CS 350 Project Part 3: System Tests and Evaluation

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Airplane Tests

Test 1: Airplane Straight-and-Level Flight

1. This test verifies that the airplane actor can fly on a constant course at a constant altitude. It is necessary for simulating moving targets.
2. An airplane is created with a speed of 10 to fly in a straight-and-level path.
3.
```
define munition bomb MUNITION_BOMB
define airplane ACTOR_AIRPLANE1 with munition
(MUNITION_BOMB)
create actor MY_AIRPLANE1 from ACTOR_AIRPLANE1 at
     49*40'30#/117*27'30#/0 with course 0 speed 10
```
4. The plane continues to fly on its path for the duration of the simulation.
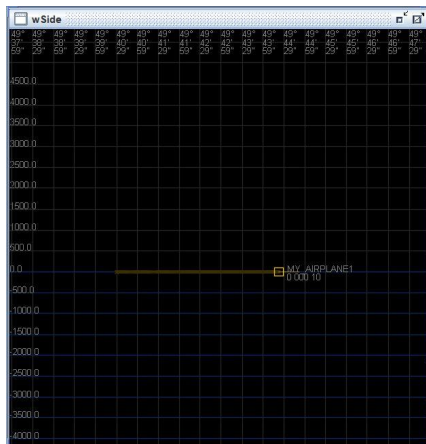
5.

6.

command	event_num	event_group	time	agent_type	agent_id	latitude	longitude	altitude	course	speed_horizontal	speed_vertical
	1	92	3.22	airplane	MY_AIRPLANE1	49.675	117.4583333	0	0	10	0
	2	93	3.255	airplane	MY_AIRPLANE1	49.67513889	117.4583333	0	0	10	0
	3	94	3.29	airplane	MY_AIRPLANE1	49.67527778	117.4583333	0	0	10	0
	4	95	3.325	airplane	MY_AIRPLANE1	49.67541667	117.4583333	0	0	10	0
	5	96	3.36	airplane	MY_AIRPLANE1	49.67555556	117.4583333	0	0	10	0
	6	97	3.395	airplane	MY_AIRPLANE1	49.67569444	117.4583333	0	0	10	0
	7	98	3.43	airplane	MY_AIRPLANE1	49.67583333	117.4583333	0	0	10	0
	8	99	3.465	airplane	MY_AIRPLANE1	49.67597222	117.4583333	0	0	10	0
	9	100	3.5	airplane	MY_AIRPLANE1	49.67611111	117.4583333	0	0	10	0
	10	101	3.535	airplane	MY_AIRPLANE1	49.67625	117.4583333	0	0	10	0

The output shows that the plane's latitude changed but the altitude remained the same

7. The actual results are consistent with the expected results.

8. A change in the course so that the plane's latitude and longitude would both change during the simulation.

Test 2: Airplane Climbing

1. This test is to confirm that a plane moving on a constant course can climb in altitude.
2. An airplane is created at sea level.
3. ```
define munition bomb MUNITION_BOMB1
define airplane ACTOR_AIRPLANE1 with munition
(MUNITION_BOMB1)

create actor MY_AIRPLANE1 from ACTOR_AIRPLANE1 at
49*39'31#/117*25'34#/0 with course 270 speed 10

@wait 5
set MY_AIRPLANE1 altitude 6000
```
4. The plan is expected to increase in altitude and stay on a constant course when the simulation is run.

5.


6.
