Acceleration Research News

Submissions from the International Acceleration Research Workshop Community

Volume 1, Issue 1 May 2000

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Trying a Different Approach

During a discussion of this year's anticipated workshop, Dr. Barry Shender suggested a modified format for the workshop which might have several advantages over our traditional approach.

A. Rather than presenting national laboratory reports orally, representatives from each participating acceleration facility and other interested parties would provide to the chairman a few paragraphs describing the status, projects and events which have occurred over the last year and what they are planning for the future.

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Where and When

This is the 14th anniversary of the International Acceleration Research Workshop conceived by Dr. Russell R. Burton. This year's workshop will be held again during the Aerospace Medical Association Annual Scientific Meeting in Houston Texas.

The workshop will take place at:

Room: Plaza 1
Westin Galleria and Oaks Hotel
Thursday, 18 May 2000
1200 - 1400 PM

Discussion Topic

The topic chosen for this year is one that seems to raise its head on a regular basis. Consider it from in-flight, training and research perspectives

"Long Term Monitoring of GLOC Effects".

Are there any long term detrimental effects of exposure to a single GLOC? What about multiple GLOC episodes? What changes in physiologic and cognitive responses should be monitored to determine any cause and effect? Are there any currently available tests that would be appropriate and practical? How would we go about collecting this data? How would we encourage cooperation among all facilities to participate in this monitoring? Do the members have any anecdotal examples of possible deficits? How can we ensure that human use concerns are addressed (e.g.,privacy issues)? Is this something to worry about at all?

Thursday May 18, 2000;
12:00 – 2:00 PM

Room: Plaza I
Westin Galleria and Oaks Hotel
Houston, Texas

International Acceleration Research Workshop

Agenda

- Welcome
- Introductions
- Special Announcements
  (safety related events, requests for information...)
- Discussion topic

  "Long Term Monitoring of GLOC Effects".
- Chair selection
- Dr. Wood:
  ”Realtime Non-invasive Detection of Zero Arterial Pressure at Brain Level”
- Discussion of newsletter articles
- Other presentations

Status, Projects, And Events Of The Koenigsbrueck Human Centrifuge (HC)

Dr. H. Welsch, Col. M.C

German Air Force Institute of Aviation Medicine, Königsbrück, Germany

1. The interactive steering system (IASS), developed by AMST, is now working since 1995. The IASS is a digital energy managing regime which allows the pilot to "fly" the HC as a dynamic flight simulator (DCS) with HUD, HDD, throttle and stick. The IASS is used for simulation of operational aspects during the development phase of new life support equipment.

2. The G-envelope of the IASS-regime is opened now from –3 Gx up to +6 Gx, –1 Gy up to +1 Gy (as side effect), and –1 Gz up to +10 Gz.

3. Since November 1999 the pilot may actively perform the push-pull-manoeuvres in the IASS-regime. There is only little lateral Gy during –Gz/+Gz-transition. The +Gx acceleration during –Gz/+Gz-transition is well accepted by the pilot and seems to be the method for the future.

4. By computing the acceleration vector of the rotation of the HC and the acceleration vector of pitch and/or roll movement of the HC it is possible to reach maximum G-onset up to +8G/s during –Gz/+Gz-transition (see fig. 1).

5. The development of the hydrostatic "Libelle"-suit, Switzerland, using the Koenigsbrueck human centrifuge, is now in the 4th year with over 350 manned runs, inclusive push-pull manoeuvres in the IASS regime. The cardiovascular reaction and regulation seems to be unproblematic (see fig. 2).

6. A research program with a full coverage air ventilated anti-G-suit ("GKSA") is running since 2 years with growing success. This research program is performed together with the inventor and the German company Ballonfabrik, Augsburg. ❖

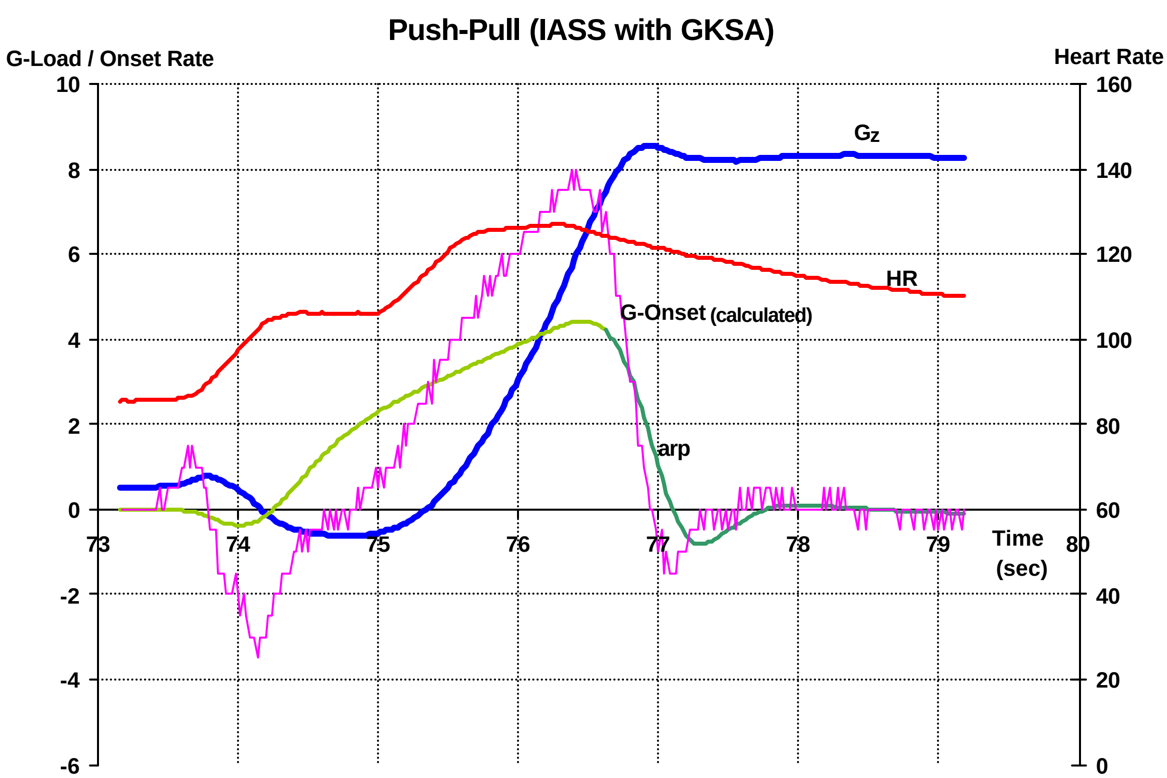


Fig. 1: push-pull manoeuvre in the IASS-regime with GKSA and maximum G-onset of +8g/s

