

MH60S/R Helicopter Crew Trainer: Via a Variety of Modeling, Simulation and Visualization Technologies

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Abstract - Stottler Henke, in conjunction with the US Navy, has developed and deployed a flexible, low-cost PC-hosted desktop crew trainer for the Navy's new MH-60S and MH-60R helicopters: Operator Machine Interface Assistant (OMIA). OMIA is currently in use by HSC-2, HSC-3 and HSM-41. This paper emphasizes some of the flexible, low-cost, rapid development methods used to reach the present deployment and are allowing for the continued flexible, low-cost, and rapid evolution of OMIA to meet evolving Navy needs. These methods include re-use of COTS software, design for evolving COTS hardware/software, and design for evolving requirements. In addition to many COTS solutions, some proprietary software was built. COTS software utilization includes the integration of Microsoft™ Flight Simulator for many aviation aspects of OMIA, and the use of two- and three-dimensional COTS libraries to develop the user interface and cockpit. The foundation that permits the flexible and rapid use of different components is the underlying design for evolving requirements. The flexible design for evolving requirements is necessary because the Common Cockpit has and continues to evolve. The flexible design allows OMIA to work with and control Microsoft™ Flight Simulator when it is available, to use COTS and/or custom hardware when attached, and to still function as a complete standalone application. Continuing enhancements of the trainer are allowing it to teach an increasingly broad variety of aviation and mission tasks; for example, OMIA software driving the MH-60S Mission Avionics Systems Trainer (MAST).

Keywords: Helicopter, Training, Flight Simulator, Games

1 Introduction

The US Navy has introduced two new helicopters, the MH-60S and MH-60R, see Figure 1. Both of these helicopters utilize Lockheed Martin's Common Cockpit design [1]. The Common Cockpit includes all the flight and

mission instrumentation in both of the helicopters and enables both the pilot and co-pilot to share workload through dual flight and mission instrumentation, see Figure 2. As can be seen in Figure 2, the pilot and copilot each have two LCD screens: the Mission Display (MD) and the Flight Display (FD). Stottler Henke in conjunction with the US Navy has developed and deployed a flexible, low-cost, PC-hosted crew trainer for the Navy's new MH-60S (SIERRA) and MH-60R (ROMEO) helicopters called the Operator Machine Interface Assistant (OMIA).



Figure 1. MH-60S

OMIA has core functionality that may be enhanced via optional software and hardware. The core of OMIA provides a partial-task trainer (PTT) of the helicopter software and hardware. The trainer includes the flight and mission displays as well as the programmable fixed function keypads, the Radio Control Unit (RCU), Control Monitor Panel (CMP), and Cockpit Control Unit (CCU) panels.



Figure 2. Helicopter cockpit

OMIA is currently in use by HSC-3 and HSM-41 at NAS North Island and HSC-2 at NAS Norfolk, as well as being available to anyone in the Navy with a PC. This paper emphasizes some of the flexible, low-cost, rapid development methods [2] used more commonly by industry than the military. Stottler Henke and the Navy are continuing to exploit these techniques to develop a flexible, low-cost, and rapid evolution of OMIA that meet evolving Navy needs. These methods include, re-use of COTS software, design for evolving COTS hardware/software, and design for evolving requirements. COTS software utilization includes the integration of Microsoft™ Flight Simulator for many aviation aspects of OMIA, and the use of two- and three-dimensional COTS libraries to develop the user interface and cockpit.

The foundation that permits the flexible and rapid use of different components is the underlying design for evolving Navy requirements. Even though the MH-60S and MH-60R both use the Common Cockpit, the helicopters have different capabilities and missions, thus many operations are different on the two platforms. However, a programmable keyset (PK) supports the differences. In addition, the software versions for the two platforms are different. The Navy supports these differences in OMIA. When OMIA starts, it asks which platform and seat it should emulate, see Figure 3. The flexible design allows OMIA to work with and control Microsoft™ Flight Simulator when it is available, to use COTS and/or custom hardware when attached, and to still function as a complete standalone application. Continuing enhancements of the trainer are allowing it to teach an increasingly broad array of aviation and mission tasks; for example, OMIA software driving the MH-60S Mission Avionics Systems Trainer (MAST), see Figure 6. In addition, being PC-based, OMIA can be placed on any number of machines, both on land and at sea.

