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RTO TECHNICAL REPORT **TR-HFM-118**

Spatial Disorientation Training – Demonstration and Avoidance

(Entraînement à la désorientation spatiale – Démonstration et réponse)

Final Report of Task Group TG-039.

Published October 2008

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Edited by:

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The Research and Technology Organisation (RTO) of NATO

RTO is the single focus in NATO for Defence Research and Technology activities. Its mission is to conduct and promote co-operative research and information exchange. The objective is to support the development and effective use of national defence research and technology and to meet the military needs of the Alliance, to maintain a technological lead, and to provide advice to NATO and national decision makers. The RTO performs its mission with the support of an extensive network of national experts. It also ensures effective co-ordination with other NATO bodies involved in R&T activities.

RTO reports both to the Military Committee of NATO and to the Conference of National Armament Directors. It comprises a Research and Technology Board (RTB) as the highest level of national representation and the Research and Technology Agency (RTA), a dedicated staff with its headquarters in Neuilly, near Paris, France. In order to facilitate contacts with the military users and other NATO activities, a small part of the RTA staff is located in NATO Headquarters in Brussels. The Brussels staff also co-ordinates RTO's co-operation with nations in Middle and Eastern Europe, to which RTO attaches particular importance especially as working together in the field of research is one of the more promising areas of co-operation.

The total spectrum of R&T activities is covered by the following 7 bodies:

- AVT Applied Vehicle Technology Panel
- HFM Human Factors and Medicine Panel
- IST Information Systems Technology Panel
- NMSG NATO Modelling and Simulation Group
- SAS System Analysis and Studies Panel
- SCI Systems Concepts and Integration Panel
- SET Sensors and Electronics Technology Panel

These bodies are made up of national representatives as well as generally recognised 'world class' scientists. They also provide a communication link to military users and other NATO bodies. RTO's scientific and technological work is carried out by Technical Teams, created for specific activities and with a specific duration. Such Technical Teams can organise workshops, symposia, field trials, lecture series and training courses. An important function of these Technical Teams is to ensure the continuity of the expert networks.

RTO builds upon earlier co-operation in defence research and technology as set-up under the Advisory Group for Aerospace Research and Development (AGARD) and the Defence Research Group (DRG). AGARD and the DRG share common roots in that they were both established at the initiative of Dr Theodore von Kármán, a leading aerospace scientist, who early on recognised the importance of scientific support for the Allied Armed Forces. RTO is capitalising on these common roots in order to provide the Alliance and the NATO nations with a strong scientific and technological basis that will guarantee a solid base for the future.

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List of Acronyms

3-D	Three dimensional
AB	After Burner
ACAS	Aircraft Collision Avoidance System
ACM	Air Combat Manoeuvres
ADI	Attitude Display Indicator
AF	Air Force
AFB	Air Force Base
AFCS	Automatic Flight Control System
AFRL	Air Force Research Laboratory
AGARD	Advisory Group for Aerospace Research and Development
AGL	Above Ground Level
AI	Aircrew Instructor
AI	Attitude Indicator
AIAA	American Institute of Aeronautics and Astronautics
AMTI	AeroMedical Training Institute
AOB	Angle of Bank
AP	Aerospace Physiology
API	Aviation Pre-flight Indoctrination
APTO	Aviation Physiology Training Officer
ASAR	Arc Segment Attitude Reference symbology (similar to NDFR)
ASCC	Air Standardization Coordinating Committee
ATC	Air Traffic Control
AVMED	Aviation MEDicine
Avn	Aviation
CA	Consultant Advisor
CAVOK	Cloud and Visibility OK
CF	Canadian Forces
CFIT	Controlled Flight into Terrain
CML	*Centrum voor Mens en Luchtvaart*, Centre for Man and Aviation, RNLAF
CRM	Cockpit Resource Management / Crew Resource Management
CRT	Cathode Ray Tube
CTP	Course Training Plan
CTS	Course Training Standard
DDI	Digital Display Indicator
DESDEMONA	DESoriëntatie DEMONstrator Amst (advanced SD trainer by AMST)
DFS	Dynamic Flight Simulator
DISO	DISOrientation trainer (SD trainer DISO Airfox by AMST)
DoF	Degrees of Freedom
DOT	DesOrientierungs Trainer
EC	Enabling Check
EO	Enabling Objective
Fatt	Fighter Attack
FFS	Full Flight Simulator
FLIR	Forward-Looking InfraRed