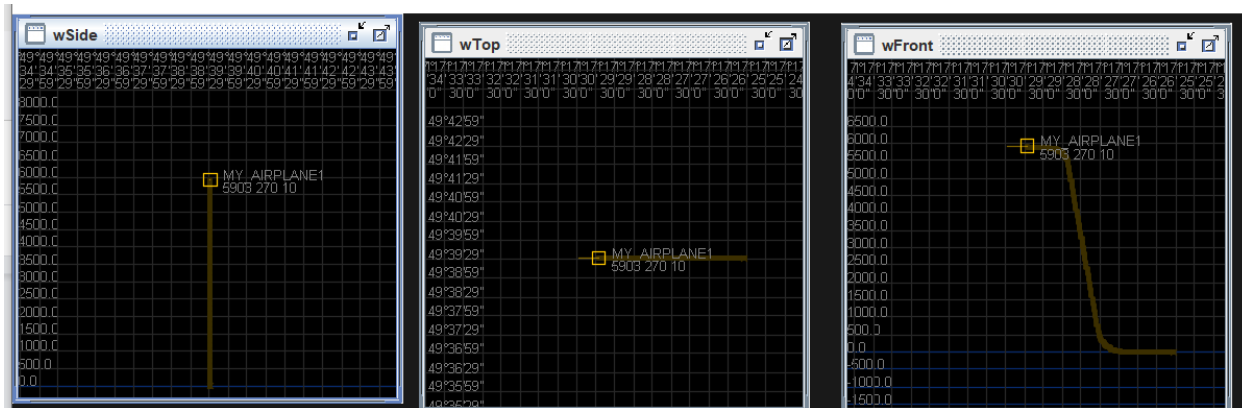
| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 209 | 978 | 34.23 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.455 | 153.384 | 270 | | 10 | 0 |
| 2 | 210 | 979 | 34.265 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4551389 | 160.039 | 270 | | 10 | 0 |
| 3 | 211 | 980 | 34.3 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4552778 | 166.96 | 270 | | 10 | 0 |
| 4 | 212 | 981 | 34.335 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4554167 | 174.159 | 270 | | 10 | 0 |
| 5 | 213 | 982 | 34.37 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4555556 | 181.645 | 270 | | 10 | 0 |
| 6 | 214 | 983 | 34.405 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4556944 | 189.431 | 270 | | 10 | 0 |
| 7 | 215 | 984 | 34.44 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4558333 | 197.528 | 270 | | 10 | 0 |
| 8 | 216 | 985 | 34.475 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4559722 | 205.949 | 270 | | 10 | 0 |
| 9 | 217 | 986 | 34.51 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4561111 | 214.707 | 270 | | 10 | 0 |
| 10 | 218 | 987 | 34.545 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.45625 | 223.816 | 270 | | 10 | 0 |
| 11 | 219 | 988 | 34.58 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4563889 | 233.288 | 270 | | 10 | 0 |
| 12 | 220 | 989 | 34.615 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4565278 | 243.14 | 270 | | 10 | 0 |
| 13 | 221 | 990 | 34.65 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4566667 | 253.385 | 270 | | 10 | 0 |
| 14 | 222 | 991 | 34.685 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4568056 | 264.041 | 270 | | 10 | 0 |
| 15 | 223 | 992 | 34.72 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4569444 | 275.122 | 270 | | 10 | 0 |
| 16 | 224 | 993 | 34.755 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4570833 | 286.647 | 270 | | 10 | 0 |
| 17 | 225 | 994 | 34.79 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4572222 | 298.633 | 270 | | 10 | 0 |
| 18 | 226 | 995 | 34.825 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4573611 | 311.099 | 270 | | 10 | 0 |
| 19 | 227 | 996 | 34.86 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4575 | 324.063 | 270 | | 10 | 0 |
| 20 | 228 | 997 | 34.895 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4576389 | 337.545 | 270 | | 10 | 0 |
| 21 | 229 | 998 | 34.93 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4577778 | 351.567 | 270 | | 10 | 0 |
| 22 | 230 | 999 | 34.965 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4579167 | 366.15 | 270 | | 10 | 0 |
| 23 | 231 | 1000 | 35 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4580556 | 381.316 | 270 | | 10 | 0 |
| 24 | 232 | 1001 | 35.035 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4581944 | 397.088 | 270 | | 10 | 0 |
| 25 | 233 | 1002 | 35.07 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4583333 | 413.492 | 270 | | 10 | 0 |
| 26 | 234 | 1003 | 35.105 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4584722 | 430.551 | 270 | | 10 | 0 |
| 27 | 235 | 1004 | 35.14 | airplane | MY_AIRPLANE1 | 49.65861111 | 117.4586111 | 448.293 | 270 | | 10 | 0 |

This screenshot shows the output. The constant change in longitude can be seen as well as the increase in altitude.

7. The actual results do not differ from the expected results.
8. This test could be expanded by having the plane decrease in altitude and increase/decrease in altitude while changing speed or direction.

## Test 3: Airplane 360-Degree Turn

1. This test is to demonstrate that a plane can make a complete circular turn, estimated by an octagonal shape
2. A plane is defined at altitude 1000, set with a 0 degree course and speed of 10
3. 
