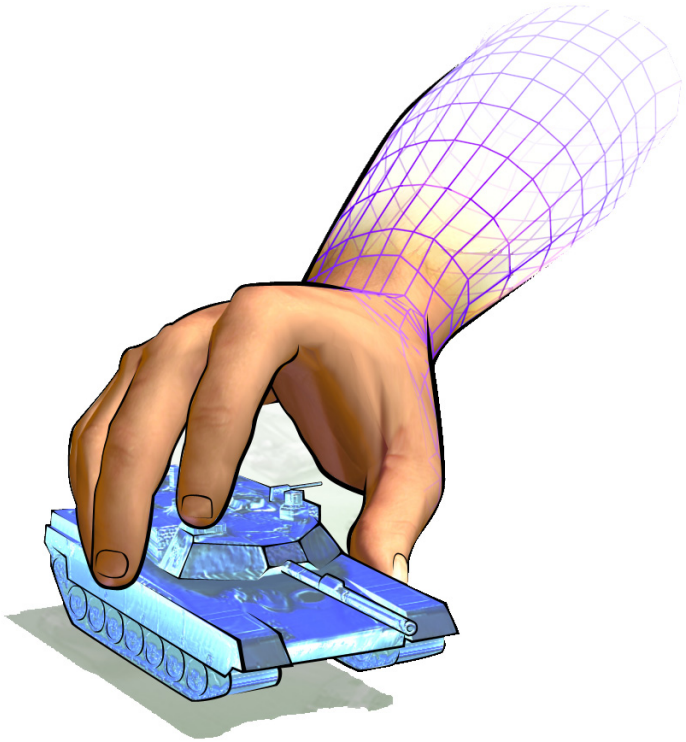

B-HAVE Module for VR-Forces

First Experience

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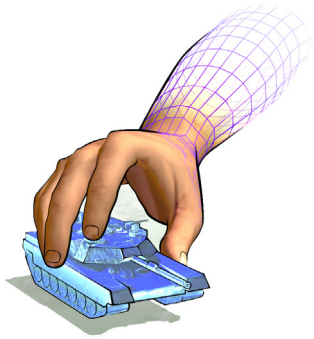
Revision BHV-2.0.4-3-120615



B-HAVE Module for VR-Forces First Experience

Thank you for deciding to try out the B-HAVE Module for VR-Forces (Brains for Human Activity in Virtual Environments). The B-HAVE Module for VR-Forces is a VR-Forces plug-in that extends the movement models for lifeforms and ground platforms. It improves:

- 3D path finding.
- Simplicity of use of basic agents (GoTo).
- Complexity and realism of behaviors (Hide, Flee, Wander).
- Complexity and realism of scenarios.

B-HAVE is powered by Kynapse®, the world's leading artificial intelligence (AI) technology solution, from Autodesk®. It is based on Kynapse's fundamental concepts of Topological Modeling for Path Finding, and Spatial Reasoning for Advanced Behaviors, which are integrated into VR-Forces as advanced planning capabilities.

Before you begin, install and license the software, as described in "Installing B-HAVE," on page 2.

When you are ready, this guide will help you:

- "Experience Improved Entity Movement"
- "Assign B-HAVE Tasks to Entities"
- "Create Multiple Entities"
- "Create Background Traffic"
- "Generate PathData"
- "Run a Lua Script"

This guide assumes that you have some basic familiarity with VR-Forces and can create scenarios, entities, and tactical graphics without detailed instructions.

1. Installing B-HAVE

B-HAVE is provided as an executable installation program. Please note the following important installation criteria:

- You must install B-HAVE into the directory in which you have installed VR-Forces. The installer defaults to the default installation directory for the associated version of VR-Forces, for example, *C:\MAK\vrforces4.0.4*. If you did not install VR-Forces into the default directory, it is your responsibility to change the B-HAVE installation directory to your VR-Forces installation directory.

  If the installer warns you that you are installing into an existing directory, ignore the warning.

- Each version of the B-HAVE is built for a specific version of VR-Forces and will work only with that version. For example, B-HAVE 2.0.4 for VR-Forces 4.0.4 will work only with VR-Forces 4.0.4. It would not work with VR-Forces 4.0.3.

➤ To install the B-HAVE, run the installation executable and follow the directions of the installation wizard.

You must have a license to run B-HAVE. Your MÄK salesperson should have provided you with a license as part of this evaluation or product purchase. Place it in the *MAKLicenseManager* directory on the license server. License management and server setup should already be complete as part of installing VR-Forces.

2. Experience Improved Entity Movement

B-HAVE improves the movement models for lifeforms and ground vehicles when they execute tasks such as Move to Waypoint or Patrol Route. This lets entities intelligently navigate terrain without the need to create complex routes or waypoints. In this first exercise, we will ask an entity to walk from the roof of one building to the roof of another. Since we cannot easily compare B-HAVE movement to non-B-HAVE movement without changing some configuration files, just take our word for it – you would not be able to do this without B-HAVE.

1. Start VR-Forces.
2. Create a new scenario that uses the VR-Village terrain.
3. In Plan View mode, zoom into the village to area just south of the intersection where the gazebo is located (Figure 1).

Figure 1. VR-Village center

4. Create a Neutral Civilian Female on the roof of the building to the left of the road, as shown by the circle in Figure 2. (Just place the entity on the roof. By default entities are placed on the highest polygon, so you do not have to specify the altitude.)

Figure 2. Entity on roof

5. Open the entity's plan window.
6. Choose **Set** → **B-HAVE Movement Mode**. The Movement Mode dialog box opens.
7. Select Free. (We will explain this choice later.)
8. Click OK. The set statement is added to the plan.
9. Choose **Task** → **Move to Location**. The Move to Location dialog box opens.
10. Click the top of the building across the street from the building on which you placed the entity. (Where the arrow in Figure 2 points.)
11. Select the Plan Path option. The dialog box should look like Figure 3.

