

# Desktop MH-60R Helicopter Training Simulator, Designed for Rapid Modification for Different Nations

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## Abstract

The US Navy in conjunction with SHAI has developed and deployed a training tool used for training for the US and the international versions of the MH-60R helicopters. Since the MH-60R helicopter can be configured differently for different nations, the training also needs to be adapted to the specific versions of the helicopter. Some nations flying or soon to be flying the MH-60R include Australia, Denmark, Greece, Spain, India, and South Korea. The tool, called the Operator Machine Interface Assistant (OMIA), is primarily an expandable, easily modifiable low-cost PC-hosted desktop crew trainer in use by US and non-US Navy training squadrons, and fleet squadrons at port, and at sea. OMIA provides much of the cockpit interface for the front seats and the Sensor Operator station. OMIA provides training in most aspects of helicopter operations except flying, this includes but is not limited to navigation operations, radio operations, emergency operations, RADAR, ISAR, ESM, FLIR, and both active and passive acoustics.

OMIA is designed to be flexible, allowing for low-cost, rapid development since the software and crew interfaces evolve, and OMIA needs to keep current. OMIA's flexibility has allowed SHAI to rapidly make the modifications necessary to keep the various non-US versions of OMIA consistent with the respective non-US versions of the MH-60R.

This paper demonstrates the significant training benefit OMIA provides and the power of OMIA as a flexible tool for rapid evolution to meet the needs of all the navies that fly the MH-60R.

## Introduction

The US Navy flies two similar but distinct helicopters, the MH-60S and MH-60R. 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. As can be seen in Figure 1 the pilot and copilot each have two LCD screens, one of which is the Mission Display (MD) and the other is the Flight

Display (FD). The pilots interact with these displays primarily through a trackball-based pointing device (PD) and a set of bezel keys around each display. There is also a Control Display Unit (CDU) in the center console, used for operator inputs.

For over a decade the US Navy's PMA-205, in conjunction with industry, has developed, deployed, and updated a flexible, low-cost PC-hosted crew trainer for the Navy's MH-60S (Sierra) and MH-60R (Romeo) helicopters called the *Operator Machine Interface Assistant* (OMIA) [2][3].

OMIA is used by US and Australian Navy training squadrons, helicopter maintenance organizations, and by fleet squadrons at port, and when deployed at sea; both navies have unlimited access to OMIA. OMIA is also used for Saudi Navy training and India Navy training. OMIA provides much of the cockpit interface for the front seats of the MH-60S & MH-60R and the Sensor Operator station in the MH-60R. OMIA provides training in most aspects of flight operations except flying, this includes but is not limited to navigation operations, radio operations, emergency operations, RADAR, ISAR, ESM, FLIR, and both active and passive acoustics.



**Figure 1. MH-60 Common Cockpit**

The core of OMIA (Figure 2) is a standalone Java program that operates under any standard Windows, Linux or Macintosh computer that is installed with a Java Runtime Environment (JRE); this flexibility should allow different nations to run OMIA on computers of their choice. The standalone OMIA provides an introduction to the Common Cockpit, including the Mission Display (Figure 3), the Flight Display (Figure 4), the Control Display Unit (CDU) (Figure 5), and several helicopter control panels. A major benefit of the standalone core OMIA trainer that benefits all Navies is that the application uses no external licensing, and therefore it can be distributed easily and only under the licensing terms of OMIA itself. In addition, the core system also supports a number of optional extensions to meet other training needs.



**Figure 2. OMIA Part-Task Trainer (PTT)**

OMIA is used by various Navies to teach all crewmembers how to operate their respective portions of the helicopter. That is, OMIA provides training in most aspects of helicopter operations except flying, this includes but is not limited to navigation operations, radio operations, emergency operations, RADAR, ISAR, ESM, FLIR, and both active and passive acoustics. The user can also run OMIA in standalone mode (the default) or in network mode. In network mode, one operator can be the co-pilot and another operator can be the sensor operator. In this scenario, both operators will see the same world, including changes made by each other.