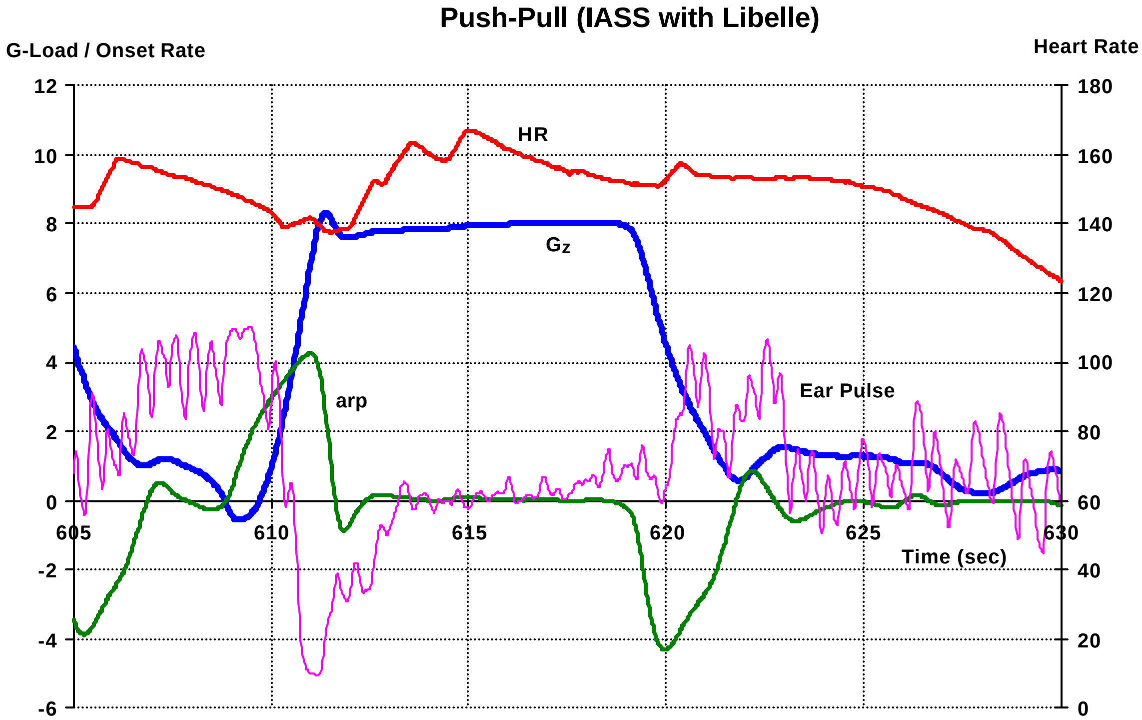


Fig. 2: push-pull manoeuvre in the IASS-regime with "Libelle": no HR-depression.

Prevention of GLOC by Beat-to-Beat Detection of Zero Arterial Pressure at Brain Level

Earl H. Wood, MD, PhD, Edward H. Lambert, MD, PhD, Charles F. Code, MD, PhD

Emeritus Members Mayo Clinic and Mayo Foundation
Mayo Clinic, Rochester Minnesota USA

Loss of ear (opacity) pulses during G_z acceleration provides a reliable real-time beat-to-beat noninvasive indication of zero systolic pressure at head level (20-23,25,27,28). This fact is documented in the last panel of an objective assay of the G_z tolerance of voluntary subject no. 247 studied on the Mayo human centrifuge during 1946 (Fig. 1).