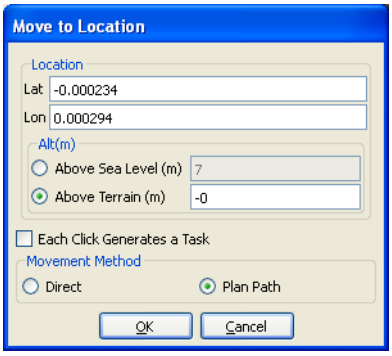


Figure 3. Move to Location dialog box

12. Click OK.
13. Click OK to save the Plan.
14. Save the scenario.

15. In the Observer Control toolbar, change the observer mode to Stealth (Figure 4).

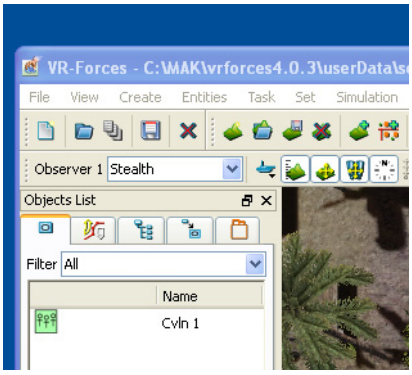


Figure 4. Observer mode

16. In the Objects List panel, right click the entity and select Attach Mimic. The observer attaches in Mimic mode. You might want to press the **s** key a few times so that the observer is just behind the entity.

17. Run the scenario. The entity walks down from the roof, across the street, into the other building, and up two sets of stairs to the roof.

2.1. The B-HAVE Movement Mode

In Step 7 of the previous section, we asked you set the B-HAVE Movement Mode to Free. B-HAVE lets you set a movement preference for entities. By default, vehicles prefer to travel on roads and lifeforms prefer to avoid roads. Lifeforms will cross a road if there is no other way to get to their destination, but otherwise they will stay off of them.

In this terrain, there is a tunnel under the street. If we did not set the movement mode to free, the entity would have walked through the first building, down into the tunnel, and then up into the building on the other side of the street. Since in the normal course of events you would expect a person to cross the street to get to the other side, we changed the movement mode.

You can test this out by removing the Set Movement Mode from the entity's plan and running it again.

3. Assign B-HAVE Tasks to Entities

As we discussed in "Experience Improved Entity Movement," on page 3, B-HAVE improves the movement models for lifeforms and ground vehicles when they execute VR-Forces movement tasks. However, B-HAVE also installs some additional tasks – Flee, Wander, and Hide – that are not available in standard VR-Forces. The Flee task causes entities to try to stay a specified distance from some other specific entity. The Hide task causes entities to flee until they are out of line-of-sight of a specified entity. The Wander task causes entities to move randomly throughout the terrain or within a specified area. Let's take a look at the Hide task.

1. Start VR-Forces.
2. Create a new scenario that uses the VR-Village terrain.
3. In Plan View mode, zoom into the village to the intersection where the gazebo is located (Figure 5).

Figure 5. VR-Village center

4. Create some civilian entities along the sidewalks, as in Figure 6.

Figure 6. VR-Village center

5. Zoom out a bit and put an Opposing force Combatant on the sidewalk, as in Figure 7.

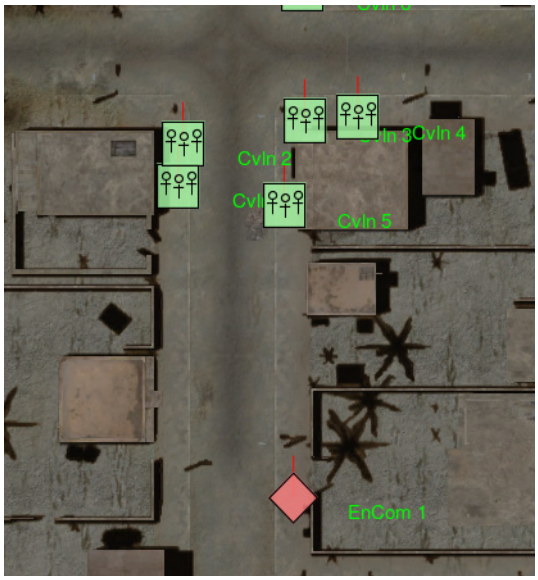


Figure 7. Combatant

6. Select the Combatant and open its Plan window.
7. Give it a Move to Location task, with the location the gazebo on the corner of the intersection.
8. Select the lifeforms that you created. (Hold down **`Alt`** and drag a box around them or **`Ctrl`**-click each one.)
9. Open a Plan window. This plan will apply to all of the selected entities.
10. Choose **Task** → **Hide From**. The Hide From dialog box opens.
11. In the window of the dialog box, select the Combatant (EnCom 1).
12. Save the Plan.
13. Save the scenario.
14. Change the Observer mode to Stealth and move the observer so that you have a good view of the intersection, as in (Figure 8).

Figure 8. Intersection in Stealth Observer mode

15. Run the scenario. As the Combatant approaches the entities, they will move away around the corner, behind doors, and into the buildings.

4. Create Background Traffic

One of the important uses for B-HAVE is to create background traffic to fill out a scenario. B-HAVE lets you create continuous streams of entities that can enter a scenario, do something, and then exit the scenario. All this takes place without the need to program actions of individual entities.

In the simple case, you do this by placing spawn points, at which entities enter the scenario, and sink points, at which they leave. You need at least one of each. When you run the scenario, entities get created at the spawn points. They then randomly choose a sink point, move to it, and exit the scenario.

