018), <https://doi.org/10.1016/j.ast.2018.04.032>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



Unsteady Aerodynamic Effects in Landing Operation of Transport Aircraft and Controllability with Fuzzy-Logic Dynamic Inversion

C. Edward Lan¹ and Ray C. Chang²

¹Dept. of Aerospace Engineering, University of Kansas, Lawrence, Kansas, 66045, USA (Professor Emeritus)

²Aviation management, College of International Education, Wenzhou University, Wenzhou, Zhejiang, China, 325035

Correspondence should be addressed to Ray C. Chang, 20170195@wzu.edu.cn

ABSTRACT

Aircraft landing in strong wind has been a safety problem for all types of aircraft. The specific issues involve hard landing, roll oscillation and runway veer-off. These issues are related to atmospheric disturbances, and/or dynamic ground effect. As a result, the aerodynamics will be different from those in steady flow concept. In this paper, some of the pertinent stability and control derivatives based on a small-disturbance concept will be presented. How these local stability and control characteristics affect global controllability will be examined with Fuzzy-Logic Dynamic Inversion. Controllability is judged from whether necessary control deflections exceed the imposed limits. Specific examples involving a twin-jet transport with hard landing, rolling oscillation before touchdown and runway veer-off event due to varying crosswind after touchdown are illustrated.

Keywords: crosswind; hard landing; rolling oscillation; veer-off runway; fuzzy-logic modeling (FLM)

I. INTRODUCTION

Unsteady aerodynamic effects on flight dynamic variables mainly arise from the lag in flow field, in particular the vortex wake, which fails to follow the motion. For example, wakes of a descending aircraft will not assume their position and strength as assumed in static conditions before the aircraft would move down further in landing. Therefore, instantaneously the horizontal tail would be closer to the vortex wake than in static conditions. As a result, the vortex wake would significantly affect the tail as a function of time to affect the control power. Near the ground, since the vortex wake cannot penetrate the ground plane, the vortex wake has a tendency to stay above the ground to induce a complex aerodynamic environment [1 & 2]. Therefore, it is more difficult to flare precisely before touchdown. Other off-nominal flights may be induced by adverse weathers, the preceding aircraft's vortex wakes, ice accretions, pilot's actions, etc.

In a turbulent air, vertical oscillatory motion has also been encountered by aircraft, making a smooth landing more difficult. In addition, if a strong varying crosswind is present, the resulting aircraft response frequently involves roll oscillation. A strong varying crosswind is the type of wind field with varying magnitude and/or direction as encountered by an aircraft. With strong varying crosswind, the vortex wake and the engine exhaust will be pushed toward the

Download English Version:

<https://daneshyari.com/en/article/8057521>

Download Persian Version:

<https://daneshyari.com/article/8057521>

[Daneshyari.com](https://daneshyari.com)