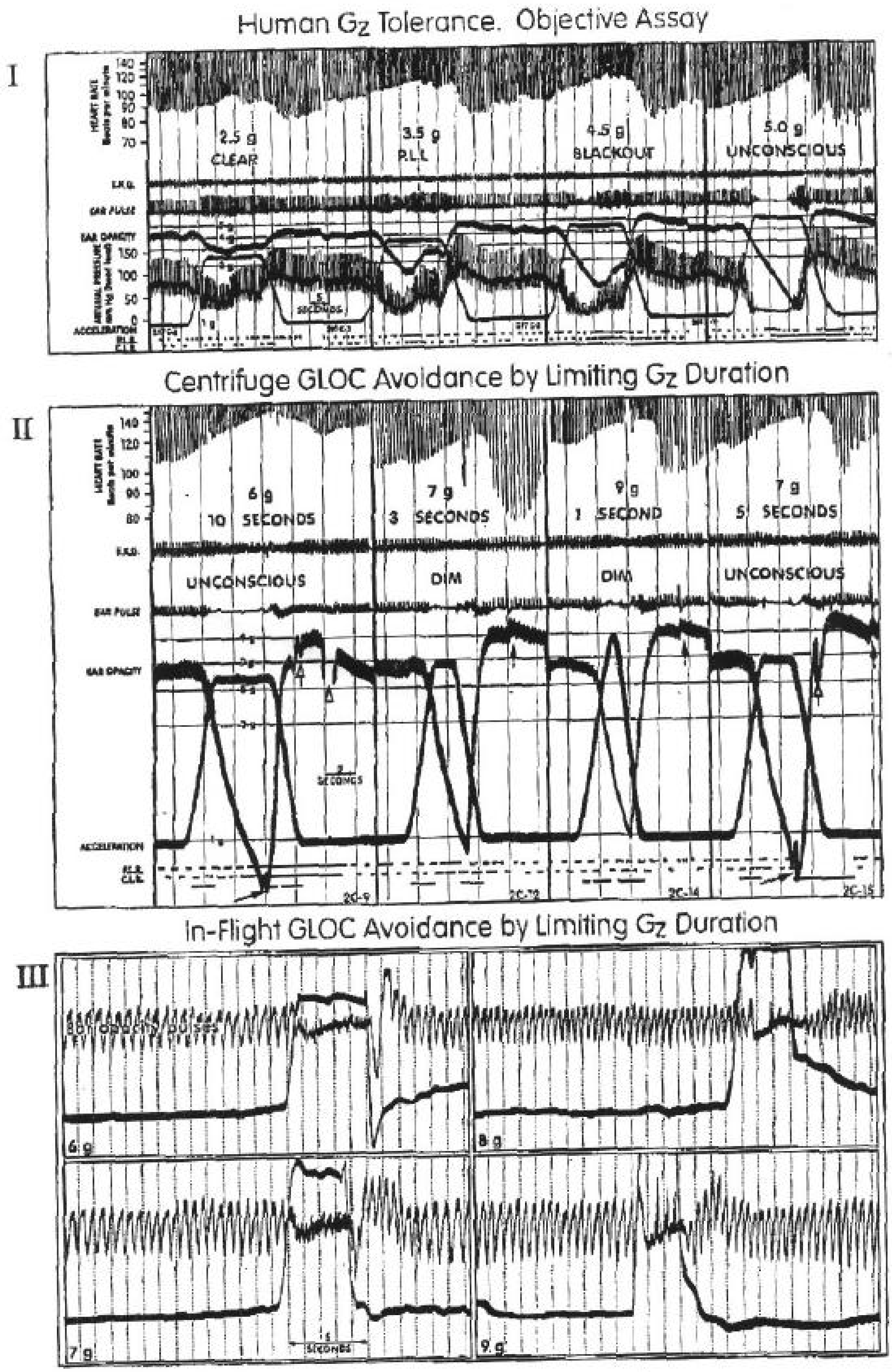
Prevention of G_z-induced loss of consciousness (GLOC) by limiting the duration of G_z exposures that obliterate the ear pulse to less than 5 seconds is documented by Figures 2 and 3 (28).

Figure 3, which consists of in-flight recordings dated May 1, 1947, fro the Aero Medical Laboratory of Wright-Patterson Air Force Base (13) is of special interest in relation to the prevention of GLOC in flight.

This research project was sponsored by Air Force consultant George W. Maison, M.D., who had witnessed the 1945 experiment illustrated in Figure 2. He also had experienced GLOC preceded by a 5-second loss of the ear pulse when serving as a volunteer subject for in-flight studies, using a specially instrumented A-24 dive bomber (6-8).

Maison, with approval of his chief (Col. G. K. Moore), persuaded two Air Force pilots to develop a diving spiral pull-out maneuver by means of which they could achieve very rapid (1 second) onset-time plateau (5 seconds) exposures at any desired acceleration to an upper limit of 9 G_z. It is of interest in regard to centrifuge training in pilots that a 1 second onset to 9 G_z from a 1 G_z baseline is still unattainable by current human centrifuges.

Continuous in-flight recordings of ear opacity pulses obtained during successive exposures to 6, 7, 8, and 9 G_z are duplicated in Figure 3. Note that although the ear pulse was obliterated throughout the plateau phase of each exposure, no incidents of GLOC occurred. Each pilot did report some dimming of vision near the termination of the higher G levels.


Human Gz Tolerance. Objective Assay
I
2.5 g
CLEAR
3.5 g
PLL
4.5 g
BLACKOUT
5.0 g
UNCONSCIOUS
Centrifuge GLOC Avoidance by Limiting Gz Duration
II
6 g
10 SECONDS
7 g
3 SECONDS
9 g
1 SECOND
7 g
5 SECONDS
UNCONSCIOUS
DIM
DIM
UNCONSCIOUS
ACCELERATION
In-Flight GLOC Avoidance by Limiting Gz Duration
III
6 g
8 g
7 g
9 g

Similar recordings were obtained on the Wright-Patterson Air Force Base human centrifuge at that time (5). Hence, it is strange that such noninvasive technologies for obtaining objective recordings of circulatory changes at brain level were not subsequently transferred to the Brooks Air Force Base human centrifuge, particularly in light of the increased incidence of GLOC-induced losses of pilots and planes coincident with the activation of maneuverable jet-powered fighters during the 1970's (24) and persisting to a lesser degree to this day.

Stoppage of the centrifuge whenever the real-time monitored ear pulse is obliterated for more than three heartbeats has provided a uniformly reliable method of preventing GLOC on the Canadian DCIEM human centrifuge since 1992 (1-3).

Although the fundamentals of this life- and plane-saving technology have been known and documented on both the Mayo and the Wright-Patterson human centrifuges, and in flight for more than a half century, this strategem has not been utilized by our air forces (17, 18).

A temporal sequence of the publications that well document this unheeded technology follows.

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GPL - Gravitational Physiology Laboratory

Dr David G. Newman

Gravitational Physiology Laboratory, Victoria Australia

The Gravitational Physiology Laboratory (GPL) was established in March 2000 in the Department of Human Biology and Movement Science of the Faculty of Biomedical and Health Sciences at RMIT University in Melbourne, Australia. This laboratory is a first for an Australian University. It is the only laboratory of its kind in Australia, and has been specifically created to examine all aspects of human exposure to altered gravitational fields. These include the high +Gz environment of pilots who fly high performance fighter and aerobatic aircraft, and the microgravity environment of long-duration spaceflight. The laboratory is also tasked with teaching both undergraduate and postgraduate students.

