

Mission Rehearsal Technology Impacts Intelligence Planning

Exercise participants evaluate applications of simulation systems for mission training.

By Robert T. Nullmeyer and Philip D. Bruce

Recent technological advances are making simulation-based rehearsal feasible for military operations. As a result, intelligence information mandates will change to meet not only the needs of mission planners and air crews, but also the requirements of digital data base developers. Researchers also are exploring the changes this technology will necessitate in the mission planning process.

The advent of the technology that supports mission rehearsal has not yet allowed planners the time to establish new utilization strategies for simulation-based rehearsal systems and associated efforts. Although the traditional mission preparation process reflects a great deal of accumulated wisdom, researchers emphasize that these procedures must be examined in light of both new needs and new capabilities associated with the rehearsal system. Some established strategies may transcend the new technology, but, the researchers believe that other, less robust, planning tactics may need revision.

Early simulation-based rehearsal concepts called for a utilization strategy much like procedures currently followed for in-aircraft rehearsals—incorporating general and detailed mission planning and immediately preceding final mission preparation. But users contend that earlier access to the capability would be beneficial. The rehearsal system is a computational device, capable of presenting, storing and manipulating information. Researchers recommend exploiting these capabilities early in the planning process, to help formulate the plan, in addition to later in the process, only to evaluate the plan. This early effort will require more intelligence data than previously could be processed or used.

The Defense Department has entered into several partnerships with

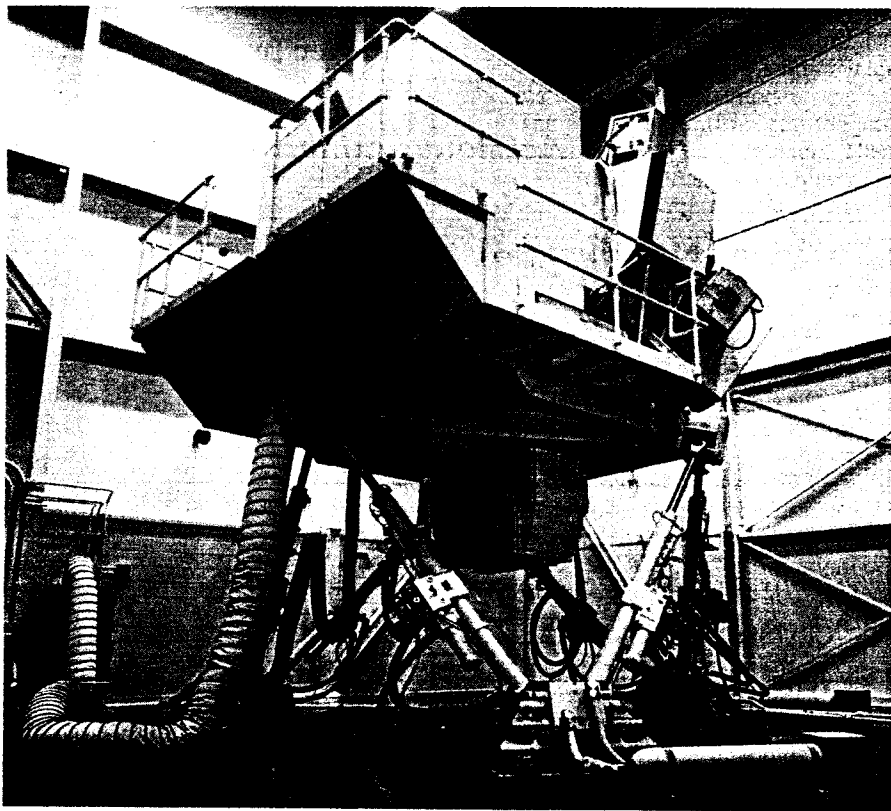
industry to build mission rehearsal capabilities based on newly emerging technologies. One program under way for Special Operations Forces as part of the group's aircrew training system will allow rehearsal of missions in any part of the world, according to Defense Department requirements. The developer, Loral Defense Systems, Akron, Ohio, has the mandate to design a system that will generate a mission data base covering up to 500,000 square miles within 48 hours. In this program, rehearsal devices will be reconfigurable among Special Operations Forces weapon systems to enable the mission to be rehearsed with the correct complement of Special Operations Forces aircraft.

Martin Marietta, Daytona Beach, Florida, already has delivered a mission rehearsal system to the Air Force that includes a mission planning sys-

tem, a data base generation system and the MH-53J weapon system trainer. The system's original developer, GE Aerospace, was acquired by Martin Marietta last year.

