Quantifying Virtual Control Tower Decision Making using Visual Discrimination of Aircraft Maneuvers

Norbert Fürstenau[1*], Monika Mittendorf[1], Stephen R. Ellis[2]

[1]Institute of Flight Guidance, German Aerospace Center (DLR),Lilienthalplatz 7, Braunschweig, Germany
Ames Research Center, NASA, Moffett Field, CA, USA
*Corresponding Author: Norbert.fuerstenau@dlr.de

The new Virtual and Remote Control Tower paradigm (RTO) [1] requires verification of technical parameters and extensive validation of the performance with simulation and field experiments. Of central importance for tower controllers are visual cues obtained from the out-of-windows view [2] which is replaced by a high resolution video panorama with pan-tilt zoom function. Here we present results of a remote tower simulation and analysis of dual choice decision errors obtained with 13 domain experts who had to observe and predict the outcome of aircraft landing under different braking conditions. High deceleration leads to stop on the runway whereas low deceleration results in runway overshoot. Bayes inference, discriminability, and subjective decision bias, derived from the response matrix data (hit rate H (correct prediction of stop stimulus), misses, correct rejections and false alarm rate FA (false "stop" prediction of no-stop stimulus) are used for deriving video frame rate requirements for minimizing decision errors [3]. Results are presented in ROC space (receiver operating characteristic) displaying (H, FA)-data together with isosensitivity (d' or nonparametric A) and isobias curves according to detection theory. Preliminary data analysis of decision error-decrease with increasing framerate FR (6 – 24 Hz) is based based on the hypothesis of an exponentially decaying visual short term memory with sample and hold delay. Exponential and linear approximations and extrapolations of the d' (or A) vs. FR data indicate a minimum FR-requirement of at least 35 Hz. The result is confirmed with Bayes inference and is supported by shooter game experiments [4]. These methods are presently used also for quantifying RTO performance and usability under field testing conditions.

References

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