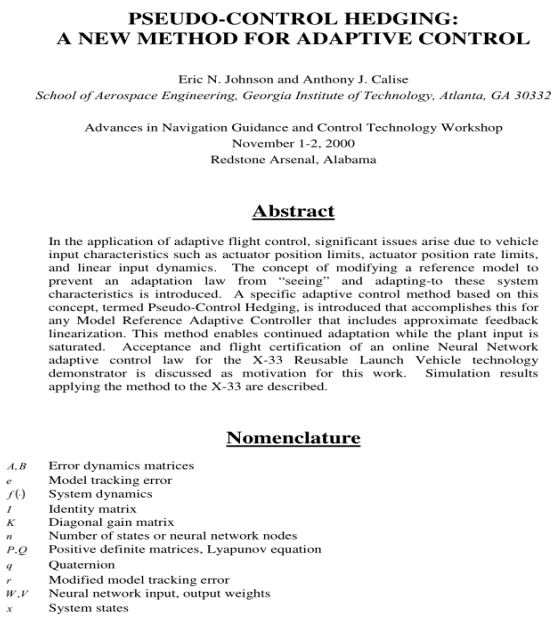
Advances In Aerospace Systems Dynamics And Control Systems



PSEUDO-CONTROL HEDGING:
A NEW METHOD FOR ADAPTIVE CONTROL

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Advances in Navigation Guidance and Control Technology Workshop
November 1-2, 2000
Redstone Arsenal, Alabama

Abstract

In the application of adaptive flight control, significant issues arise due to vehicle input characteristics such as actuator position limits, actuator position rate limits, and linear input dynamics. The concept of modifying a reference model to prevent an adaptation law from "seeing" and adapting-to these system characteristics is introduced. A specific adaptive control method based on this concept, termed Pseudo-Control Hedging, is introduced that accomplishes this for any Model Reference Adaptive Controller that includes approximate feedback linearization. This method enables continued adaptation while the plant input is saturated. Acceptance and flight certification of an online Neural Network adaptive control law for the X-33 Reusable Launch Vehicle technology demonstrator is discussed as motivation for this work. Simulation results applying the method to the X-33 are described.

Nomenclature

A, B	Error dynamics matrices
e	Model tracking error
$f(\cdot)$	System dynamics
I	Identity matrix
K	Diagonal gain matrix
n	Number of states or neural network nodes
P, Q	Positive definite matrices, Lyapunov equation
q	Quaternion
r	Modified model tracking error
W, V	Neural network input, output weights
x	System states

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