**AAR-100**

**Human Factors Newsletter # 02-12**

**June 22, 2002 – July 12, 2002**

**Research Report** - ***Investigating ATC Procedures For Simultaneous Non-Interfering Flight within The National Airspace System***

The introduction of Global Navigation Satellite System (GNSS) as the primary navigation tool for the 21st century provides an opportunity for the vertical flight community to not only develop a low altitude Instrument Flight Rules (IFR) system, but also a more precise Visual Flight Rules (VFR) system. The Global Positioning System (GPS) will provide the accuracy necessary for en route and terminal VFR operations under certain provisions and limitations. For unrestricted use in civil aviation, augmentations will be required to improve GPS accuracy for precision flying, provide integrity and continuity for all phases of flight, and provide the availability necessary to meet primary means requirements for radio navigation. In addition, a better understanding is required for the integration and the interaction of the pilot, controller and aircraft with this enhanced system flying in the National Airspace System (NAS). With this understanding, decisions can be made how to better handle this future flow of VFR traffic and what limits may need to be placed on the aircraft, pilot, and airspace.

Current ATC procedures were put in place before widespread use of GPS and other navigation aids began. Moreover, these technologies have improved over the years, so much so that the questions being asked in this research program will likely have to be revisited again in the near future. We know that technology used to assist people changes the way people can and should perform their tasks. Determining how to optimize the efficiency of the overall NAS system is dependent on our understanding of how these technologies affect in-flight performance.

**Objectives**

The overarching objective of this proposed program is to assist in the recommendation of the minimum Required Navigation Performance (RNP) value for a VFR helicopter equipped with an IFR GPS. The results of this study combined with the output from another AAR-100 Vertical Flight project entitled "Helicopter SNI helicopter Flight Data" will assist the FAA Flight Standards Office in determining the minimum RNP value that will be accepted by the Air Traffic Office in developing procedures for VFR SNI routes. We believe that a critical element of this study involves a model of pilot performance as a factor of pilotage cues (e.g. landmarks) and radio communications (e.g. GPS receivers). We need to know if a pilot fixates on landmarks

versus GPS output. Do they simply "fly the needle" off of the GPS unit, do they carefully observe visual cues, or is it some mix of both? How does this affect the envelope we can assume they are maintaining, therefore indicating how traffic can be controlled around them? We assume that too much attention to the GPS receiver may adversely affect pilotage performance, but that the reverse may also be sub-optimal. In addition, this study will investigate in the virtual environment simulation how traffic density, workload, and weather affects the minimum RNP for a qualified VFR helicopter pilot equipped with an IFR GPS

The results of this study may support the identification of additional training, equipment, and approval necessary to get the benefit of flying a VFR SNI route where the controller will be able to permit simultaneous operations.

**Benefits to the FAA and the aviation maintenance industry:**

- It will address the minimum pilot skills and ability required to achieve RNP.
- It will address what training skills, procedures, and experience are required to achieve RNP.
- It will address what navigation aids, avionics, or displays (e.g., GPS) are required for RNP.
- It will address what type of GPS display is required to provide the information needed by the minimally trained VFR pilot.

For more information on this project or other vertical flight human factors projects, please go the AAR-100 Web site: http://www.hf/gov/vfFY02.htm

