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## **Analysis of the Longitudinal Handling Qualities and Pilot-Induced-Oscillation Tendencies of the High-Angle-of-Attack Research Vehicle (HARV)**

by

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The NASA High-Angle-of Attack Research Vehicle (HARV), a modified F-18 aircraft, experienced handling qualities problems in recent flight tests at NASA Dryden Research Center. Foremost in these problems was the tendency of the pilot-aircraft system to exhibit a potentially dangerous phenomenon known as a pilot-induced oscillation (PIO). When they occur, PIO's can severely restrict performance, sharply diminish mission capabilities and can even result in aircraft loss. A pilot/vehicle analysis was undertaken with the goal of reducing these PIO tendencies and improving the overall vehicle handling qualities with as few changes as possible to the the existing feedback/feedforward flight control laws.

Utilizing a pair of analytical pilot models developed by the author, a pilot/vehicle analysis of the existing longitudinal flight control system was undertaken. The analysis included prediction of overall handling qualities levels and PIO susceptibility. The analysis indicated that improvement in the flight control system was warranted and led to the formulation of a simple control stick command shaping filter. Analysis of the pilot/vehicle system with the shaping filter indicated significant improvements in handling qualities and PIO tendencies could be achieved. A non-real time simulation of the modified control system was undertaken with a realistic, nonlinear model of the current HARV. Special emphasis was placed upon those details of the command filter implementation which could effect safety of flight. The modified system is currently awaiting evaluation in the real-time, pilot-in-the-loop, Dual-Maneuvering-Simulator (DMS) facility at Langley.