The 542nd operations training group and the aircrew training research division of Armstrong Laboratory, Williams Air Force Base, Arizona, established a research partnership to analyze the baseline mission preparation process and to explore applications for the new technology. The group studied the use of the Sikorsky MH-53J Pave Low weapon system trainer for rehearsal of a joint Air Force/Army training exercise designed to simulate a strike mission. The purpose of the mission was to recover critical avionics equipment from a remote research facility in a hostile Third World nation. The service participants conducted the exercise on two consecutive nights at White Sands Missile Range in New Mexico.

The exercise rehearsal featured the



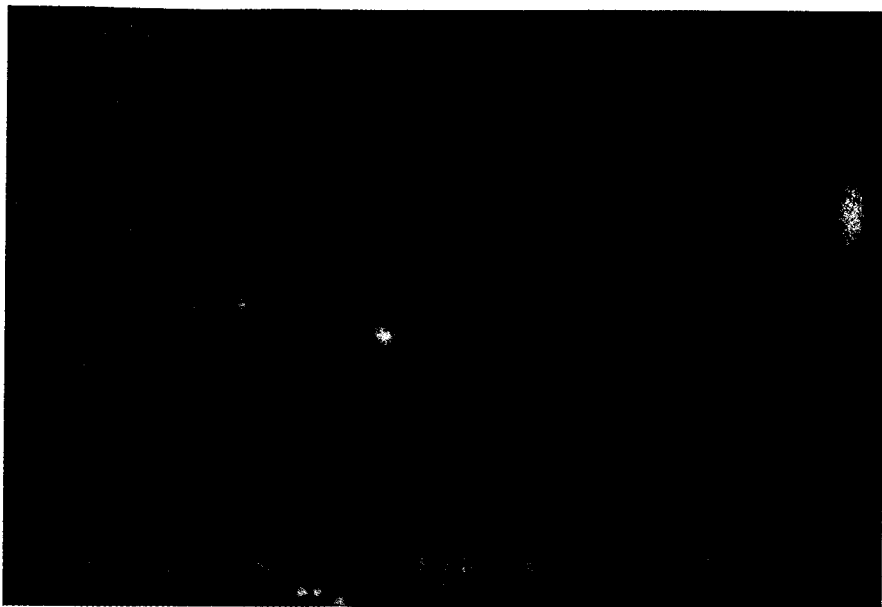
The MH-60G Pave Hawk helicopter weapons system trainer is operated by the Air Force's 542d Crew Training Wing, Kirtland Air Force Base, New Mexico.

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14. ABSTRACT Recent technological advances are making simulation-based rehearsal feasible for military operations. As a result, intelligence information mandates will change to meet not only the needs of mission planners and air crews, but also the requirements of digital data base developers. Researchers also are exploring the changes this technology will necessitate in the mission planning process.			
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A scene through night vision goggles is depicted in real time by the Martin Marietta Compu-Scene V computer image generator. In the scene, an Air Force MH-53J Pave Low helicopter flies in the foreground, with the lead helicopter the MH-60G Pave Hawk.

MH-53J weapon system trainer's high-fidelity simulation of all MH-53J flight station systems, including an eight-window, wide-angle collimated display system and a six degree-of-freedom motion platform, Martin Marietta officials explain.

The major weapon system trainer subsystems for simulating a mission rehearsal environment are the image generating system, the digital radar landmass system, the electronic warfare environment system and the helicopter flight simulator. The digital radar landmass system generates the MH-53J radar image, including the terrain-avoidance/terrain-following simulation. Radar, out-the-window and forward-looking infrared simulations all are correlated, according to the officials.

The data base generation system is a contractor-operated network for the rapid production of digital data bases. These data bases simulate out-the-window scenes, compatible with night vision goggles use; radar; and forward-looking infrared imagery of the MH-53J. The original network consisted of four Sun Sparc work stations and a Sun 4/260 file server connected by an Ethernet Sun local area network. Attached to the file server are a disk drive, a 1/2-inch tape drive, a laser printer, an Eikonix camera stand and light box and a digitizer tablet for data input and output. The system uses Compu-Scene data base generation system II software in the Sun work stations to generate a digital data base from

Defense Mapping Agency digital terrain evaluation data and its digital feature analysis data, satellite and aerial imagery, hand-held photography, Aim Point Graphics, 1:50,000 or 1:25,000 scale city maps, Joint Operations Graphic charts, Operational Navigation and Tactical Pilotage Charts, target area blueprints and Flight Information Publications charts.