**Figure 3. OMIA Mission Display with Menu Visible**

The architecture is designed to allow the OMIA trainer to automatically configure itself during the startup process to deliver the most optimum training environment possible. This includes the ability to sense when multiple monitors are connected, and/or the presence of a touch screen display. OMIA is able to detect if optional hardware is installed and will work correctly with new hardware automatically. The simplest example is multiple monitors: by attaching two displays, the Mission Display, shown in Figure 3, and the Flight Display, shown in Figure 4, can be displayed on separate monitors, with one of the monitors also displaying the Center Console panels. The bezel keys on the flight display and mission display may be operated using finger pushes on a touch screen in order to emulate the ergonomics of the actual helicopter more accurately. OMIA can support a third screen, which can be a touch screen and used for Center Console panels and placed horizontally so that the user can push the buttons in a way more similar to how it is done in the aircraft instead of using the mouse.

OMIA has the ability to integrate with a third-party flight simulator. Every time OMIA starts it checks to see if a compatible flight simulator (e.g., FlightGear) is already running. If it is running, OMIA attaches itself to the flight simulator and then gets its position, speed, and other flight information from the flight simulator.

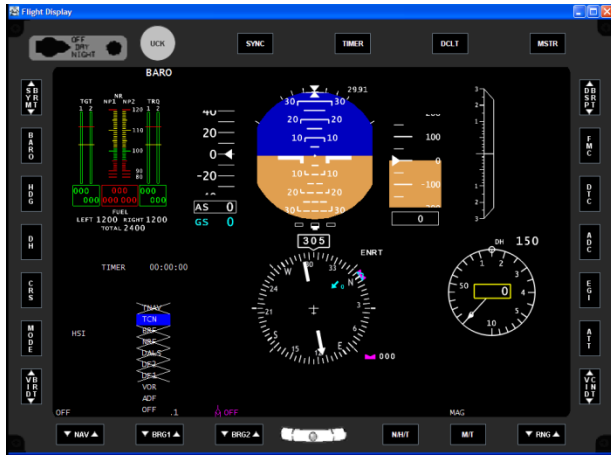


Figure 4. OMIA Flight Display

In this configuration, the user is able to have the external view be completely generated by the flight simulator. While the Flight Display, Mission Display and all of the other panels are still being used from the core OMIA. However, any other information such as ground speed, latitude/longitude location, or motion is all taken from the flight simulator. This is very beneficial if a user wishes 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 a flight simulator, other hardware can be used if desired, such as a joystick; or a head mounted display with head tracking may be added to improve the means for emulating the full field of view. Flying can be performed solely using a joystick, or a joystick and a separate control for the collective, and/or COTS pedals can be added. However, since the feedback and physics do not match the actual MH-60R usually an autopilot is all that is used to move the helicopter so other aspects of the helicopter, such as Search and Rescue (SAR) patterns can be flown.

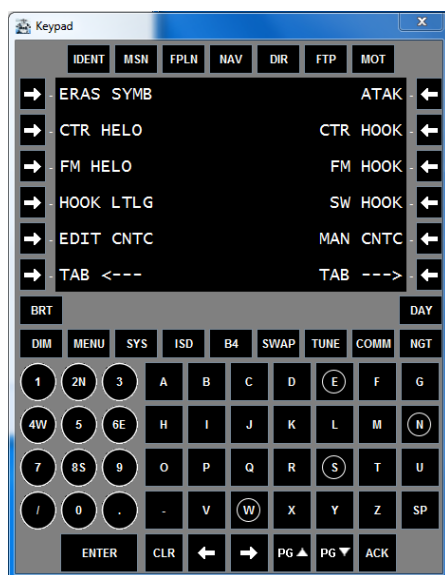


Figure 5. Control Display Unit (CDU)

## 2. JAVA AS OMIA'S DEVELOPMENT LANGUAGE

There were three main factors that drove the decision to write OMIA in Java.