FOV	Field of View
FS	Flight Surgeon
FTD	Flight Training Device
FW	Fixed Wing
GAF	German Air Force
GAFIAM	German Air Force Institute of Aviation Medicine
GCAS	Ground Collision Avoidance System
GPWS	Ground Proximity Warning System
Gyro IPT	Gyro Integrated Physiological Trainer (by ETC)
HCAM	Hellenic Centre for Aviation Medicine
HDG	Heading
HEA	Human Effectiveness Aircrew Training Division
HITS	Highway-in-the-Sky
HMD	Helmet Mounted Display
HMS	Helmet Mounted System
HP	Handling Pilot
HUD	Head Up Display
IFC	Instrument Flying Conditions
IFR	Instrument Flight Rules
IHADSS	Integrated Helmet And Display Sighting System
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IP	Instructor Pilot
IR	InfraRed
ITAF	ITalian Air Force
JHC	Joint Helicopter Command
LED	Light Emitting Diode
LS	Landing Site
LSA	Loss of Situational Awareness
MD	Medical Doctor
MFD	Multi Function Display
MMR	Multi-Mode Radar
MSDD	Multi-Station Disorientation Demonstrator
NAMRL	Naval Aerospace Medical Research Laboratory
NASTP	Naval Aviation Survival Training Program
NATO	North Atlantic Treaty Organisation
NDFR	Non-Distributed Flight Reference symbology (similar to ASAR)
NHP	Non-Handling Pilot
NM	Nautical Miles
NOE	Nap of the Earth
NOMI	Naval Operational Medical Institute
NVD	Night Vision Device
NVG	Night Vision Goggle
OTW	Out-the-Window (visuals)
OVC	Overcast

PAR	Precision Approach Radar
PO	Performance Objective
PWR	Power
QFI	Qualified Flight Instructor
RAAF	Royal Australian Air Force
RADALT	Radar Altimeter
RAeS	Royal Aeronautical Society
RAF	United Kingdom Royal Air Force
RAF CAM	RAF Centre of Aviation Medicine
RFA	Remote Field Area
RNLAF	Royal Netherlands Air Force
RT	Radio Transmission
RTB	Return to Base
RTO	Research & Technology Organisation
RW	Rotary Wing
SA	Situational Awareness
SAM	Specialist in Aviation Medicine
SD	Spatial Disorientation
SID	Standard Instrument Departure
SORD	Spatial Orientation Retention Device
SP	Student Pilot
STANAG	Standardization Agreement
STD	Standard
SUPT	Specialized Undergraduate Pilot Training
TADS	Target Acquisition and Designation System
TCAS	Traffic-alert and Collision-Avoidance System
TG	Task Group
TNO	*Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek*, Netherlands Organisation for Applied Scientific Research
TOR	Terms of Reference
TSAS	Tactile Situation Awareness System
TTTD	TNO Tactile Torso Display
UA	Unusual Attitude
UAV	Unmanned Air Vehicle
UK	United Kingdom
UNT	Undergraduate Navigation Training
US	United States
USAARL	US Army Aeromedical Research Laboratory
USAF	United States Air Force
VMC	Visual Meteorological Conditions
WP	Working Party

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[1] The authors dedicate this report to Curtis Spenny, who enjoyed working on this report. He was unable to complete his contribution because of his untimely death.

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Responses
Reviews
Situational awareness
Spatial disorientation
Spatial information
Spatial orientation
Visual displays

14. Abstract

Recent accident statistics reveal that Spatial Disorientation (SD) is still a major threat to flight safety in many NATO countries. A review of SD training programmes as applied in most NATO countries, in agreement with STANAG 3114, shows that SD training is not fully developed. The goal of the report is to provide the necessary information to improve these SD training programmes. To this purpose, the report provides many detailed examples of ground-based and in-flight SD training scenarios. Ground-based training devices range from Barany chairs to Full Flight Simulators; in-flight SD training scenarios are described for rotary wing as well as for fixed wing aircraft. A separate chapter is devoted to SD avoidance training for Night Vision Devices.

The report also pays attention to the optimization of the SD training programme by selecting the appropriate SD scenarios, by choosing and training the right personnel and by the suitable integration of basic and continuation SD courses into the pilot training programme. An adequate training programme will enhance SD awareness, and consequently, flight safety.

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