

Airborne Maritime Patrols – Oct 2005

Introduction

An automated maritime patrol module has been added to JFORCES. In essence, this module posts one or more aircraft (either fixed wing or helicopter) at a location and pulls them off as sea assets are detected within range. Topics within this document are:

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[Possible Improvements](#)

This is a module with many options and there are undoubtedly loose ends. For that reason this document includes a section entitled “Possible Improvements”. Other sections are:

Algorithm Overview

Maritime patrols are models as one or more aircraft, wither fixed wing or helicopter, patrolling an area until a sea asset is detected. After a sea asset is detected the aircraft will attack the asset and return to base. An additional patrol control routine attempts to restaff the patrol with other aircraft from a list of candidate resources provided by the analyst.

Initialization

In the interests of completeness it should be mentioned that maritime patrol specifications are read from the database in the *init_maritime_patrol* routine, currently found in *sim/engment/maritime.c*. There’s no complex processing worth discussing beyond stating that this routine starts up a cyclical call to *gen_maritime_patrols*, which is the main routine for controlling and commanding assets on maritime patrol, if and only if one or more maritime patrol specifications are found in the scenario definition.

Invocation

There are two methods to initiating a maritime patrol. These can either be initiated by time or a number of elements of interest in a specific region. The event-based invocation will be described as part of the alternate plan implementation, with a write-up following soon. The time-based implementation is controlled by the *gen_maritime_patrol* routine , currently found in *sim/engment/maritime.c*. This routine is called once every simulated half hour. At that time it evaluates all maritime patrols and determines whether or not they are active. They can be declared active if the current simulation time is between the limits set by the analyst in scenario generation, or if the patrol has been declared active by an external module. At this time the only module that can

activate maritime patrols is the alternate plan module, alluded to above. Some special notes:

- Time-based maritime patrols can be commanded to execute earlier (or later) than specified by external modules. This permits the user to specify that a patrol should start at a given time (based upon external scenario events) UNLESS an external stimulus (e.g. Observed enemy actions) provides a reason to start the maritime patrol sooner.
- There's currently no provision for canceling an externally commanded maritime mission.

Staffing

Maritime Patrols are defined as having a location. Currently aircraft fly small circles in location until an enemy ship is detected. The *gen_maritime_patrols* routine loops through all aircraft the analyst specified as available for use in this mission. It determines the total number of aircraft in flight versus the total number available and then assigns additional aircraft as required. Note that the total number of aircraft in flight is the criteria; this could lead to unexpected results if the aircraft are launched on other missions.

Prosecution

Aircraft launched on a maritime patrol initially fly towards the patrol point. However, whenever a detected enemy ship is within its on-board anti-ship sensor range the asset will attack that ship by flying towards it and dropping all of its ordinance. It will then return to base to rearm and refuel.

Special notes:

- In order to attack enemy ships the asset must have an anti-ship capable sensor (that is any sensor that can detect surface vessels) and anti-ship warheads.
- The response range against enemy ships is limited to its on-board sensor range.
- The aircraft can transition from patrol to attack before reaching its patrol point.
- The check for detected ships in range currently cycles every 10 minutes.
- Should there be multiple candidate targets in range, the largest otherwise unattacked target (as defined in weight) will be attacked first.
- The system currently flies 1-v-1. That is a single aircraft will be assigned against a single ship and no other aircraft will be assigned to that ship until the first attack is concluded. This was done to maximize targeting in a target-rich environment, but would be inappropriate in other situations.
- ASW weapon and sensor capabilities are currently evaluated, but ASW prosecution is not currently performed. This was postponed since it was not key to the scenario and more complex than the anti-ship model. This is suggested for later upgrade.
- Aircraft on patrol that have not been assigned will return to base 3 hours after launch or after reaching their low fuel warning, whichever comes first.
- Currently the algorithm always flies aircraft to their base of origin; it's not sophisticated enough to consider alternate recovery bases should the base of origin be attacked (or sunk) in the meantime

New Database Prototyping Inputs

No database prototyping changes were required for this module. But some items of note that were found during testing are:

make sure the bases can turn around the aircraft/helicopters

make sure the aircraft have both warheads and appropriate sensors for antiship work

Verify the sensors have reasonable max range. This is used by the assignment routine. Too small of range and the aircraft will not be employed. Too large might result in assignments beyond the aircraft's engagement radius (i.e. it'll run out of gas before engaging the enemy).

Verify the aircraft/helicopters cruise speed and altitude. These are the values used both for flying to the patrol station and flying to the enemy. Too low of speed will result in exorbitant times-to-attack. Too low of altitude will deny detections because the enemy will be beyond the sensor's horizon.

New Scenario Generation Inputs

New inputs are required to specify maritime patrols. These are found under Scenario Definition->Employ Automatic Rules->Plan Maritime Air Patrols, as shown in the figure on the following page.