- A language that supported the design for evolving requirements was necessary because the Common Cockpit continues to evolve. Java provides support for rapid GUI development and there are many other GUI related tools, many Opensource, available in Java. Even though the MH-60R uses the Common Cockpit, the versions of the helicopters used by different nations may have different capabilities and missions, so OMIA has to be customized to match each nations specifics. Since this process is continual, we need a flexible language for this task. Advances in the Java language and tools have proven this a great choice for rapid modification.
- Portability to other platforms (e.g., Linux). The Navy requested a Linux version of OMIA in 2009 as part of an acoustic systems trainer (ATS) enhancement. The fact that OMIA was written in Java allowed this requirement to be rapidly completed.

## 3. MENUBUILDER / KEYBUILDER

A major user interface component is on-screen menus and the corresponding keys on the Control Display Unit (CDU). To increase the development speed to create or modify menus as the software is updated in the helicopter a menu & key generation and modification tool has been developed: MenuBuilder / KeyBuilder. MenuBuilder / KeyBuilder makes it easier to move or change menu elements. Thus, OMIA can much more rapidly be updated for newer releases and customized for each nation's needs.

The MenuBuilder / KeyBuilder provides a graphical tool for developing and modifying menus and the keys on the CDU, see Figure 6. The second pane provides a list of items that can be used to modify the current selection. That is, there is a Filter option, so one can find the subset of existing items to choose from. For example, if one types 'add' in the Filter box, then only items with 'add' in their name will be included in the list.

The third pane shows the corresponding keys of the two columns of keys found on the CDU. The user can simply drag the menu item onto the key of interest and the key will update.

The fourth pane shows the corresponding menu, with the menu contents shown in the order presented. To re-order a menu item, simply drag it to the location desired. To delete an item, select the item and then hit the minus '-' at the top of the pane. To add an item simply drag the menu item from



the second pane into the menu list at the location in the menu desired.

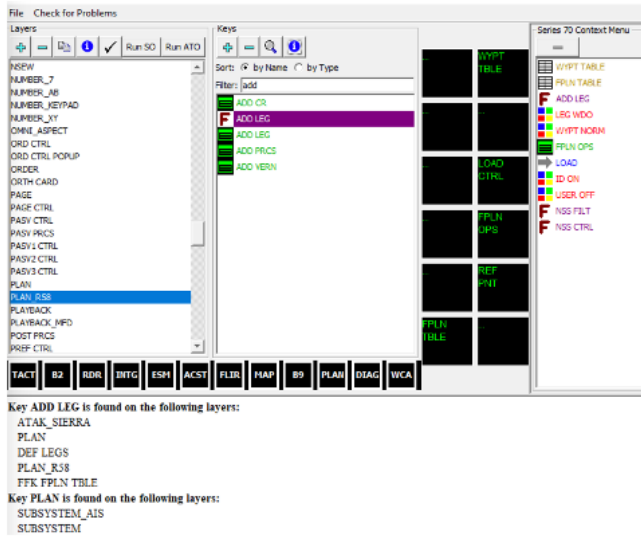


Figure 6. MenuBuilder / KeyBuilder User Interface

When modifications are completed, the author can save out this key / menu information, so that the next time the program is *compiled* the key & menu changes will take effect.

#### 4. ENHANCING THE CREW LEARNING EXPERIENCE

OMIA is much more than the Flight Display, Mission Display, CDU, and the other items described above. The MH-60R has other major systems that can be trained OMIA.

##### Center Console Panels

As can be seen in Figure 1, there are many panels in the Center Console. OMIA emulates some of these, since these are used less frequently, they are not all shown on screen at all times when OMIA is running. There is a Control Panels window where the user can select which panel(s) to display, see Figure 7. The CMP panel is shown in Figure 8, this panel is used for controlling the power to the computers and EGIs. The RCU panel is shown in Figure 9, this panel is used for emergency radio communications.