The Head of GPL is Dr David G. Newman, who is a Senior Research Fellow in the Faculty of Biomedical and Health Sciences. He is also responsible for teaching the physiology of extreme environments at both the undergraduate and postgraduate level. Dr Newman has published several scientific papers on gravitational physiology topics in the last few years.

GPL has an extensive research programme planned, including the continuation of Dr Newman's recent research efforts in the areas of +Gz-induced neck injuries and cardiovascular adaptation to high +Gz exposure. An airborne flight research programme is also being established. One of the laboratory's main projects for the year 2000 is an investigation into the effect of low-level normobaric hypoxia on orthostatic tolerance. This project is being conducted by a postgraduate research student.

GPL would like to actively encourage collaborative research projects, and would welcome contact from any acceleration research facility or centre wishing to pursue any joint scientific project. Contact details for GPL appear below;

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Swedish Armed Forces

Gunnar Larsson, LtCol, M.D.
Aeromedical Center in the Swedish Armed Forces, Sweden

The Human Centrifuge at Karolinska Institutet (KI), Solna/Stockholm has been renovated 1997 with respect to motor, gear box, functions for generation of actual profiles as well as software for medical and other surveillance. Max G is 15 with an acceleration of ≤5 G/s. In Sweden our pilots are subjected to max 9G; 5 G/s. Since 1997 451 pilots have participated in training and qualification in the centrifuge. Normally one seance takes about 20 min.

All work for The Swedish Air Force is performed using 5 attendants (Pilot training officer (PTO), assistant PTO, operator, physiologist and medical monitor). Our PTO´s have been educated at Brooks AFB, San Antonio, TX, Holloman AFB, Alamogordo, NM and in Sweden.

A Dynamic Flight Simulator made by Wyle is under construction at Linköping (130 miles south of Stockholm). Year 2001 this centrifuge will be the main training and qualification simulator for The Swedish Air Force.

The Dynamic Flight Simulator DFS Progress Report

We are happy to announce that the DFS project has progressed significantly the last couple of month. The DFS building in Linköping with the main motor and its power installations has been ready for quiet some time now and late last fall the arm and gondola assembly and the control room systems passed the factory acceptance test and were shipped from the manufacture Wyle Laboratories in El Segundo, California.

On site installations started early this year and the mechanical and power installations are now finished. At this time a test permit is required to start main motor and later pitch and roll motor tests. A second test permit will later be issued for advanced system tests with human subjects riding the centrifuge. Formal acceptance tests are scheduled to start this fall and the DFS will hopefully be operational around midsummer next year.

System Overview

The main feature of the DFS is of course the simulation of six degrees of freedom flight using only three degrees of freedom motion, rotation , pitch and roll. The sensation of free flight is created as a function of an elaborate out of the window visual system and proprioceptive input generated by means of perceptual control algorithms developed and implemented by Veda Inc.

Other features, besides high sustained G and high acceleration rate capabilities, include a flexible gondola design providing easy change of cockpit by insert substitution and a sophisticated flight simulation system with aircraft and weapon system options. The gondola may also be equipped with a turnable seat for spatial disorientation training and research.

System Applications

The DFS will initially be used for pilot G-training, pilot selection and medical investigations and evaluations.

Future uses include flight and tactical pilot training as well as research in the fields of Man Machine Interface and Interaction, aviation physiology and aviation psychology. The future will also see a lot of development, testing and evaluation of pilot, cockpit and mission specific equipment. ❖

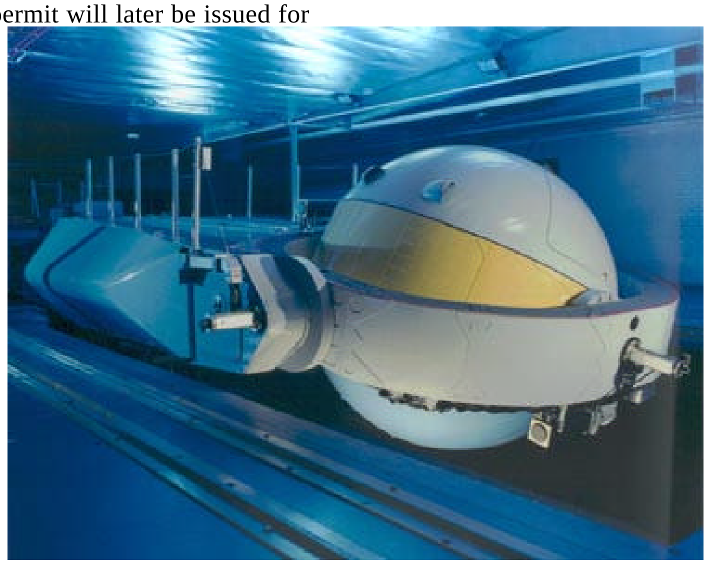

Fig.1 Swedish Air Force DFS Arm and Gondola Before Installation

US Navy Acceleration Research Programs

Barry Shender

Naval Air Warfare Center Patuxent River MD USA

1. Physiologic and neurocognitive effects of transitions from less than 1g to greater than 1g as experienced in tactical flight. A joint USN, DCIEM, USAF project in which subjects were exposed to standard (gradual and rapid onset runs and a Gillingham SACM) and simulated operational profiles (F/A-18 profiles and a CF/A-18 mishap profile attributed to push-pull) at the centrifuge facility in Warminster, PA, operated by Veridian Operations in 1998-1999. Cognitive effects were determined by subjects performing a combined math and compensatory tracking task; subjective workload assessed using the NASA Task Load Index; and subjects indicated peripheral light loss through a switch on the control stick. Physiologic changes were monitored using the Smart Aircrew Integrated Life Support System (SAILSS) suite (ECG, EEG, EMG, respiration, SpO2), Finapres (blood pressure), impedance cardiography, and cerebral tissue oxygenation (Somanetics near infrared device). Subjects wore STING anti-G suit garment and Combat Edge pressure breathing equipment. There were three anti-G protection modes: standard Combat Edge schedule, and open (G history) and closed (biofeedback) loop SAILSS control.

