ARTICLE XIV

PARTICIPATION OF ADDITIONAL NATIONS

1. It is recognized that other nations may wish to join the Project.

2. Agreement of the Parties shall be required to conduct discussions with potential additional nations. The Parties shall discuss the arrangements under which another nation might join, including the furnishing of releasable Project Information for evaluation prior to joining. If the disclosure of Project Information is necessary to conduct discussions, such disclosure shall be in accordance with Article VIII (Disclosure and Use of Project Information), Article IX (Controlled Unclassified Information) and Article XII (Third Party Sales and Transfers).

3. The Parties shall jointly formulate the terms and conditions under which additional nations might join. The addition of new Parties to the Project shall require amendment of this Agreement by the Parties to incorporate multilateral terms and conditions.

ARTICLE XV

CUSTOMS DUTIES, TAXES AND SIMILAR CHARGES

1. Customs duties, import and export taxes, and similar charges shall be administered in accordance with each Party's respective laws and regulations. Insofar as existing national laws and regulations permit, and to the extent required by applicable international agreements, the Parties shall endeavor to ensure that readily identifiable taxes, customs duties and similar charges or quantitative restrictions on imports and exports are not imposed in connection with work carried out under this Project.

2. Each Party shall use its best efforts to administer any such charges in a manner favorable to the efficient and economical conduct of the work. If customs duties or identifiable taxes are levied, the Party in whose country they are levied shall consider bearing such costs in the spirit of reciprocity.

ARTICLE XVI

DISPUTES

Disagreements arising under or relating to this Agreement shall be resolved only by consultation between the Parties and shall not be referred to an individual, to an international tribunal, or to any other forum for settlement.

ARTICLE XVII

GENERAL PROVISIONS

1. This Memorandum of Agreement will be carried out within the framework of the Memorandum of Understanding Between the Government of Israel and the Government of the United States of America Concerning the Principles Governing Mutual Cooperation in Research and Development, Scientist and Engineer Exchange, Procurement and Logistics Support of Defense Equipment with Annexes and Attachment, signed December 14, 1987.

2. All obligations of the Parties under this Agreement are subject to national laws, regulations, and the availability of appropriated funds for such purposes.

3. In the event of a conflict between the terms of this Agreement and any Annex to this Agreement, the Agreement shall control.

ARTICLE XVIII

AMENDMENT, TERMINATION, ENTRY INTO FORCE AND DURATION

1. The text of this Agreement and Annex A may be amended by the written consent of the Parties.

2. Mutual Termination

This Agreement may be terminated at any time upon the mutual written consent of the Parties. In the event both Parties decide to terminate, the Parties shall consult prior to the date chosen for termination to ensure termination on the most economical and equitable terms.

3. Unilateral Termination

In the event that a Party finds it necessary to unilaterally terminate its participation in the Project, such termination shall be subject to the general principles of this Agreement.

4. A Party wishing to unilaterally terminate its participation in this Agreement must give the other Party written notice of its intention to terminate. The Party shall give a minimum of 180 days written notice of termination. Such notice shall be the subject of immediate consultation by the Project Officers to decide upon the appropriate course of action. In the event of such unilateral termination, the following rules apply:

a. The terminating Party shall continue participation, financial or otherwise, until the effective date of termination.

b. The terminating Party shall pay its share of the costs of the Project up to the effective date of termination.

c. The Parties shall each pay the costs it incurs as a result of termination.

d. All Project Information and rights therein received under the provisions of this Agreement prior to the termination shall be retained by the terminating Party, subject to the conditions stated in this Agreement.

e. All Project Information and rights therein received from the terminating Party under this Agreement prior to termination shall be retained by the other Party subject to the conditions stated in this Agreement.

5. The respective rights and responsibilities of the Parties regarding Article VIII (Disclosure and Use of Project Information), Article IX (Controlled Unclassified Information), Article XI (Security), Article XII (Third Party Sales and Transfers), and Article XIII (Liability), shall continue notwithstanding termination or expiration of this Agreement.

