

## **Search & Summary**

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# **Human Factors in Vertical Flight Simultaneous Non-interfering Operations (SNI), Volume II: Copyrighted Literature Search Results**

Prepared for: Federal Aviation Administration (FAA)  
Office of the Chief Scientist for Human Factors  
(AAR-100)  
Washington, DC

**DAVID F. WOURMS**  
Human Factors Analyst

**SARA J. JOHNSON**  
Human Factors Analyst

**JOEL A. OGDEN**  
Human Factors Analyst

**THOMAS R. METZLER**  
HSIAC Director

**August 2001**

Distribution authorized to US Government agencies and their contractors (Special Authority) (August 2001). Other requests for this document shall be referred to the Human Systems Information Analysis Center (HSIAC), AFRL/HEC/HSIAC Bldg. 196, ATTENTION: Information Specialist, 2261 Monahan Way, Wright-Patterson AFB, OH 45433-7022

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## TABLE OF CONTENTS

<b>1. INTRODUCTION</b>	<b>6</b>
<b>1.1 BACKGROUND</b>	<b>6</b>
<b>1.2 PURPOSE</b>	<b>6</b>
<b>1.3 SCOPE</b>	<b>7</b>
<b>1.4 OVERVIEW</b>	<b>7</b>
<b>2. METHOD</b>	<b>8</b>
<b>3. ORDERING DOCUMENTS</b>	<b>9</b>
<b>3.1 DEFENSE TECHNICAL INFORMATION CENTER (DTIC)</b>	<b>9</b>
<b>3.2 NATIONAL TECHNICAL INFORMATION SERVICE (NTIS)</b>	<b>9</b>
<b>3.3 HUMAN SYSTEMS INFORMATION ANALYSIS CENTER (HSIAC)</b>	<b>10</b>
<b>ATTACHMENT A</b>	<b>A-1</b>
<i>Search Strategy Statement</i>	
<b>ATTACHMENT B</b>	<b>B-1</b>
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<i>INSPEC</i>	<b>B-Error! Bookmark not defined.</b>
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## **NOTICE**

This report comprises two volumes. Volume I (HSIAC-SS-2001-003) is the final report on Human Factors in Vertical Flight and noncopyrighted literature search results. Volume II (HSIAC-SS-2001-004) contains pertinent copyrighted citations extracted from commercial databases.

## **DISCLAIMER**

The views, opinions, and/or findings contained in this report are those of the authors and should not be construed as an official Federal Aviation Administration position, policy, or decision, unless so designated by other documentation.

# 1. INTRODUCTION

## 1.1 BACKGROUND

This Human Systems Information Analysis Center (HSIAC) Search & Summary (S&S) provides support to the Federal Aviation Administration (FAA) Office of the Chief Scientist for Human Factors (AAR-100).

The FAA (AAR-100) provides human factors support to many organizations within the FAA structure. In order to do so it often conducts applied research into human factors issues impinging on the safe and efficient operation of commercial aircraft through our national airspace. These research efforts in turn require comprehensive literature searches to provide the basis from which to begin their original work.

## 1.2 PURPOSE

There are many topics of interest to AAR-100 researchers. One issue concerns the simultaneous non-interfering operations (SNI) of visual flight rules (VFR) helicopters and fixed wing traffic instrument flight rules (IFR) and VFR in the same airspace.

A technical report produced for the National Aeronautics and Space Administration states the following with respect to SNI rotorcraft operations concept:

The possibility of designing non-conflicting procedures is provided for in the FAA *Rotorcraft Master Plan* (1990) that states that developing a system to satisfy increasing demand for IFR rotorcraft operations within the national airspace system (NAS) has been a long-term charge of the aviation community.

The helicopter industry has long believed that the efficiency of IFR rotary- and fixed-wing operations are constrained by having to operate within the fixed-wing air traffic control (ATC) structure in both the terminal and en route environments. Helicopter takeoffs and landings are delayed by waiting to be sequenced into the landing pattern and fixed-wing aircraft also experience loss of efficiency when operating behind the slower rotorcraft. The unique operating capability of rotorcraft that allow these aircraft to takeoff and land without need of runways is not being fully employed. This capability has engendered the question of whether there is a need to develop a complementary and integrated IFR operating environment for these aircraft.

With the development of new technologies that support navigation via satellites such as Global Position System (GPS) and the potential application of innovative ATC procedures, the probability of creating new procedures that permit rotary- and fixed-wing aircraft to conduct simultaneous approaches and departures without affecting or interfering with each other does exist. Of particular interest are operations at busy metropolitan airports where the potential exists for conflict between rotary- and fixed-wing aircraft using the same IFR approach and departure procedures during instrument meteorological conditions (IMC).<sup>1</sup>

To achieve this airspace redesign, it is necessary to evaluate new technological solutions that will allow VFR/IFR helicopters to fly safely in SNI operations. This requirement raises

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<sup>1</sup> Sawyer, B. M., Peisen, D. J., & Reuss, L. M. (1999). *Simultaneous and non-interfering (SNI) rotorcraft operations* (SAIC/TR 99-01). Arlington, VA: SAIC.

several human factors questions that pertain to vertical flight operations that must be answered before SNI operations can become a reality.