2. Smart Aircrew Integrated Life Support System (SAILSS). Next phase of SAILSS testing, including anti-G garments with integrated sensor suite with an enhanced software/hardware interface and interaction with ground collision avoidance and missile avoidance systems, scheduled for September 2000 at Brooks AFB, San Antonio, TX.

3. Head/neck injury: Ongoing project to determine the tolerance of the neck to injury during maneuvering acceleration, including the effects of added head weight. Integrated program includes human testing, anatomic modeling, vertebral properties determination, QCT and MRI studies, and work/rest cycle effects. Manikin centrifuge testing at Brooks AFB, San Antonio, TX in May 2000 to determine acceleration, loads and moments for +Gz stresses encountered in helicopters (up to +4 Gz) and tactical (up to +12 Gz) aircraft, for a range of added head weight configurations (pitch angles), as well as actual helmet and HMD systems.

4. G Tolerance Improvement Program pilot training. Successful curriculum for last four years at Lemoore, CA facility. G training temporarily suspended in early 2000 due to unresolved mechanical problems.

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Discrimination and Identification of Color-coded Targets at High G

Dr. Tamara Chelette,

AFRL/HEPA Wright Patterson Air Force Base USA

The development of modern display technology has made it possible to use color coding in avionics displays to enhance information presentation to pilots. In the aviation literature, there are anecdotal reports that color vision can be altered by exposure to high G force. Changes in color perception at high G is a serious concern for the USAF since we are developing helmet-mounted color displays (HMDs) for tactical aircraft. One of the main purposes of these displays is to provide color coded air-to-air weapons targeting information, which must remain unambiguous during the high G turns that are required in air-to-air combat. Situational awareness dis-plays are planned that provide both color and shape coding. The dual coding should reduce the time required to com-prehend the status of another aircraft, provided both color and shape are correctly interpreted. But what if alterations in the eye or brain resulting from reduced blood flow to the retina, optic nerve, or occipital cortex result in a misidentification, or lack of identification, of a color? Then the conflict between color and shape presented to the pilot could significantly increase his or her time to comprehend the situation. In addition, displays are planned to use color to identify which of several subsystems are currently active. If a pilot has lost the ability to discriminate the active color from the standard for inactive sub-systems, confusion and delay could put the mission in serious jeopardy.

An extensive psychophysiologic literature base on human discrimination and identification of color stimuli suggests that perception can be predicted with a model of human color vision that includes three color-coding mechanisms, two color-opponent mechanisms, and an achromatic (intensity) mechanism. In the model, the three mechanisms are characterized by equations describing their sensitivities and retinal signal processing. Visual performance under different conditions can be predicted by measuring the values of the parameters for the conditions of interest. Though previous work has shown impairments in color perception do occur with exposure to +Gz, quantitative measures of these effects as a function of G force have not been made. Such quantitative measures are necessary to the development of a design tool that will enable display de-signers to evaluate and develop color displays that are effective at high +Gz levels and also to better understand the effect of G force on a pilot's vision. Recent research at the Human Effective-ness Directorate of the AFRL has shown that color perception is altered when human observers are subjected to high +Gz and is lost altogether at levels near the viewer's gray-out point. This work indicates that colors become less colorful and their hue may shift during exposure to +Gz. Therefore, equations that predict the effects of Gz on color perception are needed to enable designers to produce color displays and HMDs that remain usable under all flight conditions. Fortunately, the AFRL has both the Dynamic Environment Simulator centrifuge facility and the Brooks AFB research centrifuge, as well as a cadre of human factors experts who are working to develop the model and the design tool.

Research projects to identify the frequency of visual deficits across individuals and the G levels at which these deficits are measurable have already been accomplished. In addition, a care-fully controlled research project to determine the effect of luminance (perceived brightness) of a target on the ability to see and correctly identify or select a target at several high G levels has been completed. A study is currently under way to measure the effect of scan-pattern and object color content (saturation) on the G level at which color objects lose their apparent color. Results so far indicate that approximately half of the high G qualified population demonstrates lose of hue discrimination at G levels significantly below their relaxed G tolerance. Also, luminance contrast between the foreground object and its background is a major driving factor of the persistent perception of the object. Further testing has revealed that a sub-population of individuals that show normal color vi-sion at 1 G may demonstrate repeatable confusion of green and yellow as well as gray and blue targets at sustained accelerations above 7 Gz. These studies have laid the groundwork for a future research program that will completely character-ize color vision under G.

The next step of the research is to quantify the nature of the color perception losses by measuring them as a function of +Gz exposure. Essentially, this means measuring how different a color stimulus must be from white to be dis-tinguishable from white. These measurements are referred to as discrimination measures. The next step is to quantify how the appearance of color stimuli that are distinguishable from white changes with exposure to +Gz. This means measuring the chromaticities (hue, saturation, and luminance) of the colors that are identified as blue, green, red, and yellow as a function of +Gz.. These measurements are referred to as the identification measures. The final step is to use the discrimination and identification measure to develop a physiologically based model of human color vision that predicts performance on these two tasks as a function of +Gz.

Because the parameters in the equations are known to be closely related to the visual system physiology, this work will advance the understanding of the physiological effects of +Gz forces on color. For example, previous work suggests that the effects of visual trauma to the retina may interfere with receptor connections to the color coding channels, whereas trauma to the optic nerve interferes with the neural channels them-selves. The parameters in the model relate to processes at these two levels, so changes in the parameters should reveal where the effects of +Gz occur within the human visual system.

Another use of the development tool may be implemented in static simulators. Many of these simulators already dim the display or provide a spatial reduction if field of view at high G in order to simulate known visual effects. The fidelity of simulators could be enhanced significantly of the displays were altered to mimic the effect of G on color vision. Training would be enhanced because pilots would become familiar with the potential for visual identification conflicts and increased workload when discrimination becomes time consuming.

The harsh environment of high G aerial combat places stresses on a pilots' body to that push him or her to their limits. Yet, in this desperate challenge, the ability to maintain better situ-ational awareness than one's opponent will be essential to tactical superiority. The Human Effectiveness Directorate is dedicated to assuring that Airman faced with such a challenge will be victorious.