In the more complex case, you can write a plan that all spawned entities will use. They still get created at the spawn points, but then do whatever the plan directs them to do. They are not removed from the scenario unless the plan includes a Delete Self command.

Spawning behaviors are managed using spawn patterns. You can have multiple spawn patterns in a scenario, which lets you create a wide variety of automatic behaviors for all entity types.

In the rest of this section we will create some scenarios that demonstrate the different ways to create background traffic.

4.1. Simple Background Traffic

1. Create a new scenario using the Makland terrain.
2. Zoom in on the town.
3. Choose **Create** → **Spawn Points** → **Veh Spawn Point**. The cursor changes to look like a waypoint.
4. Click on the terrain to locate two or three spawn points, as in Figure 8.

Figure 9. Spawn points

5. Choose **Create** → **Sink Points** → **Veh Sink Point**. The cursor changes to look like a waypoint.
6. Click on the terrain to locate two or three sink points, as in Figure 9.

Figure 10. Sink points

7. Save the scenario.

This scenario is included with B-HAVE as B-HAVE_Demos/FirstExperienceSimple-Traffic.

Run the Simple Traffic Scenario

The spawn and sink points you created use one of the default spawn patterns provided with B-HAVE. Let's look at the spawn pattern to understand what will happen when we run the scenario.

1. Choose **B-HAVE** → **Spawn Pattern Manager**. The Spawn Pattern Manager opens (Figure 10). Notice that it lists the number of spawn and sink points that you have created.

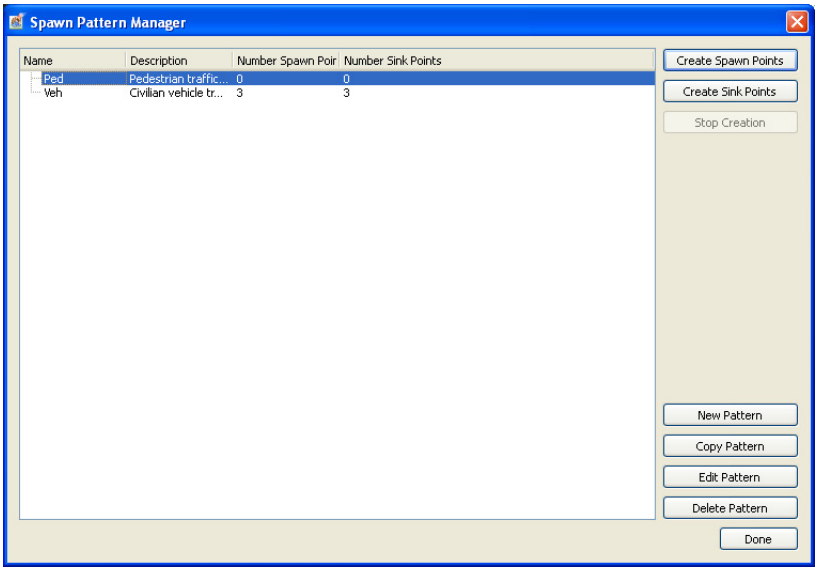


Figure 11. Spawn Pattern Manager

2. Select the Veh spawn pattern in the list.
3. Click Edit Pattern. The Edit Pattern dialog box opens (Figure 11). We do not actually want to edit it, but this is the only way to view the pattern.

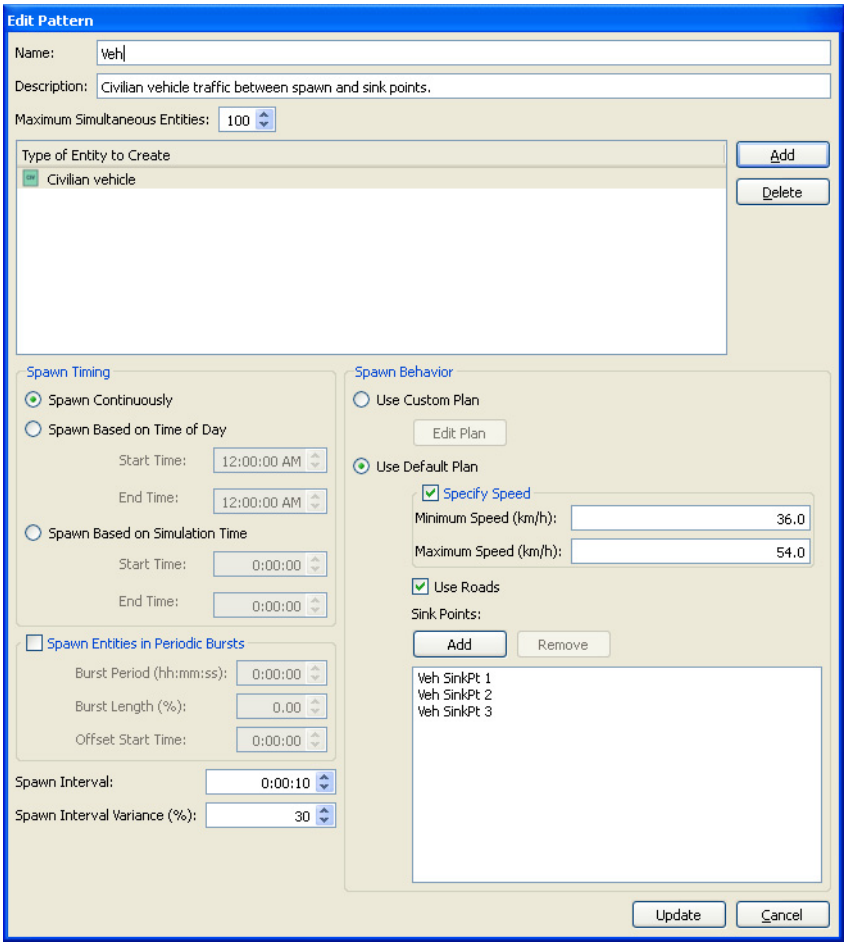


Figure 12. Edit Pattern dialog box for Veh spawn pattern

The important things to note about this spawn pattern are as follows:

- The Type of Entity to Create list has one entry – Civilian vehicle. This means the spawn points will create just civilian vehicles.
- Maximum simultaneous entities is 100. This means that VR-Forces will keep creating entities at the spawn points until there are 100 entities created from this spawn pattern in the scenario. Then it will stop until some of these entities leave the scenario.
- Spawn timing is set to spawn continuously. VR-Forces will start spawning entities when the scenario starts running and keep doing so until the scenario stops.
- Spawn Interval is 10 seconds and spawn interval variance is 30%. VR-Forces will spawn a new entity every 10 seconds plus or minus 3 seconds (30% of 10).
- Entities will behave according to the default plan. This means they will randomly choose one of the sink points listed in the window, move to the sink point, and be removed from the scenario.

Close the Edit Pattern dialog box and the Spawn Pattern Manager. Run the scenario. Vehicles will appear at the spawn points every 7 -13 seconds. Then they will travel to one of the sink points and be removed from the scenario (Figure 12).

Figure 13. Traffic

i

As entities approach the sink points, you may see console warning icons displayed. This is a known problem in this release. The entities will still go to the sink points and be removed.

4.2. Creating Traffic in Bursts

Now, let's add a little complexity and realism to the traffic scenario. Background traffic does not usually arrive in a steady stream. There are bursts of activity associated with events such as rush hour, periodic arrival of trains and buses, and so on. You can program bursts of entity creation into your spawn patterns.

We will create a scenario in which in each one minute period, starting at 20 seconds, entities get created every 5 seconds for 30 seconds. This short time period is to show the effect quickly. You can create patterns that take effect over hours or days of simulation time.

1. Create a new scenario using the Makland terrain.
2. Choose **B-HAVE** → **Spawn Pattern Manager**. The Spawn Pattern Manager opens (Figure 10).
3. Click New Pattern. The Create Spawn Pattern dialog box opens (Figure 13).

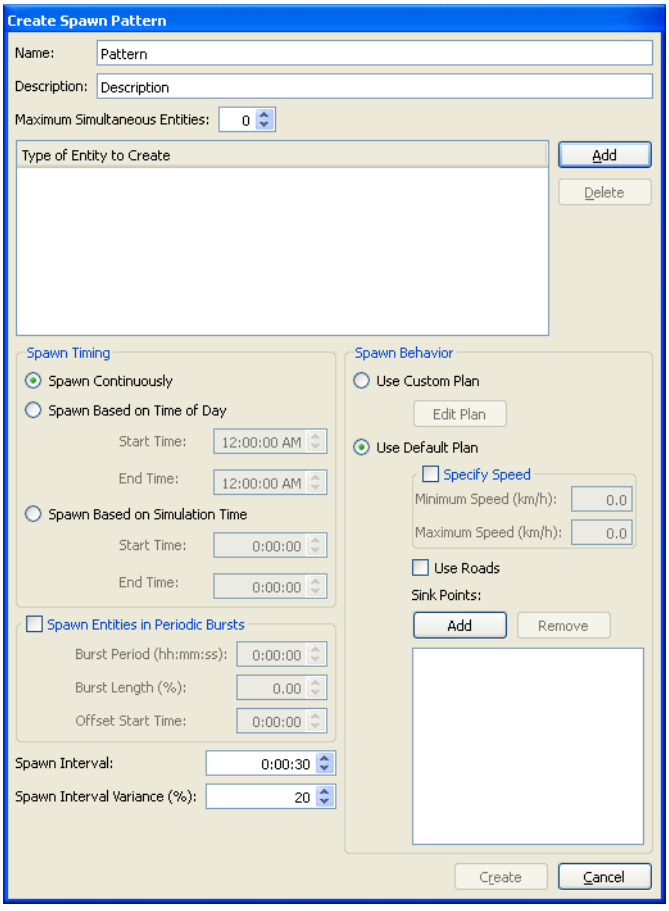


Figure 14. Create Spawn Pattern dialog box

4. In the Name box, type Burst. (This name gets used to name the spawn and sink points, so although it can be long, we do not want it to be long or the screen will get cluttered with the point labels.)
5. In the Description type, "Example of a traffic burst."
6. Set Maximum Simultaneous Entities to 20.
7. Next to the Type of Entity to Create window, click Add. The Entity Type dialog box opens (Figure 14).

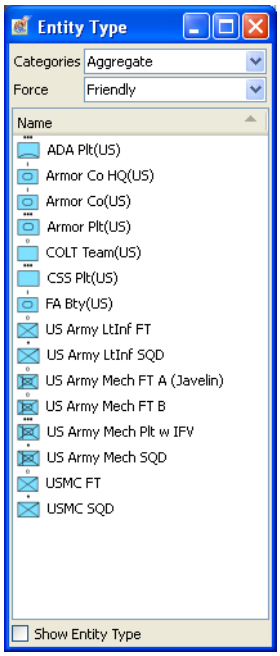


Figure 15. Entity Type dialog box

8. In the Categories list, select Ground.
9. Click HMMWV Utility Vehicle. It is added to the list.
10. Select the Spawn Entities in Periodic Burst check box.
11. Set the Burst Period to one minute (0:01:00).
12. Set the Burst Length to 50% (50.00).
13. Set the Offset Start Time to 20 seconds (0:00:20).
14. Set the Spawn Interval to 5 seconds (0:00:05).
15. Set the Spawn Interval Variance to 0.
16. In the Spawn Behavior group box, select the Specify Speed check box.
17. Set the Minimum Speed to 5 km/h.
18. Set the Maximum Speed to 80 km/h.