**Night Vision Research:**

- Representatives from the Naval Aviation Warfare Center Aircraft Division, Air Force Research Laboratory Crew Systems Interface, Air Force Research Laboratory Warfighter Training Research Division, William J. Hughes Technical Center, FAA ASW, and AAR-100 met on June 18th at FAA headquarters to review the AAR-100 Vertical Flight program entitled "Alternative Night Vision Imagining System (NVIS) Lighting Compatibility Field Assessment." The purpose of the meeting was to review methods and procedures that will allow a non-night vision goggle user to measure night vision goggle (NVG) compatibility of a modified cockpit at low cost and to have a *reasonable assurance that the measurement was accurate*. The accepted military practice to determine whether a lighting system is NVG compatible is to compare visual acuity through NVGs with and without the lighting activated. This military procedure requires expensive illumination sources and radiometric measurement equipment that costs in excess of $100K. Although the military procedure is common practice, it has not been validated nor determined to be reliable. The RTCA SC-196 committee proposed an alternative method to measure NVIS, however the method needs to be tested. AAR-100 co-funded the Air Force Research Laboratory Crew Systems Interface, Wright Patterson Air Force Base, Dayton, Ohio to test and evaluate alternative NVIS field evaluations that are accurate and repeatable. The June 18th meeting afforded Navy and Air Force night vision goggle researchers an opportunity to exchange alternative NVIS field evaluation ideas, to discuss technical approaches, and to review what has been accomplished on the project in the various Department of Defense laboratories (W. Krebs, AAR-100).

- Dr. Chuck Antonio, Naval Aviation Warfare Center Aircraft Division, and an AAR-100 science advisor presented the utility of using a night vision goggle to enhance an air traffic ground controllers' situational awareness during nighttime conditions to the Navy and Marine Corps Air Traffic Controllers Managers Conference on June 24th in Pensacola, FL. The purpose of the presentation was to inform Navy and Marine Corps air traffic controllers on how the night vision goggle (PVS-7) may enhance nighttime vision while monitoring the airport surface. The PVS-7 night vision goggle uses a single image intensifier tube that is projected to two eyes. Most likely, the goggle would be similar to daytime binoculars. For a given situation, the controller may want a better understanding on a particular area of the airport surface. The controller knows the approximate location of the area of interest, but the unaided eye lacking spatial detail cannot gather enough information to form a coherent scene. Controllers' night vision may be enhanced by using a night vision goggle similar to improving daytime vision with the aid of a binocular. The most dramatic improvement between not using a night vision goggle (unaided) and using a night vision goggle (aided) is the improvement of visual acuity. At night, an observers' unaided visual acuity is at least 20/200 while aided visual acuity is approximately 20/30. Although this effect is significant, there are some limitations associated with the night vision goggle. Potential limitations of the PVS-7 goggle include: (1) 40 degree field of view, (2) loss of stereo acuity, (3) potential lighting incompatibility due to interior tower cab lighting, (4) reflections from the tower cab window, and (5) partial scene of the goggle may be saturated by airport light sources. On the other hand, advantages of the PVS-7 include: (1) better than unaided eye, (2) improved visual situational awareness, (3) size and weight similar to a binocular, and (4) relatively short adaptation between goggle scene and outside or vice versa. In summary, the military has relied on night vision technology for over 40 years to improve operators' war fighting capability. This enhanced capability has allowed aviators and soldiers to detect, recognize, and identify nighttime objects that otherwise would be invisible to the unaided eye. The next phase of the program will be to test the goggle in a tower cab environment to determine whether the PVS-7 improves ground controllers' nighttime situational awareness A copy of the brief is located at http://www.hf.faa.gov/krebs/docs/NVG_Pcola.ppt. (W. Krebs, AAR-100).

**Aviation Maintenance** - Representatives from the Civil Aeromedical Institute (CAMI; AAM-500 and 600), NASA-Ames Research Center, State University of New York (SUNY) Buffalo, Ohio State University, and AAR-100 met on June 12th at CAMI to review the AAR-100 aviation maintenance human factors research project entitled "Vision Testing Requirements for Certain Persons Maintaining and Inspecting Aircraft and Aircraft Components." The FAA's Airworthiness Technical Community Representative Group ranked this the number-one aviation maintenance requirement for FY02. The kick-off meeting reviewed NASA-Ames and CAMI progress in determining what are the acceptable vision standards and procedures for personnel involved in nondestructive inspection and testing (NDI/NDT) and visual inspection of aircraft and aircraft components. Dr. Beard, NASA-Ames Research Center, conducted an exhaustive literature review, in both controlled laboratory settings and in other occupational settings, to determine whether information already exists that may be used to develop vision requirements for aircraft maintenance inspection workers. In addition, Dr. Beard's research team interviewed

NDI/NDT and visual inspection personnel at several different aviation maintenance facilities to further understand the multitude of maintenance tasks performed on aircraft.