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Class A Spatial Disorientation (SD) Mishaps

Clark Davenport, Maj, USAF, BSC

HQ Air Force Safety Center, USAF USA

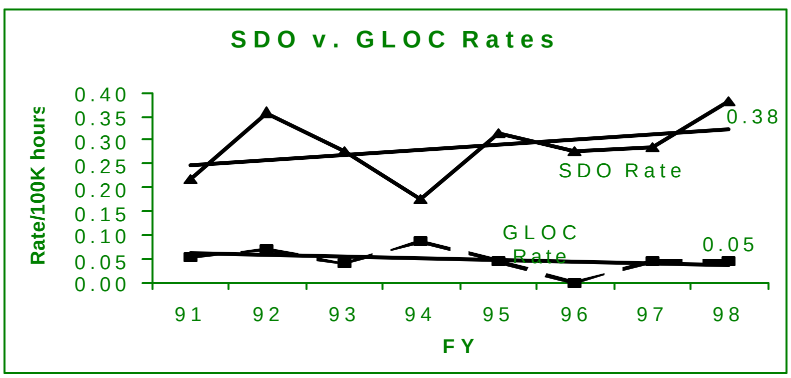
The purposes of the following paper are to illustrate the cost to the USAF of spatial disorientation, the present state of SD research at Brooks AFB, and to pose questions regarding the future direction of SD training/prevention. It outlines the impact SD has had on the USAF in the form of Class A mishaps from FY 91 to FY 98 and current status of SD research into prevention in the USAF.

A comparison with Class A G-induced loss of consciousness (GLOC) mishaps is presented, as a contrast, since GLOC mishaps have resulted in the development and deployment of new "preventive" hardware (Combat Edge, High-flow G valves).

- Definition of SDO as found in AFMAN 11-217 Instrument Flying: "SD is an incorrect perception of one's linear and angular position and motion relative to the plane of the earth's surface. Specifically in the flight environment, SD is an erroneous percept of any of the parameters displayed by aircraft control and performance flight instruments."
- The information presented below does not include Class A Mid-Air collisions, the F16 engine loss with subsequent crash into a house, or the A-10 Tower strike.
- Data search limited to Class A mishaps
- Data limited to those mishaps where SD related/GLOC related human factors rated as "Causal" or "Major Contributor" by Flight Surgeon/HF Investigator
- SD Class A mishap history: FY 91 – FY 98 across all weapon systems

Table 1: Breakdown of SDO v. GLOC and Total Class A for Y 91-98

Category	Total FY 91-98	SDO / % of Class A	GLOC / % Class A
Class A Mishaps	270	56 / 20.7%	11 / 4.1%
Cost	$4.6 Billion	$1.3 Billion / 28.5%	$174 Mil / 3.8%
Fatal Incidents	82	30 / 36.6%	7 / 8.5%
Fatalities	280	50 / 17.9%	8 / 2.8%
Overall Rates/100K hrs	Mean: 1.36	Mean: 0.29	Mean: 0.05

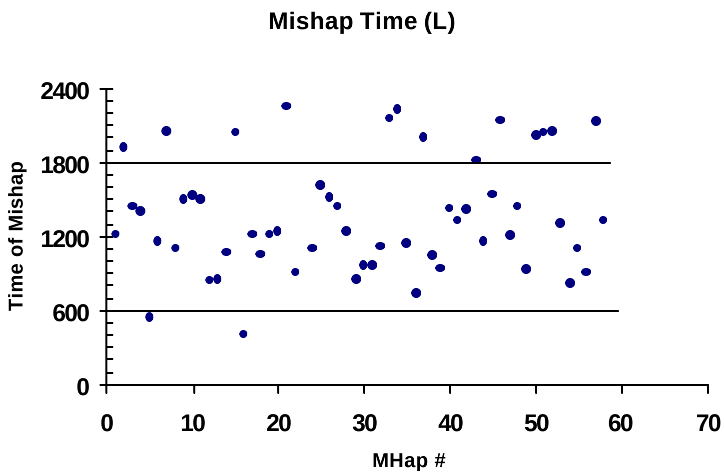


- Human and dollar cost of SDO related mishaps are far greater than GLOC related mishaps
- SDO rates for the eight-year period shows increasing rate.
- When do SDO mishaps occur?
- Traditional view is that SD is more likely to occur in absence of good visual cues, which is true to a point.
- Data reveals that a majority of SD related mishaps occurred during daylight hours as depicted in following chart/graph
- Daylight Events (0600-1800 L): 41
- Nighttime Events (1800-0559 L): 15
- No accurate way to develop a rate since USAF does not track Night/Day sorties/hours

- 37% SDO mishaps occurred at night
- % of night sorties/hours flown ??????
- Contributing Factors to SDO mishaps
- We investigated factors that contributed to the SDO event, i.e., Why did the pilot/crew become disoriented?

Data reveals that the following human factors contributed to SDO incidents

SDO Contributors (Ranked most prevalent to least prevalent)
Attention Management (Channelized Attention, Distraction, Habit Pattern Interference)
Judgment and Decision Making: (Task Misprioritization, Course of Action Selected)
Mission Demands: Vision restricted by Wx/Haze/Darkness

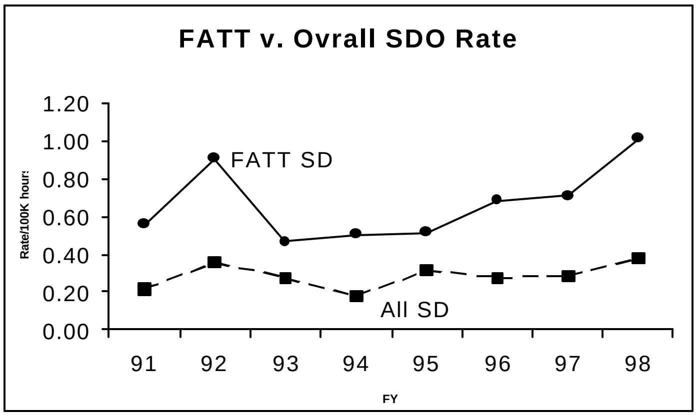


- The data reveals that cognitive factors play an important role in entering an SD situation, identifying an SD situation, and recovering from an SD event
- The contributing factors shown above are constant across weapon systems
- The following graph shows SD rate for the fighter/attack (FATT) community which accounted for 80% of our SD Class A's from FY 91 – 98