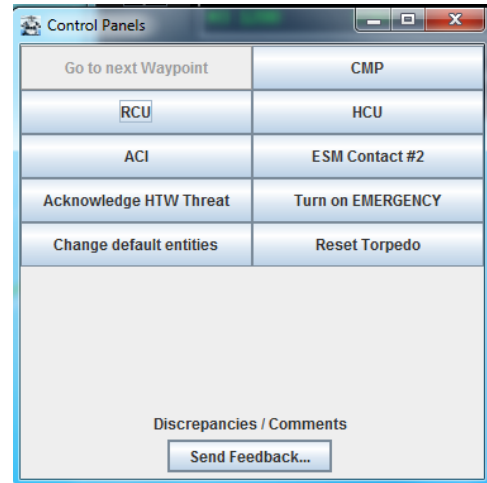


Figure 7. OMIA GUI to Select Options

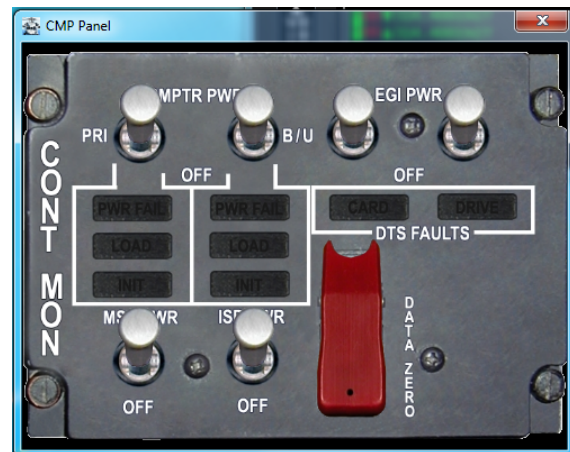


Figure 8. CMP Panel



Figure 9. RCU Panel

### *Forward Looking InfraRed (FLIR)*

One such system found on MH-60R helicopters is the Forward Looking InfraRed (FLIR) system. The FLIR user mainly controls the FLIR operations via a Hand-Control Unit (HCU), as shown in Figure 10. The Navy has developed a portable HCU hardware facsimile that can be connected to OMIA via USB, see Figure 11. In addition, if the hardware is not available, there is an option to bring up a window that provides a software emulation of the FLIR HCU, see Figure 12.



**Figure 10. FLIR Hand Control Unit (HCU)**

OMIA reacts the same way to the HCU hardware as it does to the presence/absence of other hardware units; when OMIA starts up it checks whether a FLIR HCU hardware is attached. If it is attached, the software will read input from it, if it is not detected, then the software equivalent is available.

The hardware FLIR HCU teaches both the tactile feedback and muscle memory of a physical hand control unit, in addition to the all the training available with just the software FLIR HCU. Due to the modular design of the OMIA software, adding support for the USB HCU input device required relatively little development effort.

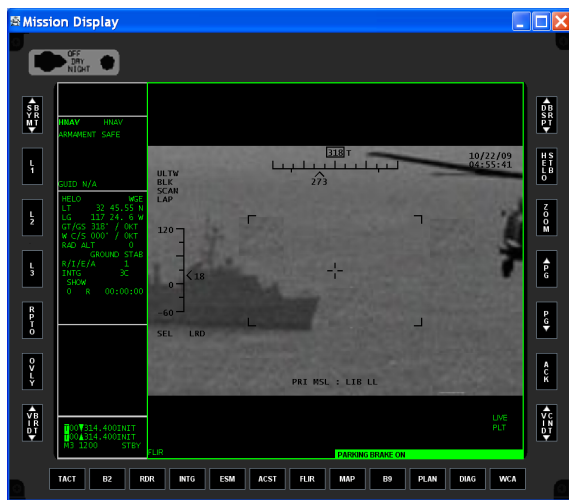


**Figure 11. Low-cost HCU used for Training**



**Figure 12. Simulated HCU in OMIA**

An example of a FLIR, with the MH-60 overlay, as shown on a Mission Display in OMIA, is shown in Figure 13. The generation of FLIR images is a difficult task in real-time. Usually, FLIR simulators are very expensive units incorporated into multi-million-dollar simulators. For OMIA a simpler solution is created to provide a high level of learning benefit sans the cost. The FLIR implementation in OMIA uses *WorldWind*, an open-source virtual globe API supplied by NASA. Much of the learning related to FLIR concerns the operation of the FLIR menus and other operations that are part of the software overlay. Through the combination of the hardware FLIR HCU and the overlay menus and other functions with the 3D world view, a great deal of learning is facilitated. For example, users can zoom in and out, slew, adjust image polarity, cycle through camera modes, and navigate through on-screen menus.