On October 15th, NASA-Ames and CAMI will submit an interim report to AAR-100. This report will recommend whether there is sufficient information from previous vision research and aviation maintenance studies that can be used to write a medial standard for Flight Standards (AFS-300). If there is not sufficient information, then AAR-100 will proceed with Phase II of the project. Phase II will involve a field experiment to determine the minimum acceptable visual processes required to conduct a particular NDI/NDT and visual inspection procedure. From these results, an assessment will be made to determine the impact these newly developed recommended vision standards may have on the current NDI/NDT and visual inspection employee population. By September 2004, a final report will be delivered to Flight Standards (AFS-300) outlining the specific minimum visual requirements for essential tasks in NDI/NDT and visual inspections which may be used to write a medical standard similar to Part 67 for pilots. (W. Krebs, AAR-100)

**NEXCOM –** During the week of July 8th, Dr. Mike McAnulty and Dr. Randy Sollenberger of the William J. Hughes Technical Center will brief RTCA on the research approach and results of the NEXCOM research simulation. The RTCA often sets the standards within aviation communication that are used internationally when developing new systems. (M. McAnulty, WJHTC)

**Fatigue –** Dr. Tom Nesthus/CAMI participated in the Fatigue and Performance Modeling Workshop, June 13-14, 2002 in Seattle, WA. Seven modelers from around the world were asked to attend and discuss their models in terms of the predictive accuracy of four scenarios based on laboratory and field research results provided to them before the meeting. A fifth scenario was provided on the first day of the workshop for the modelers to demonstrate ease of input and operation. The models and modelers included: 1) Sleepwake Predictor by T. Akerstedt, S. Folkard, & C. Portin; 2) Fatigue Audit InterDyne (FAID) by D. Dawson, A. Fletcher, & G. Roach; 3) Two-process Model and Related Approaches by P. Achermann; 4) Sleep, Activity, Fatigue, and Task Effectiveness Model (SAFTE) by S. Hursh; 5) Circadian Alertness Simulator by M. Moore-Ede, A. Heitmann, U. Trutschel, & R. Guttkuhn; 6) Interactive Neurobehavioral Model by M. Jewett & R. Kronauer; and 7) System for Aircrew Fatigue Evaluation (SAFE) by M. Spencer & A. Belyavin. A proceedings of the workshop is planned for publication as a special issue of Aviation, Space, and Environmental Medicine. (T. Nesthus, CAMI/AAM-510)

**Sleep/Wakefulness Management –** Dr. Tom Nesthus/CAMI participated in the North Atlantic Treaty Organization's (NATO) Research & Technology Organization (RTO) Human Factors and Medicine Panel Lecture Series on Sleep/Wakefulness Management in Continuous/Sustained Operations. The meeting was held at the U.S. Medical Research Laboratory at Ft. Rucker, AL. June 17-18, 2002. The lecturers included D. Legarde (Human Factors and Medical Sciences, France), J. Caldwell (USAARL, U.S.), R. Pigeau (DCIEM, Canada), M. Casagrande (Dept. of Psychology, Rome Italy), and B. Stone (Center for Human Sciences, U.K.). Program topics included: overview of the sleep-wakefulness cycle and SUSOPS/CONOPS; individual differences; sleep deprivation; napping strategies and sleep inertia; food, exercise and ergonomic measures; wakening substances: amphetamines; caffeine; modafinil; sleep inducing substances;

and chronobiotic substances to alleviate jet-lag. The translation of research results to the field commander/user were goals of the series and were met with much discussion by the participants of the two-day meeting. (T. Nesthus, CAMI/AAM-510)

**ADS-B -** Dr. Roni Prinzo/CAMI presented her paper entitled *Automatic Dependent Surveillance-Broadcast (ADS-B)/Cockpit Display of Traffic Information (CDTI): New Phraseology for Air Traffic Control Operational Communication* at the 5th International Workshop on Human Error, Safety & System Development 2002 hosted by the University of Newcastle in Newcastle Australia. The paper was well received, with a host of questions from the international audience. (R. Prinzo, CAMI/AAM-510)