6. This Agreement consists of 18 Articles and 1 Annex, and shall be entered into force upon signature by both Parties and shall remain in force for 9 years unless terminated by either Party. It may be extended by written agreement by the Parties.

IN WITNESS WHEREOF, the undersigned, being duly authorized by their respective Parties, have signed this Agreement.

FOR THE MINISTRY OF DEFENCE OF ISRAEL	FOR THE DEPARTMENT OF DEFENSE OF THE UNITED STATES OF AMERICA
SIGNATURE	SIGNATURE
UZI EILAM	MICHAEL F. FISETTE
TYPED NAME	TYPED NAME
DIRECTOR DEFENCE RESEARCH & DEVELOPMENT	ASSISTANT DEPUTY - INTERNATIONAL COOPERATIVE PROGRAMS
TITLE	TITLE
2 December 1992	2 December 1992
DATE	DATE
Alexandria, Virginia	Alexandria, Virginia
LOCATION	LOCATION

ANNEX A

The purpose of this Agreement is to perform cooperative research in the various subdisciplines of helicopter flight control and display technology; specifically, to develop analytical techniques, to improve experimental capabilities and to generate experimental data bases. The technology disciplines are as follows:

Man-machine interface. This refers to the interaction between the aeromechanical characteristics of the helicopter and the human operator characteristics of the pilot, to the extent that this interaction effects overall system performance and pilot workload. Scope includes mathematical modelling, display systems design, ground-based and inflight simulation, and simulator development.

Flight mechanics modelling. This refers to the mathematical description and analysis of the motion of helicopters in flight. Scope includes analytical and numerical modeling of aerodynamical phenomena, analysis of wind tunnel and flight test data, system identification, and piloted simulation.

Flight control system design. This refers to the design and analysis of computer algorithms that command the motion of the helicopter actuators based on pilot command and measured helicopter response. Scope includes the development of computer-aided control systems design software, case studies of design problems, and ground-based and inflight simulation of candidate designs. There will be no release of software design or development knowhow.

Within the three helicopter technology disciplines, four tasks have been identified for collaboration in the first thirty six months of the Agreement. Each of these tasks involve technology of future or emerging systems Each participant already has an active research program in each area, and there is a balance in facilities and capabilities. A coordinated approach to work on each task has been devised and is described in the following Statement of Work.

Statement of Work for US/Israel Memorandum of Agreement on Rotorcraft Aeromechanics and Man-Machine Integration Technology

Three tasks have been identified for collaboration in the first thirty six months of this Agreement. A fourth task is included in the nine year Agreement, but will not be initiated immediately. The background, objectives and scope of the proposed research work in each task is described below:

Task 1 - Biodynamic Interference in Helicopter Displays.

Background. In a calm laboratory environment, a pilot, using a helmet-mounted tele-operated sight, can easily acquire and track a target with relatively little effort. However, in the vibratory and turbulent environment of the operational helicopter, the head tends to oscillate involuntarily, primarily in elevation, at common rotor blade pass frequencies (about 5-6 hz). This involuntary head motion causes the sighting devices (reticle) to also oscillate with respect to the target. The involuntary motion of the head (or other body parts such as the arm and hand) and involuntary movement of the reticle sight is referred to as "biodynamic interference". The presence of significant uncommanded reticle motion elevates pilot workload and fatigue and degrades performance of the weapon system. The vibratory environment of current tactical helicopters, especially during aggressive maneuvering, or for aircraft that are operating out of track and balance, make these biodynamic interference effects especially troublesome for helmet-tracking tasks. Researchers at the U.S. Army Aeroflightdynamics Directorate (AFDD) and the Israel Ministry of Defence (MOD) have ongoing research programs to develop methods for eliminating biodynamic interference efforts. Under this Agreement task, researchers will work cooperatively to develop and test these methods.

Objectives. The objectives of this research task are to:

* Document the problem of biodynamic interference for tele-operated targeting using helmet-mounted displays.