### **1.3 SCOPE**

The FAA requires information in the area of human factors associated with vertical flight (or helicopter, rotorcraft, tilt-rotor) operations within the NAS. Thus, the Office of the Chief Scientist for Human Factors must have a comprehensive understanding of (1) the extent of national and international human factors research directed toward vertical flight air crew performance especially dealing with flight and navigation instrumentation; (2) the most significant research along with its conclusions and recommendations; and, (3) the national and international vertical flight research resources available to include government labs, universities, and contractors.

This HSIAC S&S effort was designed to provide a broad base of literature and research citation resources that will allow the FAA AAR-100 to pursue answers to the following questions:

- What would be considered the minimal flight instrumentation for safe VFR SNI helicopter operations?
- What would be acceptable pilot performance skills and abilities to conduct such flights?
- What should be the minimum amount of protected airspace required for the VFR helicopter flying a SNI leg/route from a human performance standpoint?

### **1.4 OVERVIEW**

A brief description of the research method used to identify relevant Vertical Flight Human Factors information is provided in Section 2, METHOD. Instructions for ordering documents of interest are provided in Section 3, ORDERING DOCUMENTS. Attachments to this report contain the literature search keyword list and strategy, and copyrighted citations and abstracts retrieved from commercial database resources.

Noncopyrighted search results extracted primarily from the Defense Technical Information Center (DTIC) database are included in the accompanying report, *Human Factors in Vertical Flight Simultaneous Non-interfering Operations (SNI), Volume I: Noncopyrighted Literature Search Results*.

## 2. METHOD

To support the FAA Office of the Chief Scientist for Human Factors, HSIAC has conducted a broad search for literature and information sources related to human factors in vertical flight. The literature search encompasses citations focused on control and display technology, pilot/operator performance, and airspace requirements. Using the strategy outlined in Attachment A, a literature search was conducted in the following government and commercial database resources:

- ✓ Aerospace Database
- ✓ Compendex
- ✓ Defense Technical Information Center (DTIC) Technical Reports (TR)
- ✓ Ergonomics Abstracts On-line
- ✓ Human Systems Information Analysis Center (HSIAC) in-house database
- ✓ INSPEC
- ✓ National Technical Information Service (NTIS)
- ✓ PsycINFO
- ✓ Science Citations Index
- ✓ Transportation Research Information Service (TRIS)
- ✓ NASA Technical Reports Server (NTRS)
- ✓ World Wide Web Resources

The literature search revealed approximately 6000 citations and abstracts. At the FAA's request, there was no attempt by HSIAC analysts to edit the search results; only minimal formatting was undertaken to facilitate readability. The relevant copyrighted material is compiled into Attachment B of this report. Material retrieved from noncopyrighted sources is found in an accompanying volume entitled, *Human Factors in Vertical Flight Simultaneous Non-interfering Operations (SNI), Volume I: Noncopyrighted Literature Search Results*.

### **3. ORDERING DOCUMENTS**

#### **3.1 DEFENSE TECHNICAL INFORMATION CENTER (DTIC)**

DTIC is the central repository for documents resulting from research supported by the Department of Defense (DoD). DTIC maintains several databases, including the Technical Report (TR) database, Technical Effort and Management System (TEAMS) database, and Independent Research and Development (IR&D) database.

Documents from the TR database are identified by an accession number that begins with "AD," such as AD-A123 456. To order DTIC documents, organizations must have a deposit account established with the National Technical Information Service (see below), against which document ordering fees will be charged. Call DTIC if you do not have information on establishing a deposit account with NTIS. When ordering documents from DTIC, please cite your DTIC User Code.

Defense Technical Information Center  
Reference and Retrieval Division (DTIC-BR)  
8725 John J. Kingman Road, Suite 0944  
F. Belvoir, VA 22060-6218  
Telephone: (703) 767-8274/DSN 427-8274  
1-800-CAL-DTIC (225-3842), menu selection 1  
FAX: (703) 767-9070/DSN 427-9070  
<mailto:msorders@dtic.mil>  
<http://www.dtic.dla.mil/dtic/docorder.html>

#### **3.2 NATIONAL TECHNICAL INFORMATION SERVICE (NTIS)**

NTIS is a major source for US and foreign government-sponsored research documentation. Orders for NTIS documents can be charged to an NTIS Deposit Account, American Express, Visa, or MasterCard. For additional information on establishing a deposit account, you may contact NTIS directly at (703) 487-4064. NTIS document orders may also be placed using the following information:

Telephone Orders: 8:30-5:50 EST (703) 487-4650  
Mail Orders: NTIS, Springfield VA 22161  
FAX Orders: (703) 321-8547  
For Assistance: (703) 487-4679  
<mailto:orders@ntis.fedworld.gov>  
<http://www.fedworld.gov/ntis/ntishome.html>

### **3.3 HUMAN SYSTEMS INFORMATION ANALYSIS CENTER (HSIAC)**

It is recommended that you discuss potential document orders with your in-house or local technical information specialist. He or she will know the most appropriate method to place orders for documents identified in this report. If questions do arise, please feel free to contact the Human Systems Information Analysis Center (HSIAC) at the address below.