```
define munition bomb BOMB1
define airplane AIRPLANE1 with munition (BOMB1)
create actor MY_AIRPLANE1 from AIRPLANE1 at
49*39'31#/117*25'34#/1000 with course 0 speed 10
@wait 2
set MY_AIRPLANE1 course 45
@wait 2
set MY_AIRPLANE1 course 90
@wait 2
set MY_AIRPLANE1 course 135
@wait 2
set MY_AIRPLANE1 course 180
@wait 2
set MY_AIRPLANE1 course 225
@wait 2
set MY_AIRPLANE1 course 270
@wait 2
set MY_AIRPLANE1 course 315
@wait 2
set MY_AIRPLANE1 speed 0
```
4. The plane is expected to travel at the given speed for two seconds, approximately the same distance each segment, and arrive at the position it started after 7 45-degree turns and constant traveling.
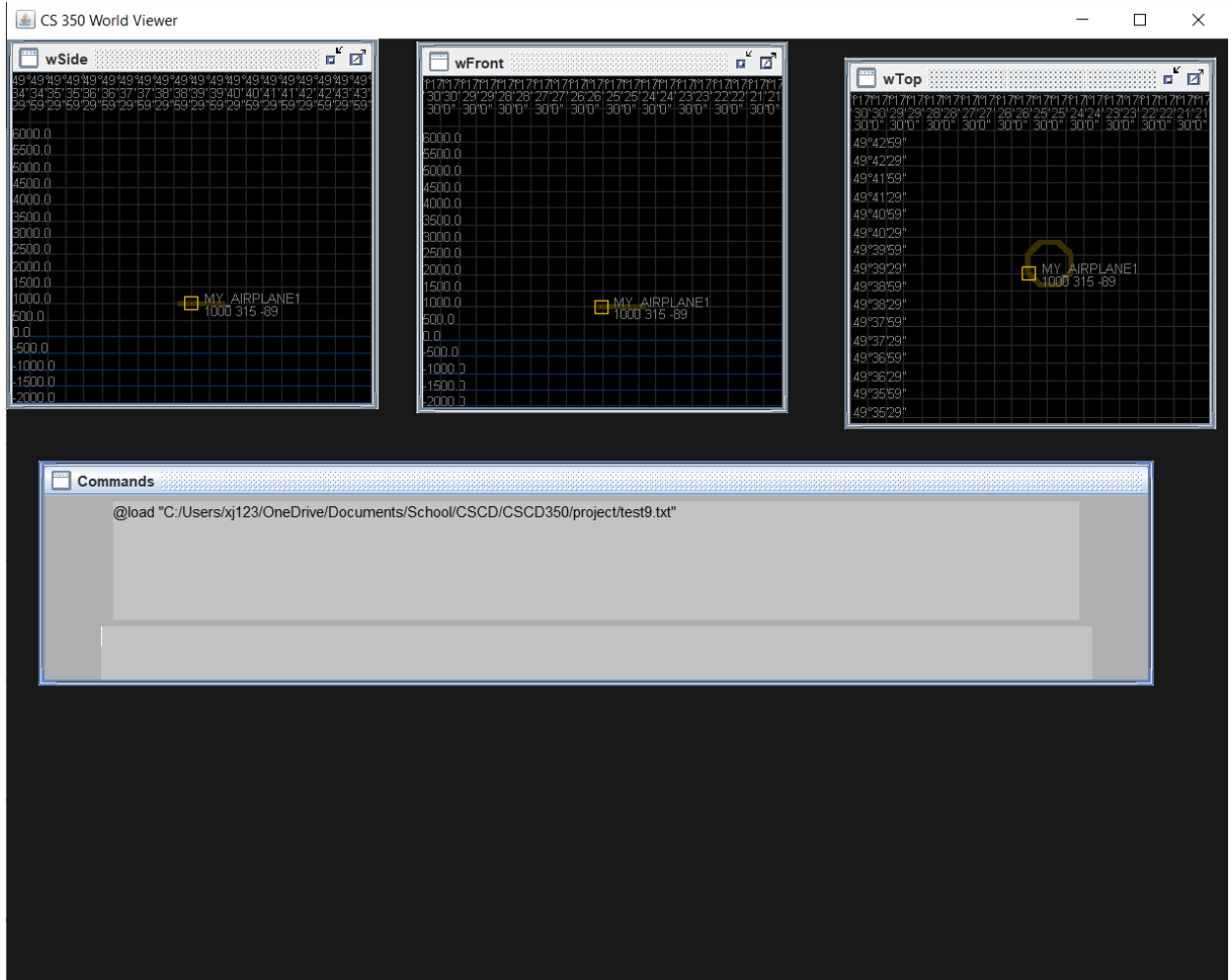
5.

| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53 | | 52 | 993 | 34.755 | airplane | MY_AIRPL | 49.66569 | 117.4261 | 1000 | 0 | 10 | 0 |
| 54 | | 53 | 994 | 34.79 | airplane | MY_AIRPL | 49.66583 | 117.4261 | 1000 | 0 | 10 | 0 |
| 55 | | 54 | 995 | 34.825 | airplane | MY_AIRPL | 49.66597 | 117.4261 | 1000 | 0 | 10 | 0 |
| 56 | | 55 | 996 | 34.86 | airplane | MY_AIRPL | 49.66611 | 117.4261 | 1000 | 0 | 10 | 0 |
| 57 | | 56 | 997 | 34.895 | airplane | MY_AIRPL | 49.66625 | 117.4261 | 1000 | 0 | 10 | 0 |
| 58 | | 57 | 998 | 34.93 | airplane | MY_AIRPL | 49.66639 | 117.4261 | 1000 | 0 | 10 | 0 |
| 59 | | 58 | 999 | 34.965 | airplane | MY_AIRPL | 49.66653 | 117.4261 | 1000 | 0 | 10 | 0 |
| 60 | course MY_AIRPLANE1 45.0 | | | | | | | | | | | |
| 61 | | 59 | 1000 | 35 | airplane | MY_AIRPL | 49.66667 | 117.4261 | 1000 | 0 | 10 | 0 |
| 62 | | 60 | 1001 | 35.035 | airplane | MY_AIRPL | 49.6668 | 117.4261 | 1000 | 10 | 10 | 0 |
| 63 | | 61 | 1002 | 35.07 | airplane | MY_AIRPL | 49.66693 | 117.426 | 1000 | 20 | 10 | 0 |
| 64 | | 62 | 1003 | 35.105 | airplane | MY_AIRPL | 49.66705 | 117.426 | 1000 | 30 | 10 | 0 |
| 65 | | 63 | 1004 | 35.14 | airplane | MY_AIRPL | 49.66717 | 117.4259 | 1000 | 35 | 10 | 0 |
| 66 | | 64 | 1005 | 35.175 | airplane | MY_AIRPL | 49.66728 | 117.4258 | 1000 | 37.5 | 10 | 0 |
| 67 | | 65 | 1006 | 35.21 | airplane | MY_AIRPL | 49.66739 | 117.4257 | 1000 | 38.75 | 10 | 0 |
| 68 | | 66 | 1007 | 35.245 | airplane | MY_AIRPL | 49.66749 | 117.4256 | 1000 | 39.375 | 10 | 0 |
| 69 | | 67 | 1008 | 35.28 | airplane | MY_AIRPL | 49.6676 | 117.4255 | 1000 | 39.875 | 10 | 0 |
| 70 | | 68 | 1009 | 35.315 | airplane | MY_AIRPL | 49.66771 | 117.4255 | 1000 | 40.375 | 10 | 0 |
| 71 | | 69 | 1010 | 35.35 | airplane | MY_AIRPL | 49.66781 | 117.4254 | 1000 | 40.875 | 10 | 0 |
| 72 | | 70 | 1011 | 35.385 | airplane | MY_AIRPL | 49.66792 | 117.4253 | 1000 | 41.375 | 10 | 0 |
| 73 | | 71 | 1012 | 35.42 | airplane | MY_AIRPL | 49.66802 | 117.4252 | 1000 | 41.875 | 10 | 0 |
| 74 | | 72 | 1013 | 35.455 | airplane | MY_AIRPL | 49.66812 | 117.4251 | 1000 | 42.375 | 10 | 0 |
| 75 | | 73 | 1014 | 35.49 | airplane | MY_AIRPL | 49.66822 | 117.425 | 1000 | 42.875 | 10 | 0 |
| 76 | | 74 | 1015 | 35.525 | airplane | MY_AIRPL | 49.66832 | 117.4249 | 1000 | 43.375 | 10 | 0 |
| 77 | | 75 | 1016 | 35.56 | airplane | MY_AIRPL | 49.66842 | 117.4248 | 1000 | 43.875 | 10 | 0 |
| 78 | | 76 | 1017 | 35.595 | airplane | MY_AIRPL | 49.66852 | 117.4247 | 1000 | 44.375 | 10 | 0 |
| 79 | | 77 | 1018 | 35.63 | airplane | MY_AIRPL | 49.66862 | 117.4246 | 1000 | 45 | 10 | 0 |
| 80 | | 78 | 1019 | 35.665 | airplane | MY_AIRPL | 49.66872 | 117.4245 | 1000 | 45 | 10 | 0 |
| 81 | | 79 | 1020 | 35.7 | airplane | MY_AIRPL | 49.66882 | 117.4244 | 1000 | 45 | 10 | 0 |
| 82 | | 80 | 1021 | 35.735 | airplane | MY_AIRPL | 49.66892 | 117.4243 | 1000 | 45 | 10 | 0 |
| 83 | | 81 | 1022 | 35.77 | airplane | MY_AIRPL | 49.66901 | 117.4242 | 1000 | 45 | 10 | 0 |
| 84 | | 82 | 1023 | 35.805 | airplane | MY_AIRPL | 49.66911 | 117.4241 | 1000 | 45 | 10 | 0 |
| 85 | | 83 | 1024 | 35.84 | airplane | MY_AIRPL | 49.66921 | 117.424 | 1000 | 45 | 10 | 0 |
| 86 | | 84 | 1025 | 35.875 | airplane | MY_AIRPL | 49.66931 | 117.4239 | 1000 | 45 | 10 | 0 |
| 87 | | 85 | 1026 | 35.91 | airplane | MY_AIRPL | 49.66941 | 117.4238 | 1000 | 45 | 10 | 0 |

6.