The Compu-Scene V image generator has a large texture map capability of 240 maps at 512 x 512 resolution that can be dynamically updated during the mission simulation. This feature allows the image generator to produce high-resolution, geospecific photovisual images over large areas when satellite, aerial and handheld photographs are available during data base development. Compu-Scene V uses a process called microtexture that enables the observer to view an object at very close range with significantly reduced blurring. When source imagery resolution is inadequate for viewing at close range, microtexture combines one of four fine generic texture patterns with the photo-specific texture pattern to provide the necessary reduction in blurring, company representatives say.

The helicopter flight simulator input/output interface integrates all the MH-53J weapon system trainer subsystems and controls the training or mission rehearsal events. It accepts inputs through either the helicopter flight simulator terminal or the instructor operator station.

Inputs such as simulator state, weather, moving model positions, time of day and percent moon are processed by the helicopter simulator host computer and sent to the other subsystems as required.

Several components have been added to the system since initial delivery. Polyfit software, which is designed to run on the Sun work stations, allows an operator to extract three-dimensional models and geospecific phototexture from digitized photographs.

The low-cost exploitation operators work station—known as LEOW—hosted on a Sun 4/470, provides the capability to remove grid lines from digitized maps, combine digitized photographs and maps, measure images, produce graphics and manage data. Images can be edited and stored in a National Imagery Transmission Format for model development using Polyfit.

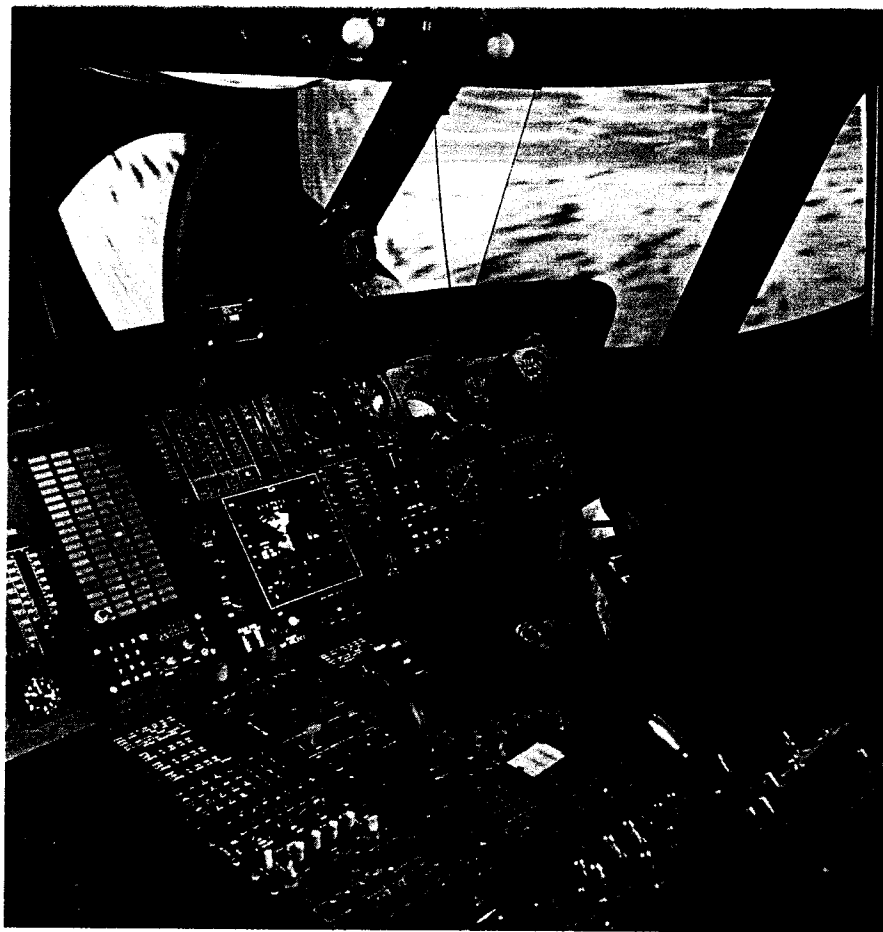
Other new capabilities include the Versatec plotter; the image manipulation and capture system, which provides the capability to digitize source data for on-screen manipulation; the audiovisual production sys-