AFRL/HEC/HSIAC  
2261 Monahan Way, Bldg. 196  
Wright-Patterson AFB, OH 45433-7022  
Phone: (937) 255-4842  
FAX: (937) 255-4823  
<mailto:hsiac@wpafb.af.mil>  
<http://iac.dtic.mil/hsiac>

## About Human Systems IAC

The Human Systems Information Analysis Center (Human Systems IAC, HSIAC) is the gateway to worldwide sources of up-to-date human factors and ergonomics information and technologies for designers, engineers, researchers, and human factors specialists. Human Systems IAC provides a variety of products and services to government, industry, and academia while promoting the use of human factors and ergonomics in the design of human-operated equipment and systems.

Human Systems IAC's primary objective is to acquire, analyze, and disseminate timely information on human factors and ergonomics. In addition to providing free basic searches, Human Systems IAC performs other services on a cost-recovery basis:

- Distribute human factors and ergonomics technologies and publications
- Perform customized bibliographic searches and literature reviews
- Prepare state-of-the-art reports and critical review
- Conduct specialized analyses and evaluations
- Organize and conduct workshops and conferences

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**2261 Monahan Way, Bldg. 196**

**Wright-Patterson AFB, OH 45433-7022**

*Phone:* (937) 255-4842      DSN: 785-4842

*Fax:* (937) 255-4823      DSN: 785-4823

***E-mail:* [tom.metzler@wpafb.af.mil](mailto:tom.metzler@wpafb.af.mil)**

***WWW:* <http://iac.dtic.mil/hsiac/>**



# ATTACHMENT A

## SEARCH STRATEGY STATEMENT FOR LITERATURE REVIEW SUPPORT TO THE FEDERAL AVIATION ADMINISTRATION (FAA) OFFICE OF THE CHIEF SCIENTIST FOR HUMAN FACTORS (AAR-100)

### HUMAN FACTORS IN VERTICAL FLIGHT

#### PURPOSE

The Federal Aviation Administration (FAA) requires information in the area of human factors associated with vertical flight (e.g., helicopter, rotorcraft, tilt-rotor) operations within the National Airspace (NAS). Thus, the Office of the Chief Scientist for Human Factors (AAR-100) must have a comprehensive understanding of (1) the extent of national and international human factors research directed toward vertical flight air crew performance especially dealing with flight and navigation instrumentation; (2) the most significant research along with its conclusions and recommendations; and (3) the national and international vertical flight research resources available to include government labs, universities, and contractors.

#### BACKGROUND

This issue concerns the simultaneous non-interfering (SNI) operations of visual flight rules (VFR) helicopters and instrument flight rules (IFR) and VFR fixed wing traffic in the same airspace. The requirement to implement an appropriate infrastructure for helicopter and tilt-rotor aircraft is highlighted in the Agency's Performance Plan. One of the necessary elements of redesigning the airspace infrastructure is the evaluation of new technological solutions that will allow VFR/IFR helicopters to fly safely in SNI operations. This requirement raises several human factors questions that pertain specifically to vertical flight operations that must be answered before SNI operations can become a reality.

#### TASK

Human Systems Information Analysis Center (HSIAC) will conduct a comprehensive literature search of relevant sources that have been published for information concerning human factors associated with vertical flight in environments similar to SNI operations. The literature and source search shall be designed to answer the following questions:

- ✓ What would be considered the minimal flight instrumentation for safe VFR SNI helicopter operations?
- ✓ What would be acceptable pilot performance skills and abilities to conduct such flights?
- ✓ What should be the minimum amount of protected airspace required for the VFR helicopter flying a SNI leg/route from a human performance standpoint?

In addition, Human Systems IAC shall prepare a list of international research facilities (Government, University, and Contractor) having subject-matter expertise in the area of human factors associated with helicopter aircrew performance. The list should also include points of contact with current phone, email, and addresses and a brief capabilities overview and research highlights for each.

**SUGGESTED SEARCH TERMS/STRATEGY**

transportation

aircraft

helicopter

rotor-wing

rotorcraft

tilt-rotor

vertical flight

vertical flight IFR terminal area

procedures (VERTAPS)

terminal flight activities

and

human factors (engineering)

avionics

airspace (requirements)

margin of safety (requirements)

simultaneous non-interfering (SNI)

operations

visual flight rules (VFR)

instrument flight rules (IFR)

human performance

flight/navigation instrumentation

maneuverability

*...and others as you see fit.*

**SUGGESTED DATABASES**

Abstracts in New Technologies and Engineering (ANTE)

Aerospace Database

Applied Social Sciences Index and Abstracts

Dissertation Abstracts

EiCompendex

Federal Research in Progress (FEDRIP)

IHS International Standards and Specifications

INSPEC

National Technical Information Service (NTIS)

PsycINFO

SciSearch

Transportation Research Information Service (TRIS)

Wilson Applied Science & Technology Abstracts

*...and others as you see fit.*

**ATTACHMENT B**  
**COPYRIGHTED LITERATURE SEARCH RESULTS**