   a.  This snippet shows an example of the first 45-degree turn the plane makes, and its continuation on its path. This process is repeated 6 more times consistently throughout the length of the script.

7. The actual results are consistent with the expected results.
8. This test could be extended by having the plane change altitude and come back to its original altitude.

# Bomb Tests

## Test 8: Bomb Drop, High Speed

1. This test is to show the ability for an airplane to drop a bomb onto a ship while travelling at a high speed.

2. A ship is defined at sea level and an airplane is defined at an altitude of 8000, facing west and a good distance east of the ship, quickly moving west.

3. 
```
define munition bomb MUNITION_BOMB1
define airplane ACTOR_AIRPLANE1 with munition
(MUNITION_BOMB1)
define ship ACTOR_SHIP1 with munition (MUNITION_BOMB1)

create actor MY_AIRPLANE1 from ACTOR_AIRPLANE1 at
49*39'31#/116*40'1#/8000 with course 270 speed 500
create actor MY_SHIP1 from ACTOR_SHIP1 at
49*39'31#/117*25'34#/0 with course 270 speed 0

@wait 1
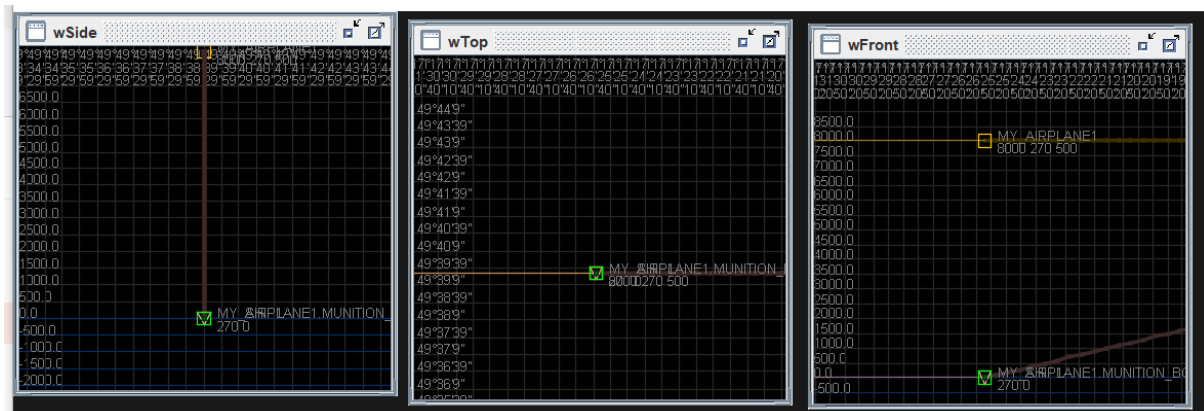set MY_AIRPLANE1 load munition MUNITION_BOMB1
set MY_AIRPLANE1 deploy munition
MY_AIRPLANE1.MUNITION_BOMB1.1
```

4. The expected behavior for this test is that the airplane launches the bomb after one second, and the bomb hits the ship.

5.



