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A MODEL FOR THE EFFECTIVENESS OF AIRCRAFT ALERTING AND WARNING SYSTEMS

Renwick E. Curry
NASA Ames Research Center

James E. Neu
Major, USAF

ABSTRACT

There are many behaviors that have been observed with Cockpit Alerting and Warning Systems (CAWS). We know that pilots ignore alerts from a CAWS with high false alarm rate; pilots come to rely on the CAWS as a primary system instead of a backup system; pilots miss alerts during periods of high workload; pilots adopt "unusual" criteria when evaluating alerts; pilots confuse one alert with another; and pilots turn off or otherwise defeat CAWS systems.

This paper presents an analysis of the effectiveness of an alerting system with a single alert. The pilot's decision behavior is modeled by the Theory of Signal Detection and therefore accounts for different "strengths" of cross-check information and different pilot criteria. The model includes the effects of the CAWS error rate; the pilot's past experience with the CAWS accuracy; his reliance on the CAWS rather than independent monitoring; missed alerts (due to high workload or other reasons); and adoption of a minimum error or Neyman-Pearson objective rather than minimum cost objective. (The model does not account for a pilot turning off the CAWS or confusing one alert with another.)

Exercising the model in a sensitivity analysis shows, among other things, that for rare events (a) the expected cost is greatly increased if the pilot ignores the a posteriori information in the existence of an alert; (b) the expected cost is insensitive to CAWS Type I (missed event) errors; and (c) the expected cost is sensitive to CAWS Type II (false alarm) errors only when the cross-check information is ambiguous.