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The flight deck of the MH-60G Pave Hawk helicopter trainer is operated as part of the special operations and air rescue inter simulator network, which also includes the MH-60G weapon system trainer/mission rehearsal system, the TH-53A operational flight trainer and the training observation center.

tem for the simultaneous recording of the visual scene, forward-looking infrared, radar, radar warning receiver and cockpit audio; the Schafer scanner; the Compu-Scene target providing additional tools for developing terrain from stereo aerial photographs, extracting features from images and data base preview capability, building three-dimensional models and creating special effects; the data base generation system III for faster user response time using the latest Sun operating system; the enhanced low-cost exploitation operators' work station; and Special Operations Forces simulation network, which enables networked training and rehearsal as additional simulators come on line.

A training observation center also has been added to the system's capabilities. It allows flight following and observation of all mission systems trainer/mission rehearsal system operations on the Special Operations Forces network.

Planned expansions include integrating the HC-130P weapon systems trainer into the network in 1994.

To test the mission rehearsal equipment and procedures, the exercise's participants from 542nd operations training group included two MH-53J and three Sikorsky MH-60 Pave Hawk instructor crews, an intelligence officer and two wing planners. Each of the five crews comprised two pilots, a flight engineer, scanners and gunners.

The concept of operation called for five 542nd operations training group helicopter crews to insert a 90-person Army support team into the general vicinity of the objective area on the first night. This Army team was to move to positions near that location so they could support the assault during the next night.

On the second night, the support team would be sent to take control of a barracks housing off-duty security personnel at the facility to prevent the entry of these personnel into the objective area. Then, an MH-53 and an MH-60 would provide fire support to suppress on-duty security personnel, and a 26-member assault team would be fast roped into the objective area from one additional

MH-53 and two additional MH-60 helicopters to search for the avionics equipment. The two MH-53s and three MH-60s would transport the assault team and the recovered avionics equipment out of the area and then return to transport the support element to the same landing zone.

Martin Marietta officials say that they were notified to generate an enhanced data base. Mission planners then gave the company information about the mission to support data base development and told it that an assessment would be made of the ability of the resulting simulated environment to support rehearsal of a training exercise 72 hours later. During the next 72 hours, wing planners developed a general mission plan. Concurrent with this Air Force activity, Martin Marietta personnel processed information, developed enhanced data bases and generated additional materials to support crew planning activities.

Crews arrived for detailed mission planning 72 hours after the original notification had been given to Martin Marietta. Mission planners told the crew that the weapon system trainer/mission rehearsal system would be available all day and evening to support mission preparation and that they should focus rehearsal efforts on activities planned for the second night. Each pilot flew the MH-53J weapon system trainer/mission rehearsal system. The flight engineers, gunners and scanners observed the out-the-window visual scene from a television monitor in the observation room and listened to conversations on the crew intercom. Each crew flew approximately 45 minutes.

Pilots used a variety of techniques to validate their mission plan and rehearsal, officials report. Most observed their objective area from different vantage points. They used the freeze capability of the simulator extensively. Crews also slewed the simulator to different approach headings and altitudes to preview and select the best course inbound for their particular part of the mission. Participants used the freeze/slew capability on the ground, at the objective area, to determine distances between buildings and relative size of the landing zones. Others used the simulator to assess the rate of climb capability, power requirements and single-engine performance of the MH-53J given the altitude of the facility. Most crews flew a com-

ination of daytime and night vision goggle conditions.