Specific comments:

- Initially an overview screen describes the missions and aircraft assigned. It's legal to assign the same asset to multiple missions, but might lead to unexpected staffing failures if the missions are coincidental.
- Mission fields are:
 - Side – Only the selected side (Red or Blue) will staff the mission.
 - Trigger – whether the mission should be triggered on time or external assignment (e.g. Alternate plans). As mentioned above, it's legal for an event mission to also be time triggered, so the time fields are always available. This would be the case in a mission that should be executed 2 hours into the scenario unless triggered to start earlier by ISR.
 - Start/Stop time – The minimal mission epoch, measured in simulated minutes from the start of the scenario. Again, this can be extended by external events.
 - Latitude/Longitude – The patrol position of the aircraft.
 - Active ratio – This is the ratio the staffing algorithm tries to maintain between available aircraft (as specified in the next frame to the right) and those in flight. Because this is a ratio the staffing manpower will drop as losses are taken. Note that if you put the at 1. you'll have a very large surge when the mission starts but then no staffing after the first surge returns to base for refueling & rearmament. A lower ratio (e.g. .5) provides a more continuous staffing over a long duration.
 - Locate on Map – Permits the analyst to indicate the mission location via map click.
- The Element (aircraft) list has a couple of unusual items. Clicking on a specific aircraft will give you the option of removing it from the mission. Clicking on the aircraft class line will give you the option of removing all aircraft of the class from this mission. In neither case will it delete the aircraft from the scenario. The add button will permit the analyst to add aircraft to

the mission. These aircraft can be specified as:

- All aircraft of the class (on the mission side)
- All aircraft of a type at a base
- All aircraft of a type in a squadron. or
- Specific aircraft.
- While not part of this module, it should be mentioned that the user must specify the airbase support profile for all bases used when he chooses to use the detailed airbase maintenance model. Otherwise the aircraft will not be rearm & refueled. So they will not be available for any but the first sortie. Using the simple airbase model bypasses this concern.

Scenario Evaluation
Define Scenario:
Scenario Configuration
Data Collection
Specific Elements
Routes
Critical Regions
Communications
Environmental Elements
Macro Changes:
Nuclear Exchange Planner
Air Mission Planner
Employ Automatic Rules
Mass DR Updates
Study Specific Options
Air Defense C2 Options
Auto Sensor_Roving Targets
Plan Maritime Air Patrols
Define High Value Immediate Limits
Define High Value Immediate Response Targeting Rules

MARITIME PATROLS
Double Click on Mission to Review or Edit
Blue Mission #1, at 25.8225/55.2026 Time 0 - 999999, Staffing 0.5
AS532 Cougar #1
AS532 Cougar #3
AS532 Cougar #5
Blue Mission #2, at 26.5551/56.3418 Time 0 - 999999, Staffing 0.5
AS532 Cougar #2
AS532 Cougar #4
Blue Mission #3, at 25.9661/55.8592 Event Triggered, Staffing 0.5
ALL AS565 Panther
Create New Mission
Exit

OR

MARITIME PATROLS
Double Click on Mission to Review or Edit
Blue Mission #1, at 25.8225/55.2026 Time 0 - 999999, Staffing 0.5
AS532 Cougar #1
AS532 Cougar #3
AS532 Cougar #5
Blue Mission #2, at 26.5551/56.3418 Time 0 - 999999, Staffing 0.5
AS532 Cougar #2
AS532 Cougar #4
Blue Mission #3, at 25.9661/55.8592 Event Triggered, Staffing 0.5
ALL AS565 Panther
Mission Overview
Side: Blue
Trigger: Event Time
Start Time (Min): 0
Start Time (Min): 999999
Latitude: 25.8225
Longitude: 55.2026
Active Ratio: 0.50
Click To Delete
AS532 Cougar:
#1
#3
#5
Add
Delete
Save
Locate On Map
Exit

Runtime Interface Changes

The only runtime interface change is that “MARITIME PATROL” has been added to the aircraft scramble button. It works fine.

Data Analysis Changes

Not changes to date

Possible Improvements

- Currently maritime patrols are defined as a single point and until an enemy is detected aircraft fly in a circle near this location. A reasonable upgrade would be to fly a patrol route in a specified region.
- Currently ASW is not addressed. Some work was started in implementing ASW in this mission, but then it was realized that ASW was not a crucial component of this scenario and ASW prosecution was dropped due to resource constraints. At some point in the future ASW should be implemented as part of maritime patrols.
- Currently the aircraft fly all of the way to the target ship to attack. It might be better to use standoff weapons where possible. This was not done because it was not certain how to use mixed weapons loads. If the procedure is determined altering the algorithm to use standoff weapons of less than 100 NM range should be straightforward.
- It might be better to change from the current staffing profile to the total # of aircraft that should simultaneously be employed on this mission. This would reduce inter-mission staffing problems.
- It also might be better to simply specify the bases that aircraft for these missions should be deployed from and a criteria for employment. This is the way most automated missions are performed in JFORCES. This method reduces analyst workload and increased staffing flexibility. However, it was thought that greater analyst specificity might be a benefit, so specific aircraft are typically identified currently (although there is an option to specify entire classes of aircraft).
- Currently the algorithm always flies aircraft to their base of origin; it’s not sophisticated enough to consider alternate recovery bases should the base of origin be attacked (or sunk) in the meantime. Evaluating for alternate bases would be a reasonable upgrade.
- *perform_maritime_patrol*, in `sim/engment/air_mission.c`, is the controlling routine for runtime maritime patrol execution.