***More information on human factors research can be found at the FAA Human Factors (AAR-100) web site:*** http://www.hf.faa.gov

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**August 5-8, 2002** – AIAA Guidance, Navigation and Control Conference and Exhibit, Hyatt Regency Monterey, Monterey, CA http://www.aiaa.org/

**August 22-25, 2002** – 110th Convention of the American Psychological Association, Hilton Chicago Hotel/Hyatt Regency McCormick Place Hotel, Chicago, IL
http://www.apa.org/convention

*August 27-29, 2002 – 4th Workshop on Risk Analysis and Safety Performance, Atlantic City, NJ*
http://aar400.tc.faa.gov/aar424/workshop2002

**August 27-30, 2002** – Measuring Behavior 2002, 4th International Conference on Methods and Techniques in Behavioral Research, University of Amsterdam, Amsterdam, The Netherlands
http://www.noldus.com/events/mb2002/index.html

**September 16-18, 2002** – Conference on Aerospace Materials, Processes and Environmental Technology, Huntsville, AL http://ampet.msfc.nasa.gov/

**September 17-18, 2002** – FAA R,E&D Advisory Committee, Holiday Inn Rosslyn Westpark Hotel, Arlington, VA mailto:gloria.ctr.dunderman@faa.gov

**September 17-20, 2002** – International Air Cargo Forum, Hong Kong http://tiaca.org/

**September 30- October 4, 2002** – Human Factors and Ergonomics Society 46th Annual Meeting, Baltimore Waterfront Marriott Hotel, Baltimore, MD http://www.hfes.org/

**September 30** – October 1, 2002- FAA R,E&D Advisory Committee (REDAC) Meeting, Holiday Inn Westpark, Rosslyn, VA http://research.faa.gov/aar/redac_meetings.asp

**October 10-19, 2002** – The World Space Conference, Houston, TX ww.aiaa.org/wsc2002

**October 14-16, 2002** – Third LOSA Week, Dubai, United Arab Emirates mailto:dmaurino@icao.int

**October 21-24, 2002** – 2nd Annual FAA Centers of Excellence Meeting, Wichita, KS http://www.niar.twsu.edu/faacoe

**October 23-25, 2002** – International Conference on Human-Computer Interaction in Aeronautics, Massachusetts Institute of Technology, Cambridge, MA http://www-eurisco.onecert.fr/events/hci-aero2002.html/

**October 27-31, 2002** – 21st Digital Avionics Systems Conference, Hyatt Regency Hotel, Irvine, CA http://www.dasconline.org/

**April 7-27, 2003** – Aviation World's Fair, Newport News/Williamsburg, VA http://www.worlds-fair.com/ or http://aviation-worlds-fair.com/

**May 4-9, 2003** – 74th Annual Scientific Meeting of the Aerospace Medical Association, Convention Center, San Antonio, TX http://www.asma.org/

**July 14-17, 2003** – AIAA/ICAS International Air & Space Symposium and Exposition, Dayton Convention Center, Dayton, OH http://www.flight100.org/

**August 7-10, 2003** – 111th Convention of the American Psychological Association, Toronto, Ontario, Canada http://www.apa.org/convention

**October 13-17, 2003** – Human Factors and Ergonomics Society 47th Annual Meeting, Adams Mark Denver Hotel, Denver, CO http://www.hfes.org/

**May 2-7, 2004** – 75th Annual Scientific Meeting of the Aerospace Medical Association, Egan Convention Center, Anchorage, AK http://www.asma.org/

**September 20-24, 2004** – Human Factors and Ergonomics Society 48th Annual Meeting, Sheraton New Orleans Hotel, New Orleans, LA http://www.hfes.org/

*Note: Calendar events in Italics are new since the last Newsletter*

Comments or questions regarding this newsletter?
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