6.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 78 | 136 | 4.76 | bomb | MY_AIRPL | 49.65861 | 116.8406 | 8000 | 270 | 500 | 0 | FALSE |
| 79 | 137 | 4.795 | airplane | MY_AIRPL | 49.65861 | 116.8475 | 8000 | 270 | 500 | 0 | |
| 80 | 137 | 4.795 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 81 | 137 | 4.795 | bomb | MY_AIRPL | 49.65861 | 116.8475 | 8000 | 270 | 500 | 0 | FALSE |
| 82 | 138 | 4.83 | airplane | MY_AIRPL | 49.65861 | 116.8544 | 8000 | 270 | 500 | 0 | |
| 83 | 138 | 4.83 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 84 | 138 | 4.83 | bomb | MY_AIRPL | 49.65861 | 116.8544 | 8000 | 270 | 500 | 0 | FALSE |
| 85 | 139 | 4.865 | airplane | MY_AIRPL | 49.65861 | 116.8614 | 8000 | 270 | 500 | 0 | |
| 86 | 139 | 4.865 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 87 | 139 | 4.865 | bomb | MY_AIRPL | 49.65861 | 116.8614 | 8000 | 270 | 500 | 0 | FALSE |
| deploy MY_AIRPLANE1.MUNITION_BOMB1.1 | | | | | | | | | | |
| 88 | 140 | 4.9 | airplane | MY_AIRPL | 49.65861 | 116.8683 | 8000 | 270 | 500 | 0 | |
| 89 | 140 | 4.9 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 90 | 140 | 4.9 | bomb | MY_AIRPL | 49.65861 | 116.8683 | 8000 | 270 | 500 | 0 | TRUE |
| 91 | 141 | 4.935 | airplane | MY_AIRPL | 49.65861 | 116.8753 | 8000 | 270 | 500 | 0 | |
| 92 | 141 | 4.935 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 93 | 141 | 4.935 | bomb | MY_AIRPL | 49.65861 | 116.8753 | 7900 | 270 | 500 | 0 | TRUE |
| 94 | 142 | 4.97 | airplane | MY_AIRPL | 49.65861 | 116.8822 | 8000 | 270 | 500 | 0 | |
| 95 | 142 | 4.97 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 96 | 142 | 4.97 | bomb | MY_AIRPL | 49.65861 | 116.8822 | 7800 | 270 | 500 | 0 | TRUE |
| 97 | 143 | 5.005 | airplane | MY_AIRPL | 49.65861 | 116.8892 | 8000 | 270 | 500 | 0 | |
| 98 | 143 | 5.005 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 99 | 143 | 5.005 | bomb | MY_AIRPL | 49.65861 | 116.8892 | 7700 | 270 | 500 | 0 | TRUE |
| 100 | 144 | 5.04 | airplane | MY_AIRPL | 49.65861 | 116.8961 | 8000 | 270 | 500 | 0 | |
| 101 | 144 | 5.04 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 102 | 144 | 5.04 | bomb | MY_AIRPL | 49.65861 | 116.8961 | 7600 | 270 | 500 | 0 | TRUE |
| 103 | 145 | 5.075 | airplane | MY_AIRPL | 49.65861 | 116.9031 | 8000 | 270 | 500 | 0 | |

The above screenshot shows the airplane increasing in longitude, as well as the point when the bomb is deployed. Then it shows the increase in longitude and decrease in altitude of the bomb.

