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Nonlinear Longitudinal Flight Mode Using Volterra Series

Abstract:

There are two linear modes for aircraft longitudinal motion: short- and long-period. In this research, a new definition of one nonlinear mode in the longitudinal motion of aircraft is presented. The proposed mode is caused by the nonlinearity of the drag coefficient as a function of the angle of attack. The proposed mode is a coupling between linear short-period and linear phugoid modes. Volterra theory is used to model the proposed nonlinear mode in both time and frequency domains. The proposed nonlinear mode using the Volterra model can be used to estimate the nonlinear drag coefficient in both wind tunnel tests as well as flight tests.

Biography:

Dr. Ashraf Omran is currently a faculty member at Johns Hopkins University (JHU). Dr. Ashraf Omran is an adept educator, aerospace and mechanical engineer, and instructor. Dr. Omran has been in previous roles as a senior software and control engineer with major engineering firms such as CNH-FIAT. He earned a Bachelor's degree and a Master's degree in Aerospace Engineering from Cairo University, Egypt. He earned a Ph.D. in Aerospace Engineering from Old Dominion University (ODU), Virginia. Shortly after receiving his doctorate, he joined the Faculty of Mechanical and Aerospace Engineering at ODU. While maintaining his faculty position at Old Dominion University, he worked as a research scientist at Virginia Modeling, Analysis and Simulation to serve on a flight simulator NASA project. From 2011 to 2017, Dr. Omran worked as a senior control engineer at Case New Holland Fiat Industry, Burr Ridge, Illinois. In 2018, he returned to academia to teach at Texas A&M, Texas followed by teaching at Loyola University Chicago. Dr. Omran has authored 24 patents in the field of transmission control systems and more than 40 papers in the field of flight dynamics, robotics, and control. Dr. Omran is a member of AIAA. He was the Session Chair of "Nonlinear Systems II", American Control Conference, San Francisco, CA, June 2011. He was a distinguished and keynote speaker at the International Conference and Exhibition on Mechanical & Aerospace Engineering from 2019 to the present. His biography is listed in Marquis Who's Who in the World, Marquis Who's Who in America, among others.



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