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From: Vertical Flight Human Factors Program Manager, AAR-100
To: Vertical Flight TCRG

Subj: VERTICAL FLIGHT HUMAN FACTORS FOURTH QUARTER '03 REPORT

Ref: (a) Vertical flight human factors execution plans (http://www.hf.faa.gov/vffunded.htm)

1) Fourth quarter report for each project is listed below.

a) NVG lighting requirement. Project is complete. The final report is available at http://www.hf.faa.gov/docs/508/docs/VF%20-%20NVG%20Pinkus.pdf. The NVIS instrument was sent to ASW-170 (POC: Anne Godfrey) for evaluation. We're waiting for feedback from ASW-170. The researcher presented the FY03 annual report at the program review.

Project completed.

b) NVG resolution requirement. The MATLAB model was delivered. Visual acuity by NVG tube detection performance plots for visual acuity stimuli and natural image stimuli will be delivered by December 2003. The researcher presented the FY03 annual report at the program review.

Project completed.

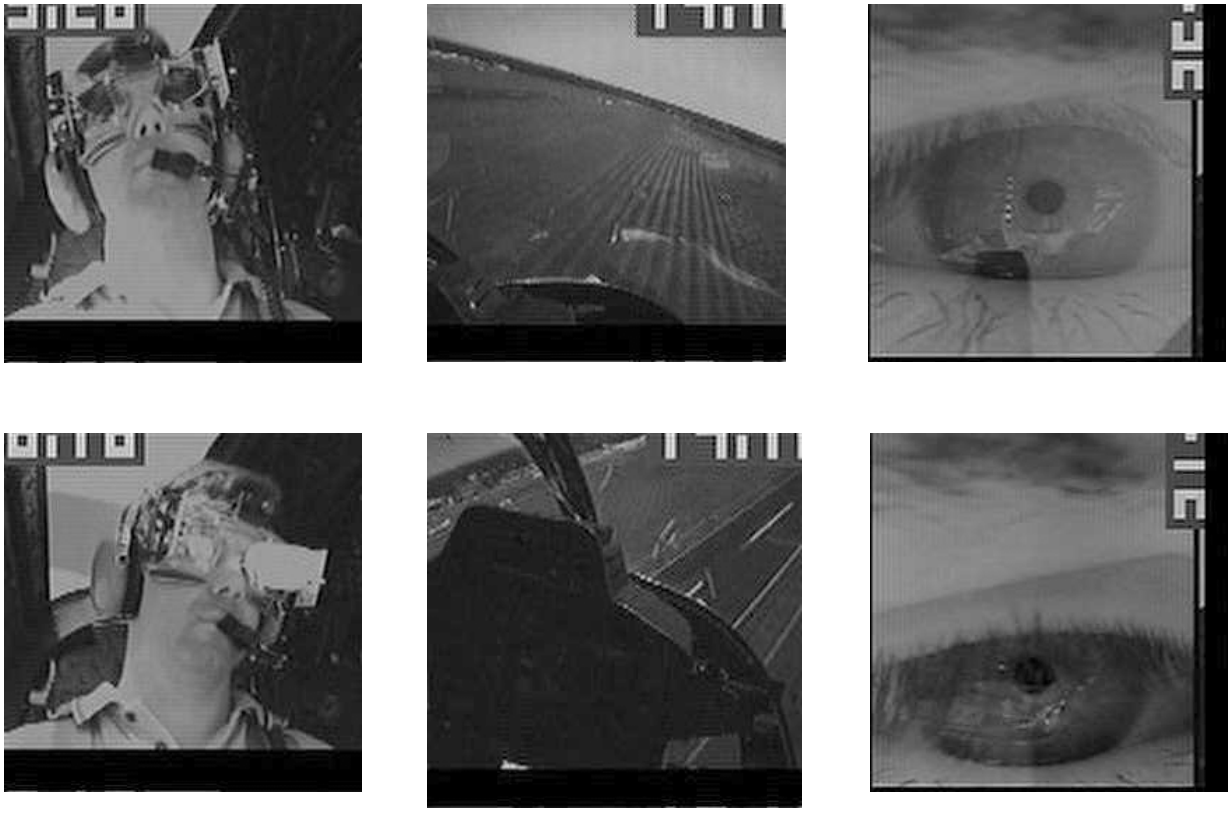
c) Simultaneous Non-interfering Operations - Quantify VFR Navigation Performance.