| 319 | 217 | 7.595 | airplane | MY_AIRPL | 49.65861 | 117.4031 | 8000 | 270 | 500 | 0 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 320 | 217 | 7.595 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 321 | 217 | 7.595 | bomb | MY_AIRPL | 49.65861 | 117.4031 | 300 | 270 | 500 | 0 | TRUE |
| 322 | 218 | 7.63 | airplane | MY_AIRPL | 49.65861 | 117.41 | 8000 | 270 | 500 | 0 | |
| 323 | 218 | 7.63 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 324 | 218 | 7.63 | bomb | MY_AIRPL | 49.65861 | 117.41 | 200 | 270 | 500 | 0 | TRUE |
| 325 | 219 | 7.665 | airplane | MY_AIRPL | 49.65861 | 117.4169 | 8000 | 270 | 500 | 0 | |
| 326 | 219 | 7.665 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 327 | 219 | 7.665 | bomb | MY_AIRPL | 49.65861 | 117.4169 | 100 | 270 | 500 | 0 | TRUE |
| 328 | 220 | 7.7 | airplane | MY_AIRPL | 49.65861 | 117.4239 | 8000 | 270 | 500 | 0 | |
| 329 | 220 | 7.7 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 330 | 220 | 7.7 | bomb | MY_AIRPL | 49.65861 | 117.4239 | 0 | 270 | 500 | 0 | TRUE |
| 331 | 221 | 7.735 | airplane | MY_AIRPL | 49.65861 | 117.4308 | 8000 | 270 | 500 | 0 | |
| 332 | 221 | 7.735 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 333 | 222 | 7.77 | airplane | MY_AIRPL | 49.65861 | 117.4378 | 8000 | 270 | 500 | 0 | |
| 334 | 222 | 7.77 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 335 | 223 | 7.805 | airplane | MY_AIRPL | 49.65861 | 117.4447 | 8000 | 270 | 500 | 0 | |
| 336 | 223 | 7.805 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 337 | 224 | 7.84 | airplane | MY_AIRPL | 49.65861 | 117.4517 | 8000 | 270 | 500 | 0 | |
| 338 | 224 | 7.84 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 339 | 225 | 7.875 | airplane | MY_AIRPL | 49.65861 | 117.4586 | 8000 | 270 | 500 | 0 | |
| 340 | 225 | 7.875 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 341 | 226 | 7.91 | airplane | MY_AIRPL | 49.65861 | 117.4656 | 8000 | 270 | 500 | 0 | |
| 342 | 226 | 7.91 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 0 | 270 | 0 | 0 | |
| 343 | 227 | 7.945 | airplane | MY_AIRPL | 49.65861 | 117.4725 | 8000 | 270 | 500 | 0 | |

The above screenshot shows the point in which the bomb expires at sea level. It is very close to the ship's coordinates.

7. The results for this test differed from expectations by the bomb not actually hitting the ship despite coming within 0.003 degrees longitude.
8. This test could be expanded by using a moving ship in the test and/or using different maneuvers for the plane and ship.