* Develop new compensation algorithms to reduce interference effects without introducing degrading effects of phase lags.

* Test compensation techniques using piloted-simulation and flight experiments.

Scope. Algorithms for suppression of biodynamic interference are developed using analytical tools, and validated in off-line simulations. Efforts are concentrated on stabilization of helmet-tracked sights and targeting systems, and helmet-mounted display symbology. Piloted evaluation and algorithm refinement is completed using the motion-based simulators. The suitability of the concept and related hardware to incorporation in a flight vehicle will be evaluated. If approach and hardware are deemed suitable, they will be evaluated in helicopter flight tests.

Task 2 - Rotorcraft Flight Mechanics Modeling

Background. The ability to accurately and efficiently simulate the flight mechanics of helicopters in flight is extremely valuable. Simulation models enable the manufacturers to detect and correct possible problems with the design in the development phase, prior to building a prototype. For helicopters in production, an accurate, real-time, pilot-in-the-loop model permits safe development of improvements and also allows investigations into the cause of accidents through the safe duplication of possible scenarios. As a result, there is an ongoing need for newer and better models capable of simulating the ever more complex helicopters in production and under development. The U.S. Army Aeroflightdynamics Directorate and the Technion-Israel Institute of Technology are currently developing real-time helicopter simulation capabilities for the AH-64 Apache attack helicopter. Under the Agreement task, researchers will compare modeling methods and predictive results as applied to the AH-64 and other helicopters of mutual interest.

Objectives. The objectives of this research task are to:

* Cooperatively develop helicopter simulator models for flight mechanics applications.

* Validate the math models based on the AH-64.

* Development mathematical models suitable for parameter identification studies.

Scope. Simulation models of the AH-64 are developed in the US and Israel using different physical approaches for modeling the rotor systems. The predicted responses are compared with each other and with the available AH-64 flight test data base. The results are used to improve the validity of both models. Parameter identification techniques are used to extract the aerodynamics characteristics of the rotor system and thereby allow the model methods to be improved. Models of other helicopters that are of mutual interest are developed and compared.

Task 3 - Human Factors Aspects of Thermal Imagery Interpretation

Background. Most pilots receive familiarization and training with thermal and image-intensified sensors in the cockpit during training flights. This might be due to the lack of availability of appropriate training systems, but may also be due to the apparent similarity of the sensor imagery to normal television (TV) images. Human factors research on IR imagery has demonstrated clearly that it is very different from TV imagery. For example, IR imagery results from the emission of energy (heat) from an object rather the reflection of visible light off of the object. This difference may yield less detail for an object viewed with IR imagery than for TV imagery. Since IR imagery is very different from TV in the ways discussed above, a part-task trainer for thermal imagery is desirable to allow aircrews to learn these differences in a systematic, low-cost manner. Development of such a trainer has been ongoing in the US and Israel. Under this task, researchers will coordinate efforts to complete a trainer design concept.

Objectives. The objectives of this research task are to:

* Define the human factors problems and considerations inherent in the use of IR imagery for targeting and navigation.

* Establish design guidelines for a thermal imagery part-task trainer.

Scope. Candidate thermal imagery operator interpretation problems will be studied. The presence of these problems and training to compensate for the problems will then form the basis for training using a thermal imagery part-task trainer. The trainer will allow pilots to become familiar with the sensor imagery prior to actual flight. Additionally, such an imagery trainer will allow pilots to experience geography, climate, terrain and vegetation conditions that are not available in the pilots' own limited flight operations area.

Task 4 (future) - Helicopter Flight Control System Design Techniques

Background. Handling qualities specifications for modern combat helicopters require high levels of agility and flying precision, hands-off stability, and low pilot workload. These seemingly contradicting characteristics are achievable with multi-mode digital flight control systems. Prototype digital flight control have been demonstrated with some success on helicopters, but the design cycle has been prohibitive. New techniques for advanced flight control system design offer the potential for improved system performance and a shortened design cycle. Techniques are under development in the US and Israel that are particularly well suited to the difficult problem of the helicopter. Helicopters are inherently unstable, coupled, and of high dynamic order. These new techniques take the helicopter characteristics directly into account and allow for rapid studies of design tradeoffs between improved performance and reduced robustness.