- F16s accounted for ~ 50% of the SD Class As
- F15s accounted for ~18% of the SD mishaps
- A/OA10s accounted for ~18% of the SD mishaps

Challenges for SD mishap prevention:

- Initial and recurrent TRAINING for SD:
- Currently, lecture format



- Lucky few get "demonstration" in Brooks AFB Advanced Spatial Disorientation Demonstrator (ASDD)
- No program "trains" multitasking/mission management in tactical environment other than actually flying (increases exposure to the hazard)
- As of 22 Sep 99, AETC/DOFI staffing a package through AETC command regarding new training device for UFT. Might recommend use of ASDD.
- Question is what is the purpose of the device…demonstration of illusions or training of SD recognition/prevention/recovery?

What causes attention management problems?

- Proficiency?
- Cognitive/spatial task management by crew?

What research is occurring to assess prevention and future hazard mitigation?

- As of FY00, USAF SD research effectively disappears
- Some funding restored to ARL, however, SD branch is not expected to receive funds.

What SD hazards are pilots exposed to in highly agile (F-22, JSF) aircraft ?

- Especially considering the use of helmet mounted displays?

What effect do helmet mounted displays have on spatial awareness of aircrew?

- A relatively new dimension added to flying USAF fixed wing aircraft
- How steep is the learning curve?

Can we develop, with the hardware available today, training, not demonstration, scenarios to help pilots recognize SD precursor and SD events?

What tools are available to help mitigate losses?

- AGCAS for situations where pilots/crews get themselves disoriented
- System to keep aircraft out of the dirt…doesn't increase pilots' SA as to where they are in relation to the dirt
- May be the best solution (cost/benefit) v. preventing SD in the first place

Do we accept fact SD will occur and best solution is to make the error non-lethal and recoverable?

- Standard instruments (HUD and Heads-down) to maintain orientation
- Based on mishap history for SD, instrumentation coupled with the human not effective in those cases where pilots became disoriented
- Instrument design/HF intervention to increase effectiveness for reorienting pilot before AGCAS has to activate?

Bottom Line:

- SD has cost the USAF greater than $1.3 billion dollars over the last eight years
- There is no USAF SD research entity remaining due to budget cuts at AFRL
- For FY 99 to date there are 3 SD mishaps out of 30 Class A mishaps for 10% of mishaps and a cost of $79,809,190.00
- AGCAS is "accepted" but addresses recovering the aircraft after SD upset (which may be the best solution❖

USAF ANNUAL REPORT

Wright-Patterson AFB (HEPA) activities over the past year

William Albery, PhD

Wright Patterson Air Force Base, USA

Over this past year the DES centrifuge facility has been busy with color perception at high G research and helmet biodynamics issues. John Frazier retired 31 Dec 99 after 43 years with the DES facility. We celebrated the 30th anniversary of the DES centrifuge in Dec 99 as well. This past Fall we picked up the Spatial Disorientation program from Brooks. Dr Albery and Dr Chelette will begin to devote more and more time on SD issues and less on acceleration research.

We took delivery of a computer model of the human under high sustained acceleration. Dr Rafik Grygoryan, of the Ukrainian National Academy of Sciences, adapted the model from a zero gravity model of the human developed for the space program.

We signed a Cooperative R&D Agreement with ETC this past year to look at some drive algorithms on a closed loop, gimbaled centrifuge. ETC plans a follow-on effort looking at the Push-Pull maneuver and how to best emulate this research/training in a gimbaled centrifuge.

We also evaluated a hand-held, portable IntraOcular Pressure (IOP) monitoring device, called a tonometer. A paper on this evaluation will be presented by Dr Draeger (see abstract #359 to be presented 18 May). We measured increases in the IOP at -1Gz and at +2 and +3Gz.

The color perception research will be presented first thing Mon May 15. We have now completed six studies on this phenomenon where certain colors may wash out entirely or combine with an adjacent color and form a new color. The abstracts are listed in the program (abstracts #7-12).

The helmet biodynamics research continues very nicely. We are looking at the effect of helmet mass and center-of-gravity on helmet tracking performance and neck EMG activity. This work will help define future helmet mounted system requirements in the high G environment.

Bill Albery participated on an RTO (formerly AGARD) working group on Human Consequences of Supermaneuverable Aircraft this past year. Lecture Series on the results of the team were given in Munich and Preston (UK) in March. One more lecture series is offered at Wright-Patterson AFB 19-20 Oct 00. Those interested in attending should contact Dr Albery.

Numerous papers were written (SAFE Journal, Aircraft Symposium at Zhukovsky, Russia), presentations at SAFE-Atlanta were given and at this AsMA, and several Window-on-Science visitors were received at Wright-Patterson AFB. Working with HEPM at Brooks, Business Plans for both the Sustained Acceleration and Spatial Disorientation areas which cover the next five years, were developed. Dr Chelette won two engineering awards in the Dayton area and had a baby girl along the way. It has been a busy year at HEPA.

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Brooks AFB (HEPM) activities over the past year

Paul Werchan, PhD

Brooks Air Force Base, USA

We have survived. The planned October closure and related RIF (reduction in force) within AFRL's Biodynamics and Crew Protection Division were rescinded in August of 99. Since that time, remaining personnel have reconstituted critical programs and established new ones. These include a mixture of training, research and protective equipment development:

Training accounts for about a third of our 5500 exposures in the past year and includes students from AETC's PIT (Pilot Instructor Training) at Randolph AFB, and trainees from USAFSAM's Aeromedical Primary and Aerospace Physiologist courses.