19. Select the Use Roads check box. The spawn pattern should now look like Figure 15.

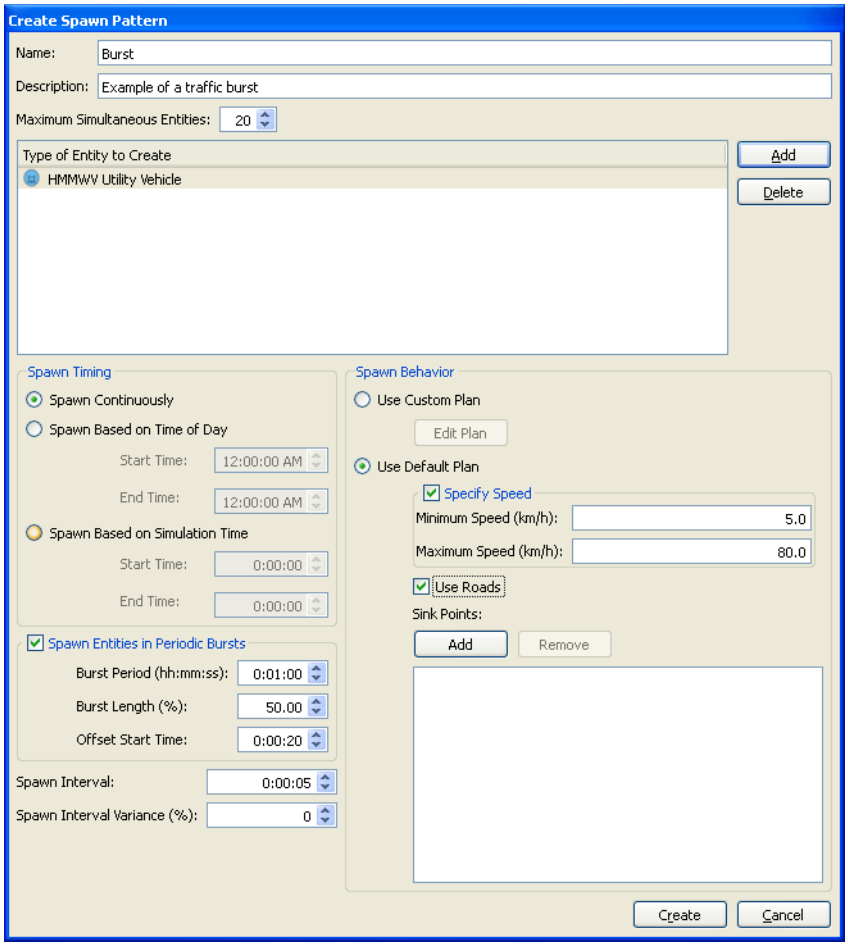


Figure 16. New spawn pattern

20. Click Create. The spawn pattern is added to the Spawn Pattern Manager.
21. Save the scenario.
22. In the Spawn Pattern Manager, select the Burst pattern.
23. Click Create Spawn Points. The cursor changes to a point symbol.
24. Place a spawn point on the terrain. Notice that its label uses the name of the spawn pattern.
25. Click Create Sink Points.
26. Place two or three sink points.
27. Save the scenario.

28. Run the scenario. Keep one eye on the spawn point and the other on the simulation clock. After 20 seconds (the offset start time), VR-Forces will spawn an entity every 5 seconds (the spawn interval) for 30 seconds (the burst length – 50% of the 1 minute burst period). At 50 seconds into the scenario it will stop spawning entities. At the 1:00 mark a new burst period starts. At 1:20, VR-Forces starts spawning entities again. The cycle will repeat as long as the scenario runs.

This scenario is included with B-HAVE as B-HAVE_Demos/FirstExperienceBurstTraffic.

4.3. Creating Traffic that Uses a Custom Plan

The first two traffic scenarios we created used the default plan for spawned entities – when an entity is created it selects one of the sink points in its pattern, moves to the sink point, and is removed from the scenario. But what if you want the entities to engage in more complicated behaviors? You can achieve this by writing a custom plan.

A custom plan can include all of the tasks, set data requests, conditions, and global plans that any VR-Forces plan can have. B-HAVE adds an additional global command – Delete Self. This command lets you easily delete the entity from the scenario when it has completed its plan. (You do not have to delete spawned entities if you do not want to.)

When you create a custom plan for a spawn pattern, each entity spawned using that pattern executes the same plan, so you must be sure that you want all these entities to do the same thing.

In this scenario we will write a custom plan that spawns aircraft at an airport and has them take off.

1. Create a new scenario. Use the *SanLuisObispo.mtf* terrain.
2. Find the airport and zoom in on it (Figure 16).

Figure 17. San Luis Obispo airport

3. Create a route that starts on the taxiway and goes to the beginning of the runway (Figure 17).

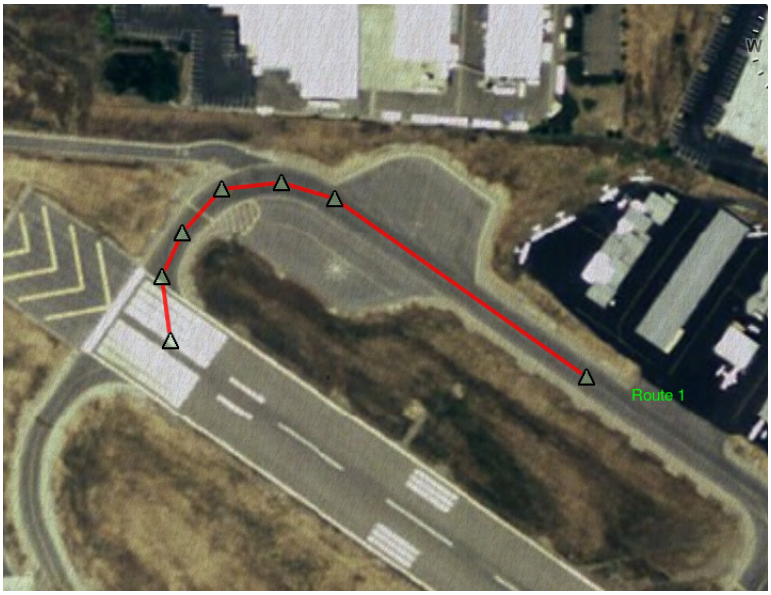


Figure 18. Runway route

4. About halfway down the runway, create a waypoint at an altitude of 300 meters (Figure 18). The planes will take off toward that point.

