N95-23325

Handling Qualities of the High Speed Civil Transport

by

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The low speed handling qualities of a High Speed Civil Transport class aircraft have been investigated by using data of the former Advanced Supersonic Transport (AST) 105. The operation of such vehicles in the airport terminal area is characterized by "backside" performance. Main objectives of this research effort were: a) determination of the nature and magnitude of the speed instability associated with the backside of the thrust required curve, b) confirmation of the validity of existing MIL-SPEC handling qualities criteria, c) safety of operation of the vehicle in the event of autothrottle failure, and d) correlation of required engine responsiveness with level of speed instability.

Preliminary findings comprise the following:

The critical velocity for speed instability was determined to be 196 knots, well above the projected approach speed of 155 knots. This puts the vehicle far on the backside of its thrust required curve. While the aircraft can be configured to have static and dynamic stability at this trim point, a significant speed instability emerges, if a pilot or autopilot attempts flight path control with elevator and/or canard control surfaces only. This requires a properly configured autothrottle and/or variable aerodynamic drag devices which can provide speed stability.

An AST 105 type vehicle meets MIL-SPEC criteria only in part. While the damping criteria for phugoid and short period motion are met easily, the AST 105 falls short of the required minimum short period frequency, meaning that the HSCT is too sluggish in pitch to meet the military criteria. Obviously the military specification do not consider a vehicle with such high pitch inertia. With regard to speed stability and flight path stability criteria, the vehicle meets levels 2 and 3 of the military requirements, indicating that it could be landed safely with manual controls in case of an autothrottle failure, even though the pilot workload would be high.

This requires quick thrust response to throttle adjustment, however. If the engine responsiveness is slow, the aircraft handling qualities are further deteriorated. Progress has been made in correlating required engine response dynamics with the given level of speed instability of the vehicle.