Construction of portable eye movement recording system completed and delivered to UTSI for the August thru October 2003 helicopter data collection flights. Eye tracking data was successfully demonstrated, data was digitized, and the researcher is writing software to output results to flight technical error data.

The figure shows two images from each of three cameras. The left hand column shows the head and neck of the pilot, who is wearing eye tracking goggles. The center column shows images from the head-mounted scene camera, which takes a

picture in the direction the pilot's head is pointing. The right hand column shows images of the pilot's right eye.

pilot’s head head camera view pilot’s eye



Each row of images corresponds to a single moment in time, the two rows are separated in time by a few seconds. In the first row, the pilot is looking out the window. We can see in the scene camera image (center) that the aircraft is banked steeply to the left; in the head image (left) we see that the pilot is partially compensating for the bank by tilting his head. The scene camera image shows mostly windshield, indicating that the head is oriented towards the window. The pupil in the eye image (right) is located near the center of the image; after the calibration procedure has been performed we will be able to relate the position of the pupil to a particular location in the scene camera image, that has not been done yet but it is probably a pretty good guess that the pilot is looking somewhere near the center of the scene camera image.

In the lower row, the pilot is looking at the instrument panel. We see that the head is tilted downward, both in the image of the head (left) and the scene camera image (center), which now shows a large portion of the instrument cluster. In addition, the eye (right) has moved downward; in the absence of a calibration, all we can say is that the target of gaze in the scene camera image is lower than that

in the upper row. This set of images illustrates how gaze shifts are made with coordinated movements of both the head and eye.

A low-level video recording was conducted over the Tullahoma, TN flight route to collect low-level features for the virtual environment terrain. Researchers will incorporate these low-level features on the terrain model and finalize the interface this fall. The researchers anticipate preliminary data collection to begin December 2003 with test data to begin spring 2004.

The researcher presented the FY03 annual report at the program review.

All indications indicate that this project is on track to complete the milestones as planned.

d) Rotocraft Precision Visual Flight Rules Simultaneous Non-Interfering Human Factors Project.

During the week of August 25th, STI successfully completed the second system integration and installation helicopter flight at UTSI, Tullahoma, TN. Mr. Larry Buehler (AFS-410) served as the FAA test pilot to certify that STI's proposed data collection meets AFS-400's test plan requirements as specified in the SNI PVFR test plan. From the test flight, Larry's observations and comments were as follows:

a. The GPS receiver will remain according to an IFR installation, however, Mr. Buehler agreed that the use of the OBS should not be required and instead left up to the subject pilot's discretion (option). This is a deviation from our previous course established during the last telecom; when it was decided that the 5 IFR pilots would use the OBS, and the 5 VFR-only pilots would not use the OBS. Mr. Buehler expressed that he did not use the OBS during his data collection flight
b. b. If the pilot does not choose to use the OBS, the Project/Safety Pilot will acknowledge the message associated with setting the OBS to clear the screen. The Project/Safety pilot will announce that action as he performs it so the subject pilot knows why he is interacting with the GPS receiver.
c. c. The daytime data collection flight will be conducted prior to the night data collection flight. This is a reversal of the previous plans and will be changed in the test plan.
d. A welcome letter will be provided to all subject pilots (1 page) that also provides a brief and bullet version list of what their activity will include. Attached to the welcome letter will be the pilot qualification sheet (i.e. hours and qualifications, etc.) to be filled out and brought to UTSI on the day of testing.
e. A punch list for all test team activities will be finalized (there had been plans for the punch list, however, had not been finished by this trip). There will be specific Project Pilot actions included, data collection

engineer actions, etc., and the punch list will be reviewed in a checklist fashion prior to each data collection flight.

f. The test plan will be changed to replace the airspeed to be flown between 70-90 KIAS to read the subject should maintain 80 KIAS. This is in concert with the pilot standards (+/- 10 knots).

g. Not totally resolved, discussions about weather requirements for testing ensued. Currently the test plan requires VFR … however, the definition of VFR is somewhat less than definitive. Discussions of using 500'/1 mile as a minimum weather and shutting down operations if below were not resolved. Subsequent discussions of between 500'/1 and up to 1,000'/3 were also unresolved. The following is recommended for an **immediate** decision by FAA to resolve this matter (note: it must be resolved for my completing the final test plan):