Objectives. The objectives of this research task are to:

* Evaluate and compare flight control design techniques used in the US and Israel.

* Develop new approaches for helicopter flight control design and apply to a configuration of mutual interest.

* No flight control system hardware design or software integration knowhow will be released.

Scope. Cooperative studies of alternative flight control system design techniques will be conducted under this task. New approaches for helicopter flight control system design are developed based on an understanding of the advantages and limitations of each country's techniques. These techniques are applied to a configuration of mutual interest in studies that will allow the advancement of design capabilities by the US and Israel.

Dr Bartov

TO: AMCICP-RDE (Mr. Steve Connors) 10 December 1991

SUBJECT: U.S./Israel MOU on Helicopter Flight Controls and Display Technology

The following comments were surfaced by the Israeli MOD representative, Mr. Kuritsky and LTC Wagner and discussed by the U.S. AVSCOM representatives:

a. Title to be changed (as also requested at Jun 91 meeting):

Rotorcraft Aeromechanics and Man-Machine Integration Technology

Rationale: Project Reliance changed AVSCOM's mission to be the National Asset for Rotorcraft. Title change better reflects work being accomplished under the 9-year MOU.

b. Change Helicopter to Rotorcraft throughout MOU.

Rationale: Same as above.

c. Article II, para 3: Change paragraph to read:

. . . by the Technion Israel Institute of Technology, Department of Aeronautical Engineering, and/or as designated by the Israeli Ministry of Defence, and by the Aeroflightdynamics Directorate of the U.S. Army Aviation Systems Command, or as designated by the U.S. Army Materiel Command, on behalf of the Department of the Army.

Rationale: Same as submitted in June 91, as Government of Israel has no in-house laboratory capability to perform the work under the MOU, it will give the MOD the flexibility to give contracts to other universities other than just Technion.

d. Article IV, para 3. Add under Moffett Field, CA, "or as designated by the Army Materiel Command." and for Israel, Add under Technion City, Haifa, Israel, or as designated by the Israeli Ministry of Defence."

Rationale: Same as above.

e. Article V, Financial, has been changed so many times, that it now does not mention manyears at all. To merely express the work in dollars is inaccurate. First of all if this is a U.S./Israel MOU, there is no mention of schekels. Secondly, their costs of engineering differ depending on which contractor is doing the work, i.e., Technion's engineering manyear is $50,000 however, University of Tel Aviv (which may be doing a task) is $100,000 a manyear. The Israelis request that the total dollar figures be eliminated and use the 3 manyears of scientific effort as previously outlined. They again request (as in the Jun 91 meeting) that it be specifically outlined "one manyear of scientific effort per task".

f. Article VIII, para 5. Israeli MOD recommends adding the word, "Mutually" before "generated" in line 2.

Rationale: Adds clarity.

g. Article XII. para 1.a. The Israeli MOD requests the insertion of "Ministry of Defence" after Department of Defense.

Rationale: Sentence is unclear. It reads: . . . each other's Department of Defense. . ." They have a Ministry of Defence not a DOD.

h. Article XVI. Delete translation in Hebrew.

Rationale. The Israeli MOD has stated it is not necessary to translate, as Mr. Uzi Eilam is willing to sign an English version.

i. Article XV. Recommend for para 4. 180 days notification instead of 90 days.

Rationale: Israeli MOD that 180 days notice is needed to stop contract work.

Request clarification of this Article. para 4.c. If withdrawing Participant must pay termination costs, which country determines costs?

[illegible] contracts.

Any assistance is supporting these changes into the MOU is greatly appreciated.

Rita Hassinger
AMSAV-NSJ