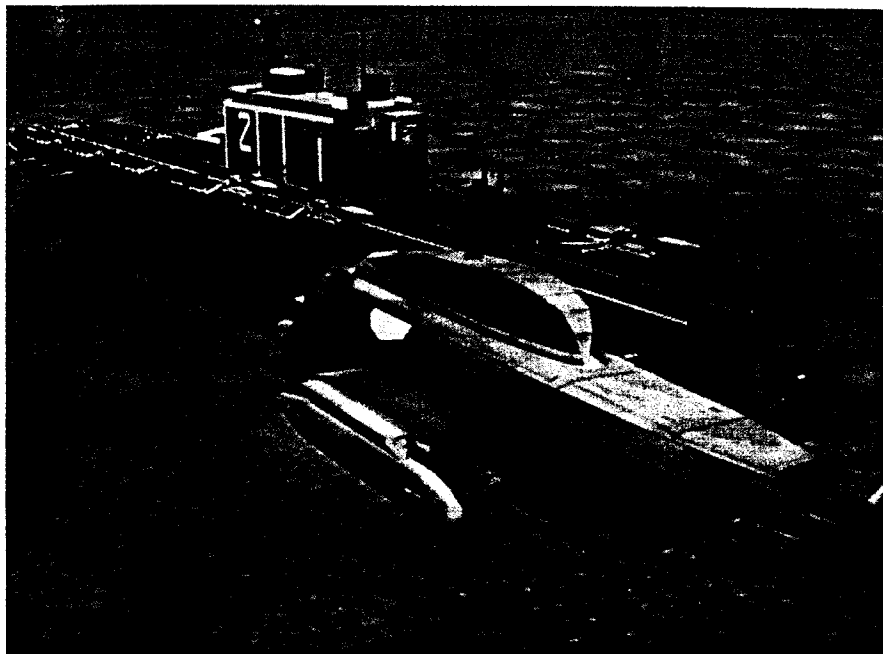
Pilots gave mostly high ratings to terrain and cultural features in the visual data base. They pointed out the need for the simulator to show the wires on poles in the target area as these could be dangerous obstacles for helicopters. The wires were highlighted on target area photographs provided to the crews at their initial briefing, but they had not been added to the data base, mission officials explain. According to one pilot, it was difficult to distinguish between roads and streams in the weapon system trainer when using night vision goggles.

Most pilots reported that rehearsing in the simulator resulted in a better understanding of the mission plan. In addition, several changes to the crew mission plans resulted from the simulator sessions. The capability to rehearse in the target area typically was mentioned as being the most beneficial.

Loadmasters, aerial gunners and scanner crewmembers who did not rehearse the mission in the device suggested that the mission rehearsal include the entire crew. They indicated that the scanners need a visual capability of their own. They also emphasized the need to communicate with the front-end portion of the crew during the rehearsal.

Prior to rehearsal in the weapon system trainer, the mission commander stated that pilots who had not been to the area needed a familiarization flight prior to the second night of the mission. His primary concern, according to the analysts, was that the terrain, including a noticeable slope in one of the recovery zones and the 8,000 foot altitude, would add to the difficulty of the mission. Following the rehearsal, the mission commander said that he felt the environment in the weapon system trainer was sufficient to prepare crews for the mission. The wing deputy commander for operations, who also observed the rehearsal, eliminated the requirement for the familiarization flight.

Crew responses concerning the effect of mission rehearsal on actual performance of the mission indicated that the mission rehearsal equipment gave them a good awareness of the target area, including better knowledge of the terrain. Pilots rated the match between the visual data base and the real world terminal area of operations better in quality than the en route portion of the data base.



An MH-53J Pave Low helicopter is depicted in a real-time ocean rendezvous. The simulation is generated by a Compu-Scene V computer image generator.

Some pilots felt the en route portion could have contained more terrain features such as rocks and bushes, and four pilots stated that at least one and possibly two towers were missing from the rehearsal data base. All 10 pilots stated that more planning was necessary prior to rehearsal to receive the most benefit from the rehearsal system. They suggested that planning commence from 24 to 48 hours before actual mission rehearsal.

The reactions of the participants in this rehearsal indicate that digital simulation can play a useful role in mission preparation, the researchers relate. Following mission execution, all participating pilots reported that the rehearsal had helped their actual performance. From an operational point of view, perhaps the most compelling data point regarding the value of rehearsal was the elimination of the requirement for a familiarization flight prior to carrying passengers during the exercise.

The effectiveness of a mission rehearsal system will be based on how the capability is actually used, development officials emphasize. All of the participating pilots support the need to develop a basic template to ensure that the rehearsal capability is integrated effectively into the mission preparation process.

As powerful new technologies come on line, hardware and software often receive the attention at the expense of the underlying uses of

technology by people, researchers explain. Instead, developers should view technology and its uses by people as an integrated system. A focus on the human element, including planners, data base developers, intelligence analysts and flight crews, and what this group must accomplish collectively, is necessary to affect the ultimate outcome.

Integrating the MH-53J mission rehearsal system into the mission preparation process for the exercise required close coordination among the contractor, government contract representatives, intelligence analysts, wing planners, aircrews, the Army and others. For rehearsal capabilities to be beneficial, the participants must know what resources can be accessed and when these resources will be available, the researchers conclude.

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