- Unconditional Weather: 1,000' and 3 miles visibility. When the weather is reported at or above 1,000/3 flight operations will be conducted without further action. The only requirement is that a printout of weather is completed, and becomes part of the data flight historical records for each flight.
- Conditional Weather: 800' or 2 miles visibility. When the weather is reported less than 1,000'/3 but not less than 800'/2 a determination will be made by the project/safety pilot **'during the familiarization flight'** based upon actual weather encountered along the PVFR route as to whether the flight will continue, and the subsequent data collection flight should be conducted. The project/safety pilot will record his determination on the weather printout sheet by writing *"weather check completed and acceptable for continued flight operations."*
- Marginal Weather: 600' or 1 mile visibility. When the weather is reported less than 800'/2 but not less than 600'/1 the project pilot will conduct a weather launch flight **without test personnel or subject pilot on board the aircraft**. Based upon the project/safety pilot's determination, flight operations may be conducted, or will be terminated. If the project/safety pilot determines the weather conditions are acceptable, an entry will be made *"weather check completed and acceptable for flight operations"* on the weather printout sheet that becomes part of the historical records of each flight activity.
- Weather Cancellation: When the weather is reported less than 600' or 1-mile visibility flight operations will not be conducted.

h. PVFR Chart: there were numerous recommendations for changes in the chart discussed between Mr. Buehler, the Project Pilot (Mr. Allison), and Mr. Hickok. The following summarizes these findings:

- There are several places that information is provided by Jeppesen that is unknown why. (i.e. 1229' (F) TLA and others).

Definitions by Jeppesen should be provided, or removed from the chart.

- Wire symbols: Jeppesen used their typical wire symbols for this kind of charting, but it was noted to ask if wire symbols that included wire-towers could replace the current dotted lines.
- Altitudes are provided, but using the line over (max altitude), below (min altitude), or both over and below (maintain specific altitude) should be incorporated into the charting.
- Compulsory reporting points: it was decided to keep these points, however, to consider them reporting points to be made over the radio to UTSI's discrete frequency as "Test Control". Reports should be made while either approaching the waypoint, or passing the waypoint and entry into the next leg, to solve the issue of 'when' to report on a flyby waypoint (i.e. when you will not pass directly over the waypoint). This will also be included in the pilot briefing materials.
- All charted headings are 2 degrees off. What occurred, and went unnoticed until these flights, was that while STI provided readings to Jeppesen to use, they recalculated headings based upon the Tullahoma (TLA) airport Magnetic Variation (STI's were based upon 3 degrees west variation, which is current, while FAA has not updated the TLA magnetic variation. This is a normal situation, which FAA employs to prevent airports from having to remark runway thresholds until greater magnetic variations occur.) STI will have Jeppesen correct all headings by 2 degrees; however, this should be considered as an operational issue for future implementations. Magnetic Variation notation on the chart also requires changing.
- Removal of Waypoint 34 and changed direct between waypoints 33 and 35. (See database discussion below).
- Improved graphics for annotations of the test-only restricted area around Arnold AFB. Some confusion regarding the current chart occurs and more typical restricted area charting should be used instead.
- Altitude changes to be made (these items were noted during the night flight conducted by Mr. Hickok, Tuesday night). Changes will be made to have the minimum altitude between waypoint 2 and waypoint 29 increased to 1,800'; with a notation to cross waypoint 29 at 1,800'. The remaining portion of the route will be charted for 1,500'. This effectively raises the previously charted area (at 1,300') by 200', and the area between waypoint 2 and waypoint 29 by 300'. This change will still provide for the intended altitude changes to be incorporated with the tests.

i. After the final charting is acceptable, a blow up will be produced for briefing purposes during pilot in briefings.

j. A textual description of the route will be investigated (i.e. a two page chart in concept, providing both typical charting accompanied by a textual description.) This was proposed by Mr. Wilder (graduate student) and further identified as beneficial during Mr. Hickok's night flight. (i.e. Even with good knowledge of the route itself, it is essentially impossible to read the chart during the night flight do to inadequate aircraft lighting and pilot workload. This is a routine and historic problem associated with night flight, amplified when requiring precision navigation under single pilot/hand flown without autopilots, etc. The GPS provides heading information, which essentially is the only means to remain on the PVFR route. However, a text description that provides some critical information about the route, which could be used on a kneeboard, may be of benefit and is consistent with other charting formats.

The researcher presented the FY03 annual report at the program review.

All indications indicate that this project is on track to complete the milestones as planned.

William K. Krebs