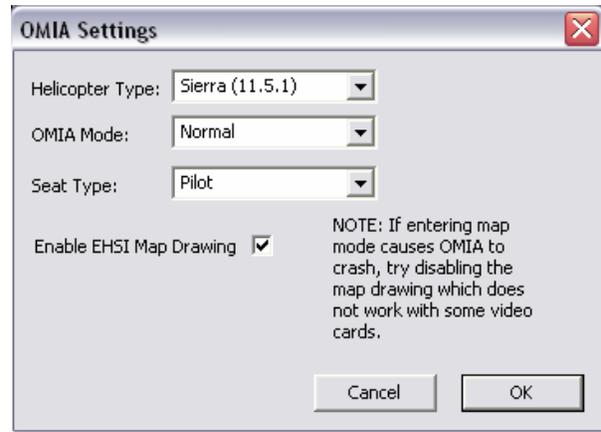


Figure 3. OMIA Splash Screen Configure Settings

The various components of the OMIA software have been implemented in a distributed manner to provide greater flexibility for future enhancements to the software.

2 OMIA configurations

As mentioned above, OMIA has many configurations. The core OMIA is a standalone product that operates under any standard Windows 2000 or Windows XP computer and provides an introduction to the Common Cockpit. The common cockpit includes the Mission Display, the Flight Display, the Center Console's Fixed Function and Programmable Keys, and the CMP, RCU and CCU units. The CCU (which is the head-mounted display control unit) is currently only available on the SIERRA.

A major benefit of the standalone core OMIA product, that the Navy requires, is that it requires no external licensing, and therefore it can be distributed freely to anyone in the US Navy via CD or via the Web.

The core OMIA can be used to teach both the SIERRA and ROMEO versions of the helicopter. When the program is started, the user has the option to change the present configurations. They can select either the SIERRA or ROMEO helicopter. They can also select the pilot or co-pilot seat for the SIERRA or the pilot, co-pilot, or sensor operator (SO) seat for the ROMEO. In addition, the user can also state whether they are flying solo, as in standalone training, or if they are in a network configuration, in which one operator can be the pilot and one operator can be the co-pilot. In this scenario, both operators will see the same world, including changes made by each other. To do this, you have to state whether you are the server or the client. The first person to start OMIA has to be the server so that the second person can designate them self as the client and the program will search for a server for them to join on the network.

OMIA or Windows automatically detects optional hardware and makes the appropriate software

modifications to allow the hardware to work correctly. The simplest example is multiple monitors: by attaching two displays, the Flight Display, shown in Figure 4, and the Mission Display, shown in Figure 5, can be displayed on separate monitors, with one of the monitors also displaying the Center Console. Another option is to have one or more of the screens made a touch screen. This is done in the Mission Avionics System Trainer (MAST), described

below, in which the Flight Display and Mission Display are touch screens so the Bezel Keys can be operated using finger pushes to more accurately emulate the ergonomics of the actual helicopter. Of course, the third screen containing the Center Console panels could also be a touch screen so the user could push the buttons as is done in the aircraft instead of using the mouse.



Figure 4. OMIA Flight Display

At this time, software additions for OMIA consist of Microsoft Flight Simulator (MSFS) [3]. Every time OMIA starts, it checks to see if MSFS is already running. If it is running, OMIA attaches itself to MSFS to get position, speed and other flight information from MSFS. In this configuration, the user could have the external view completely generated by MSFS, and the Flight Display, Mission Display and all of the other panels use the core OMIA. However, any other information such as ground speed, latitude/longitude location, or motion is all being read from MSFS. This is very beneficial if you wish to fly or see the terrain while navigating a search and rescue pattern. As one navigates, the helicopter may be guided along the search and rescue pattern on the Mission Display, and as search and rescue points are reached or captured, the pattern will update appropriately. When using MSFS, other hardware can be added if desired, like a joystick or a head mounted display with head tracking to provide a full field of view. These are handled seamlessly by OMIA and MSFS. Flying can be performed solely using a joystick, a joystick and separate control for the collective, or COTS

pedals. Microsoft Flight Simulator also provides an automatic pilot, or SLEW function, to move the helicopter without having to concentrate on flying. Since the flying performance is not realistic of the MH-60S or MH-60R helicopter, it is normally better to use the SLEW function.

The Mission Avionics Systems Trainer (MAST) combines all the above mentioned capabilities that can be added to the core OMIA. The MAST is further described in a section below.

3 Interfacing with Flight Simulator

Microsoft Flight Simulator (2004) is an extensible program using Microsoft's Software Development Kit (SDK). Third parties may also provide extensions to MSFS 2004, one being a more powerful version of the SDK called FSUIPC (www.schiratti.com/dowson.html).