Figure 19. Runway and waypoint

5. Choose **B-HAVE** → **Spawn Pattern Manager**. The Spawn Pattern Manager opens (Figure 10).

6. Click New Pattern. The Create Spawn Pattern dialog box opens (Figure 13).
7. In the Name box, type Plane.
8. In the Description type, “Create airplanes and have them take off.”
9. Set Maximum Simultaneous Entities to 30.
10. Next to the Type of Entity to Create window, click Add. The Entity Type dialog box opens.
11. In the Categories list, select Fixed-Wing.
12. In the Force list, select Neutral.
13. Click Airbus 320. It is added to the list.
14. Add Boeing 707, Boeing 747-400, and Bombardier CRJ200 Air France entities to the list.
15. Set the Spawn Interval to 45 seconds.
16. Set the Spawn Interval Variance to 0.
17. In the Spawn Behavior group box, select Use Custom Plan.
18. Click Edit Plan. The Edit Custom Plan dialog box opens.
19. Add the following statements to the plan (if you are not familiar with creating plans in VR-Forces, please see the VR-Forces documentation):
    - **Task** → **Move Along Route**. Select Route 1.
    - **Task** → **Move to Waypoint**. Select Waypoint 1. (Since the point is in the air, the planes will take off towards it.)
    - **Task** → **Fly Altitude**. Set the altitude to 1000 meters. Use the default climb rate.
    - Select the top line of the plan and add a When statement, as follows:
      - When Entity Altitude, Use Self, is greater than 975 meters.
      - Delete self.

    The plan should look like Figure 19.

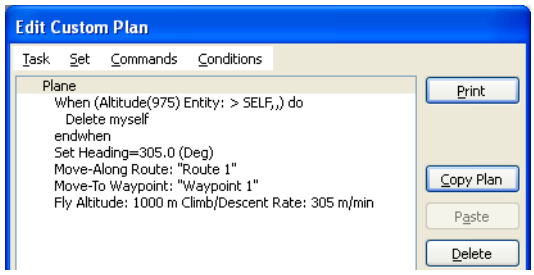


Figure 20. Custom plan

20. Click OK in the Plan window.

21. Click Create in the Create Spawn Pattern dialog box.
22. In the Spawn Pattern Manager, select the Plan pattern.
23. Click Create Spawn Points.
24. Place a spawn point near the beginning of the route (Figure 20).

Figure 21. Plane spawn point

25. Save the scenario.

Run the scenario. A new plane will be added every 45 seconds. It will taxi along the route and then take off. You might want to switch to Stealth observer mode or XR mode and watch in 3D.

Select one of the entities and open its plan window. You will see that it has the plan defined in the spawn pattern.

- The entities are spawned facing heading 0, so they have to rotate to line up with the taxiway. This does not look too good. If you want to fix this, put a Set Heading statement at the beginning of the plan and set it to 305 degrees.
- After you run the scenario, you might find that the spawn point does not quite line up with the route and the planes have to adjust their heading. If you want to fix this, move the point until it lines up. It is easier to see this in Stealth observer mode than Plan View mode.

This scenario is included with B-HAVE as B-HAVE_Demos/FirstExperienceBurst-Traffic.

5. Create Multiple Entities

Another way to quickly populate a scenario with entities is to create multiple entities at once and give them a task, set their state, or both.

1. Create a new scenario using the TerraSimSampleUrban terrain.
2. Zoom in to the high-resolution area.
3. Choose **B-HAVE** → **Create Multiple Entities**. The Create Multiple Entities dialog box opens (Figure 21).

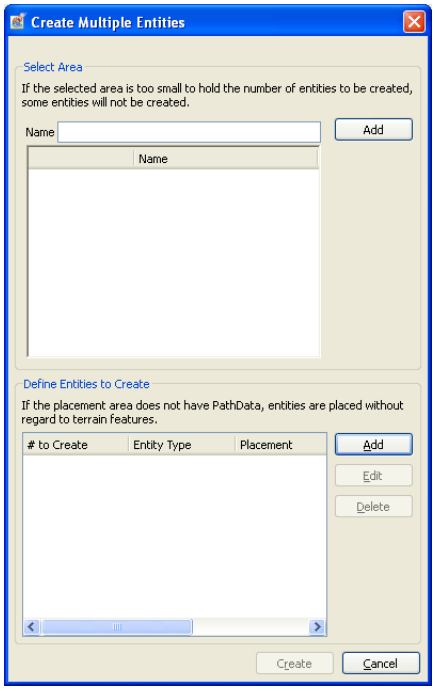


Figure 22. Create Multiple Entities dialog box

4. When you create multiple entities, you must create them in an area and this scenario does not have one yet, so in the Select Area group box, click Add. A Create Area tab is added to the window.
5. Create an area following the standard VR-Forces procedure for creating areas. The area is added to the window in the Select Area group box.
6. In the Select Area window, select the area you created.