**Figure 13. Screenshot of FLIR in OMIA**

### *Acoustics*

Another very important capability of the MH-60R is both passive and active acoustics. To support this there is also a version of OMIA that includes an Acoustics Trainer Simulator (ATS) enhancement, this is referred to as OMIA-ATS. This capability is mainly used by the Sensor Operator (SO) that sits at the SO station; see Figure 14. OMIA-ATS requires capabilities currently only available under Linux, so OMIA-ATS is restricted to use on Linux. This enhancement is supplied to various navies as a complete hardware/software solution, the OMIA-ATS hardware includes a computer/laptop with an external touch screen and OMIA-ATS installed.



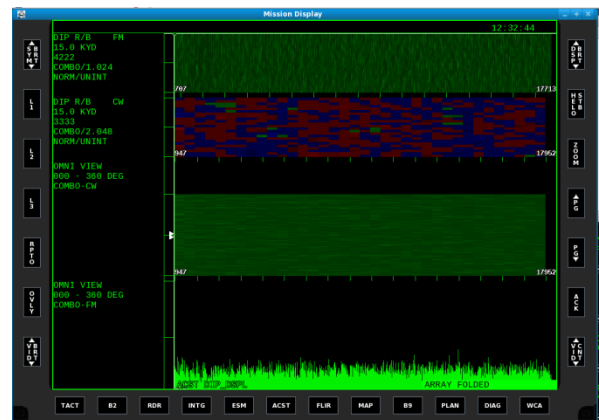
**Figure 14. Sensor Operator Station**

The user interface for the acoustics aspects utilizes the same menus and CDU as most of the rest of the user interface, so the interface can be quickly changed via the MenuBuilder/KeyBuilder tool described above.

OMIA-ATS provides a highly capable training tool for MH-60R sonar operators. The OMIA-ATS includes, but is not limited to:

- Providing system familiarization for displays and keysets (with or without instructor support)
- Supporting independent skills review in a Training facility environment
- Preparing operators to take full advantage of TOFT training sessions
- Providing a platform for acoustic return recognition training
- Supporting independent skills review for deployed squadron personnel.

A screenshot of OMIA running in the SO mode is shown in Figure 15.



**Figure 15. OMIA-ATS Running in SO Mode**

The (non-ATS) OMIA benefited as much as possible from the acoustics enhancements, so OMIA allows the learner to get an introduction to acoustics operations and menus but does not allow for pinging and viewing realistic acoustic returns as OMIA-ATS does. The same output from the MenuBuilder/KeyBuilder tool is used for the acoustics portion of OMIA & OMIA-ATS.

## **4. CONCLUSION**

The complexity as well as the number of the sensors under control by the crew on the MH-60R helicopters, pose a difficult training task for the Navy. To meet this challenge, the US Navy in conjunction with industry has developed and deployed OMIA, a flexible, low-cost PC-hosted desktop crew trainer. OMIA has evolved with the changing helicopter software; with every iteration, it has become an ever more functional trainer providing greater flexibility and benefit to all the navies that fly the MH-60R.

OMIA demonstrates the utility of designing a flexible system that allows for quick responses to ever-changing demands. Since the software configuration of the helicopter evolves, and that evolution may also be different for different navies, OMIA needs to evolve also and thus

development tools MenuBuilder/KeyBuilder have been developed to facilitate this evolution to be as rapid as possible. The OMIA program has been able to adapt to new challenges with a minimum amount of additional development.

OMIA's capabilities benefits both the US Navy and the expanding list of navies throughout the world that have chosen the MH-60R for their own needs.

### **Acknowledgements**

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