Research activities have included our investigation of the effects PRK (photorefractive keratectomy) on vision at high G, our support to the Navy SAILSS (Smart Aircrew Integrated Life Support System) program, investigation of the effects of transitioning from PBG to PBA, participation in development of an Israeli G-LOC detection system (based on dry electrode technology), and completion of a 12-subject study assessing the thermal burden potentially associated with COMBAT EDGE. The latter study is noteworthy because it was completed in less than four months and assessed the influence of two different flying ensembles (PBG and non-PBG) on dehydration, G-tolerance, and performance at a closed loop F-16 flying task. No meaningful differences were found between the two ensembles.

Development activities have included support of a new flying ensemble for Singapore's F-5 Tiger aircraft, successful assessment of the acceptability of a camera attachment to NVG goggles, ongoing man-rating of the productionized ATAGS design, and a program which man-rated COMBAT EDGE and ATAGS for use in the F-22 life support system.

Future activities will focus on both better understanding of physiological changes occurring under G, together with the assessment and development of technologies intended to support that physiology. We will revisit G-suit inflation and PBG pressure schedules with the idea of individually adjusting or tailoring those schedules. We will begin to assess the potential of hydrostatically activated garments like Libelle. We will also assess the value of electronic regulation in controlling both garment inflation and PBG, and explore the benefits of additionally pressurizing the arms and possibly the neck. We will additionally continue to develop our dynamic simulation capability in hopes of discriminating between protective means on the basis of performance at simulated tasks, rather physical performance on classic endurance profiles.

Surviving staff includes Dr Paul Werchan, Lt Col Tom Morgan, Mr Wayne Isdahl, and Curtis White together with Mr Bob Shaffstall (Colonel, USAF, Ret), Dr Ulf Balldin (Sweden, Ret), Mr Larry Meeker (soon to retire again), and Mr Durell Bess (MSgt, USAF, Ret). All with variants of the (Ret) suffix are employees of Wyle Laboratories, our in-house contractor. We regret to announce the departures of Col Don Stork (to retirement), Dr Brian Self (to the Air Force Academy) and Dr Don Sheriff (to the University of Iowa).

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Current Status of AMST's Human Centrifuge Programme Contract at the Flight Research Institute in Zhukovsky, Russia

Wolfgang Tischer

AMST Systemtechnik Ges.m.b.H, Austria

AMST Systemtechnik Ges.m.b.H. has pleasure to announce that the world's most powerful Human Centrifuge programme at the Zhukovsky Flight Research Institute (LII „Gromov") is on schedule. The current centrifuge installation programme has now completed the entire equipment for the Aviation Medicine Research and Training Centre in Zhukovsky, Moscow Region, Russia. The building complex will house the human centrifuge, offices and attached laboratories for physiological, biomedical and aeromedical research and examinations.

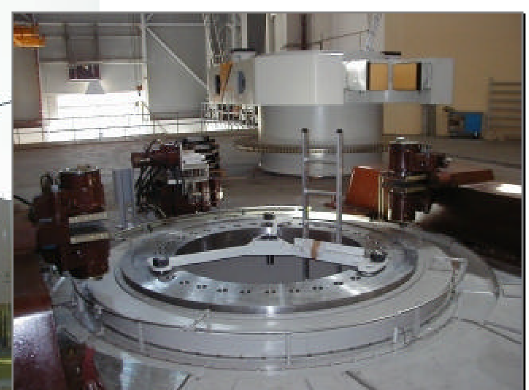
The biggest main drive ever produced for a Human Centrifuge has been installed. The 24 megawatt, 300 ton, high-performance synchronous engine was placed precisely in its final position with an accuracy of tenths of a millimetre. The commissioning of the main drive has been finished.

The installation of the 8 meter main arm, the gimballed gondola system and the remaining centrifuge components, is now in progress. All control room facilities and auxiliary equipment for centrifuge operation have already been completely installed and tested.

The picture below shows the building complex of the Aviation Medicine Research and Training Centre at the Flight Research Institute LII „Gromov" in Zhukovsky, that is ready for occupation. It consists of the centrifuge hall, and an office and laboratory wing. The lower right picture shows the mechanical interface between the centrifuge structure and the electric main drive system together with the mechanical brake, the positioning system and other centrifuge components during installation in April 2000.

This human centrifuge will reach a maximum of 15 G with an onset rate of about 9 G/s for linear acceleration profiles in preprogrammed and closed loop modes with full payload in the gondola system. The powerful hydraulic gondola drives and the direct electric main drive (without gearbox) enable to run both linear and non-linear acceleration profiles with a high accuracy. The gondola with a diameter of 4 m is equipped with a comprehensive medical monitoring system and can be used in research and training configuration.

During an executive meeting held in Moscow, Richard Schlüsselberger, President & Owner of AMST informed his LII „Gromov" counterpart that AMST's activities are on track and the Institute's training programme can start on time. ❖



Trying a Different Approach: continued from page 1

These would be similar to the presentations which are normally given at the meeting and could include a graphics or tables. The chairman would then combine this information into a newsletter which would be emailed to all participants and would be made available as a handout at the workshop.

B. The chairman would define a topic of interest which would be discussed during the workshop. After introductions and special notices we could have at least an hour to discuss this topic fairly thoroughly. This means that it needs to be a good topic and it also means that participants need to bring considered thoughts to the meeting. The chairman would compile the discussion results and present them to the Science and Technology Watch column of the ASEM journal for publication.

This process is a bit of effort but I see the advantages as:

a. Better dissemination of the laboratory and project status.

b. Much greater opportunity to discuss a pressing topic meaningfully

c. More visibility for our group in the journal

-Dennis Kiefer

Chair International Acceleration Research Workshop 2000 Wyle Laboratories

Other Resources of Interest

Aviation Medicine Home Page: http://www.ozemail.com.au/%7Edxw/avmed.html

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