7. In the Define Entities to Create group box, click Add. The Add Group of Entities dialog box opens (Figure 22).

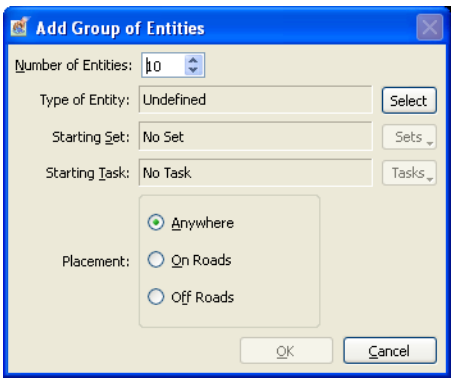


Figure 23. Add Group of Entities dialog box

8. The default number of entities to create is 10. This is fine, but you can change it if you want to.
9. Click the Select button that is next to the Type of Entity text box. The Entity Type dialog box opens. It is similar to the Entity Palette.
    a. Select the Lifeform category.
    b. Select the Neutral force.
    c. In the entity list, select Civilian Male.
10. Click the Tasks button. A list of tasks is displayed. Choose Wander. The Wander dialog box opens.
    a. Leave the Duration as Indefinitely.
    b. In the Movement group box, select Restricted to Area.
    c. Select the area you created.
    d. Click OK.
11. In the Placement group box, select Off Roads.
12. Click OK. The entity set is added to the list in the Define Entities To Create group box.
13. Click Create. The entities get created in the area.
14. Save the scenario.
15. Start the scenario. The entities will wander within the area.

6. Generate PathData

To use B-HAVE features, a terrain must have PathData. PathData is a topological model of the 3D environment that B-HAVE uses to plan the paths for entities when they move. The terrains that are shipped with VR-Forces all have PathData, which is why you are able to use B-HAVE in the previous sections of this guide without having to generate it yourself. However, the guide would not be complete if we did not give you a chance to generate it yourself.

1. When you generate PathData, you overwrite any existing PathData for the terrain. So, before you start this exercise, you should rename the PathData directory for the terrain you are going to use so that you can revert to the original PathData when you are done. Rename *./userData/terrains/Ground-db_PathData* to something else, such as *./userData/terrains/originalGround-db_PathData*.
2. If a scenario is open, close it.
3. Choose **File** → **Open Terrain**.
4. Open *Ground-db.mtf*.
5. Choose **B-HAVE** → **Generate PathData**. The PathData Generation dialog box opens and the cursor changes to a cross-hair.
6. Draw a box on the terrain similar to that in Figure 23.

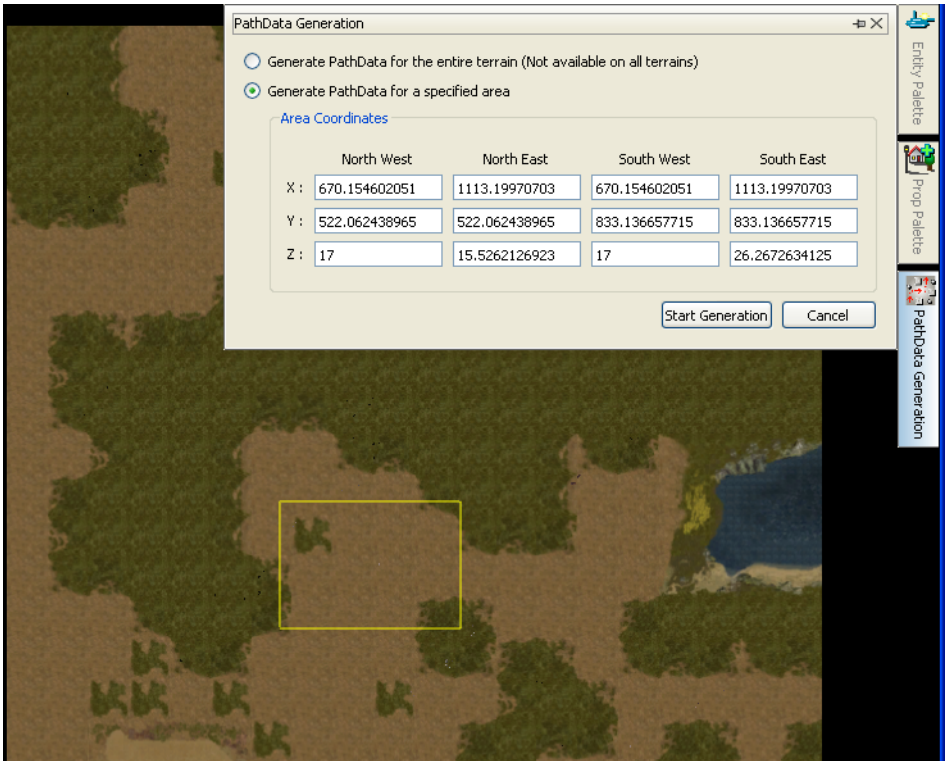


Figure 24. PathData generation box

7. Click Start Generation. An informational prompt is displayed.
8. Click OK. It will take 2-3 minutes to generate PathData for the area shown. When generation is complete, VR-Forces displays a notification prompt.
9. Choose **B-HAVE** → **Show Generated PathData** → **Lifeform**. The new PathData is displayed.
10. Zoom in to see the polygons.