The FSUIPC Dynamic Link Library (DLL) allows external programs to communicate with (and in many

situations control) MSFS. Many companies and hobbyists have interfaced extensions, including external hardware, to MSFS using FSUIPC.

Upon startup, OMIA silently searches for a running instance of MSFS using FSUIPC, and if found, the interface is automatically established. Otherwise, OMIA will run in its non-MSFS mode.

If the interface is established, OMIA utilizes FSUIPC to get the:

- wind heading,
- wind speed,
- ground speed,
- true heading,
- altitude, and
- latitude and longitude.

This information is used to provide correct readings for the OMIA interface that shows the user all of the above information. An update is performed once each second.

Currently, OMIA only gets information from MSFS, but successful experiments have been conducted in setting information as well. An example of the interface in action is represented in Figure 5. In the figure, the MH-60S is being flown from North Island Naval Air Station, near San Diego California. The top of the figure shows the out-of-window view provided by MSFS, below is the mission display of OMIA, and to the right is part of the center console. In the mission display there is a hexagonal icon representing the helicopter with a white velocity vector depicting the direction and velocity. In the second area from the top in the data strip along the left side of the mission display, note that the:

- latitude (Lat),
 - longitude (Long),
 - ground track & ground speed (GT/GS),
 - wind course & speed (W C/S), and
 - radar altitude (RAD ALT),
- are all being read in and updated from MSFS every second.



Figure 5. OMIA Interfaced with MSFS

This level of integration greatly enhances the realism provided by OMIA. For example, many of the training exercises require the pilot and/or copilot to establish a set of fly-to points (FTP) and then fly to (capture) the FTPs while performing other operations. The establishment and

management of FTPs is performed via the Mission Display and Center Console. With flight simulator incorporated, OMIA can have the operator fly to the FTPs and then the mission display and the rest of OMIA will be updated properly when the operator captures the FTPs.

4 Mission Avionics Systems Trainer (MAST)

The MAST, as shown in Figure 6, includes actual hardware in the Center Console that is exact aircraft hardware or a very close facsimile. One can actually push physical buttons, change actual knob positions, feel feedback, open covers, etc. There are two seats, the pilot and co-pilot. Each seat has two screens just as in the helicopter, one for the Flight Display and one for the Mission Display. There are individual screens for the pilot and co-pilot showing the outside view, generated by MSFS. There is a simple cyclic in the MAST, and the screens for the Flight Display and Mission Display are actual touch screens. Another feature of the Center Console hardware is the actual hook hardware, used to control the cursor in the Mission Display.

The MAST is a medium resolution trainer driven completely by OMIA software and MSFS software. Again, there is only one version of OMIA: it can work with or without MAST hardware, demonstrating that flexible software can be created to exist independent of hardware. The MAST can be used for many different types of operations, including coordinated operations because, as described above, the two seats can be used either independently, or in conjunction so the pilot and co-pilot are flying the same mission. The MAST has been in use since 2004 at HSC-3 at NAS North Island, and another MAST is available at HSC-2 at NAS Norfolk. They are mainly used for SIERRA training; however, since they are being completely driven by OMIA software, they can be quickly reconfigured as ROMEO stations via restarting the programs in ROMEO mode.

5 Planned enhancements

Navy future enhancement plans for OMIA include a lower cost PK/FFK Center Console hardware unit, which will be used mostly for ROMEO training. This will only be the size of the PK/FFK hardware; it is much thinner than the real hardware, so it could be used in a lab type environment or taken with a notebook computer to sea.

Another option being developed is a FLIR hand control unit (HCU) so FLIR operations can be performed via a PC with the HCU being plugged into the USB port. Finally, a hardware bezel is being developed, that will also attach via a USB port.

OMIA will react the same way to any of these hardware units. When OMIA starts up it will detect which hardware is attached. In the cases where there is a software equivalent shown by default for the attached hardware, the software equivalent will not be displayed. For example, if there is hardware for the PK/FFK connected to the USB

port, then the software panel will not come up automatically when OMIA is started.



Figure 6. Mission Avionics System Trainer (MAST)

6 Future directions & more information

The complexity and number of the sensors under control of the crew on the MH-60S and MH-60R helicopters pose a difficult training task for the Navy. To meet this challenge the US Navy partnered with Stottler Henke to develop and deploy the OMIA software, a low-cost PC-hosted desktop crew trainer. Various hardware developers have built optional hardware that enhances OMIA. OMIA is a flexible solution leveraging COTS solutions, designed for evolving needs and able to be integrated with MSFS and hardware for enhanced functionality.

7 References

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