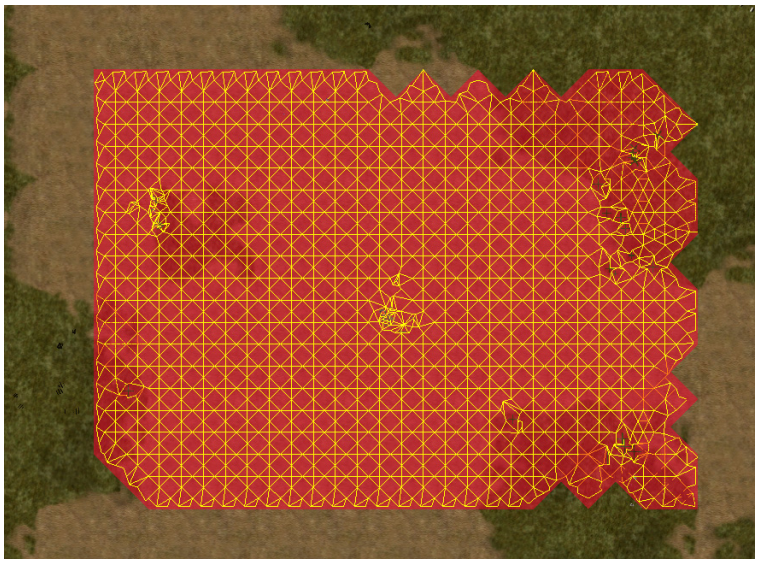


Figure 25. PathData generation box

11. Close the terrain.
12. To restore the PathData for the entire terrain, delete *./userData/terrains/Ground-db_PathData* and rename *./userData/terrains/originalGround-db_PathData* to the original name.

7. Run a Lua Script

One of the most powerful features of B-HAVE is its support for Lua scripts. Lua is a scripting language commonly used in artificial intelligence applications. B-HAVE has a library of functions that give you access to most VR-Forces tasks and set data requests and to B-HAVE features as well. You can use Lua scripts to supplement or replace the plan language in VR-Forces.

We will not ask you to do any actual scripting, but we want you to know about this feature and try out one of the supplied scripts.

1. Create a new scenario with at least three civilian entities. The only real requirement is that there is an entity named Cvln 1 and a second one named Cvln 2.
2. Select Cvln 1.
3. Choose **Set** → **B-HAVE Script**. The Set B-HAVE Lua Script dialog box opens (Figure 25).

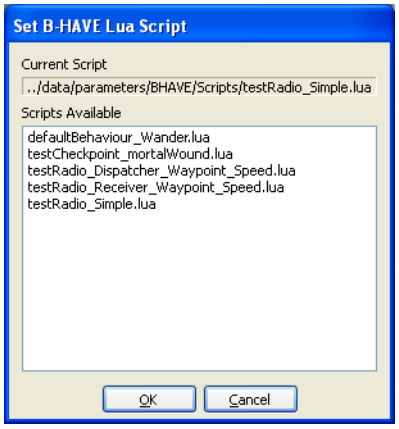


Figure 26. Set B-HAVE Lua Script dialog box

4. Select *testRadio_Simple.lua*.
5. Click OK.
6. Save the scenario.
7. Select Cvln 1 and press **`i`**. The Entity Information dialog box opens.
8. Open the Entity Information dialog boxes for Cvln2 and Cvln 3.
9. In the Entity Information dialog box for each entity, change the Notify Level to Info.
10. Run the scenario. Every ten seconds or so, Cvln 1 will send a message to its console that it is sending a message. Then it will send “Hello world” to all entities (including itself). It will also send a message only to Cvln 2. If you compare the messages received on the Cvln 2 console to Cvln 3, you can see the difference.

If you would like to look at the script that you ran to get a sense for how it works, do the following:

1. Choose **B-HAVE** → **Lua Scripts**. The B-HAVE Scripts dialog box opens (Figure 26).

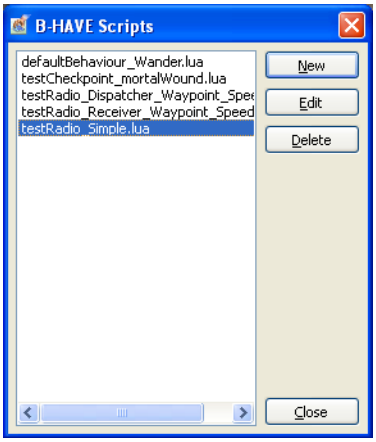


Figure 27. B-HAVE Scripts dialog box

2. Select *testRadio_Simple.lua*.
3. Click Edit. You will be prompted to do so. If you do not have a personal preference for text editors, you can select Notepad.
4. The script opens (Figure 27).

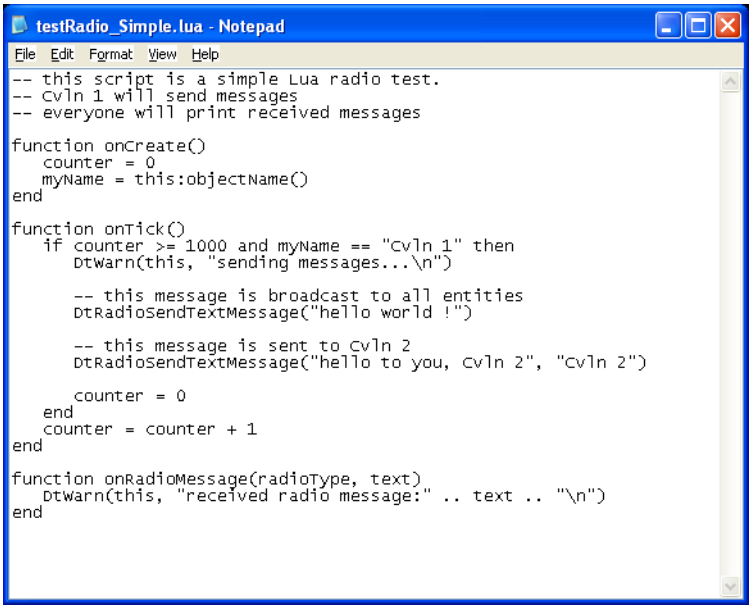


Figure 28. Lua script