# Test 9: Bomb Drop, Low Speed, Hit

1. This test is to show proper ability for a moving plane to hit a ship with a bomb from a given altitude.
2. A ship is defined at sea level. An airplane is defined at an altitude of 8000, slightly behind the ship, slowly moving toward the ship. A bomb is loaded into the airplane.
3. 
```
define munition bomb BOMB1
define ship SHIP1 with munition (BOMB1)
define airplane AIRPLANE1 with munition (BOMB1)
create actor MY_AIRPLANE1 from AIRPLANE1 at
49*39'31#/117*26'34#/8000 with course 90 speed 2
create actor MY_SHIP1 from SHIP1 at 49*39'31#/117*25'34#/1
with course 90 speed 0
set MY_AIRPLANE1 load munition BOMB1
@wait 18
set MY_AIRPLANE1 deploy munition MY_AIRPLANE1.BOMB1.1
```
4. From this test I expect the airplane to launch the bomb after the specified wait, and for the bomb to hit the ship once it reaches it.
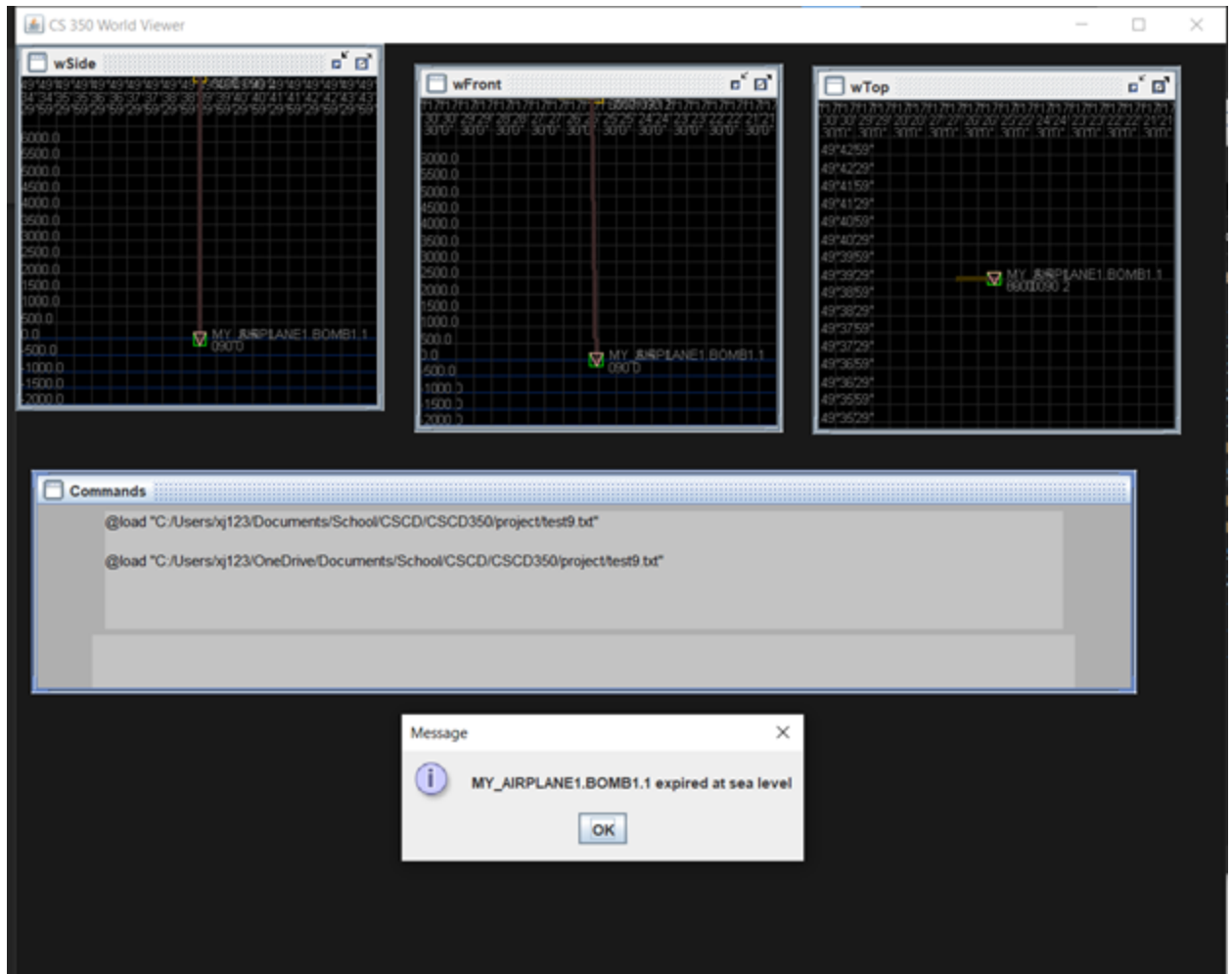
5.

| | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1770 | | 1768 | 1858 | 65.03 | airplane | MY_AIRPL | 49.65861 | 117.4264 | 8000 | 90 | 2 | 0 | |
| 1771 | | 1769 | 1858 | 65.03 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 1 | 90 | 0 | 0 | |
| 1772 | | 1770 | 1858 | 65.03 | bomb | MY_AIRPL | 49.65861 | 117.4264 | 600 | 90 | 2 | 0 | TRUE |
| 1773 | | 1771 | 1859 | 65.065 | airplane | MY_AIRPL | 49.65861 | 117.4264 | 8000 | 90 | 2 | 0 | |
| 1774 | | 1772 | 1859 | 65.065 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 1 | 90 | 0 | 0 | |
| 1775 | | 1773 | 1859 | 65.065 | bomb | MY_AIRPL | 49.65861 | 117.4264 | 500 | 90 | 2 | 0 | TRUE |
| 1776 | | 1774 | 1860 | 65.1 | airplane | MY_AIRPL | 49.65861 | 117.4264 | 8000 | 90 | 2 | 0 | |
| 1777 | | 1775 | 1860 | 65.1 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 1 | 90 | 0 | 0 | |
| 1778 | | 1776 | 1860 | 65.1 | bomb | MY_AIRPL | 49.65861 | 117.4264 | 400 | 90 | 2 | 0 | TRUE |
| 1779 | | 1777 | 1861 | 65.135 | airplane | MY_AIRPL | 49.65861 | 117.4263 | 8000 | 90 | 2 | 0 | |
| 1780 | | 1778 | 1861 | 65.135 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 1 | 90 | 0 | 0 | |
| 1781 | | 1779 | 1861 | 65.135 | bomb | MY_AIRPL | 49.65861 | 117.4263 | 300 | 90 | 2 | 0 | TRUE |
| 1782 | | 1780 | 1862 | 65.17 | airplane | MY_AIRPL | 49.65861 | 117.4263 | 8000 | 90 | 2 | 0 | |
| 1783 | | 1781 | 1862 | 65.17 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 1 | 90 | 0 | 0 | |
| 1784 | | 1782 | 1862 | 65.17 | bomb | MY_AIRPL | 49.65861 | 117.4263 | 200 | 90 | 2 | 0 | TRUE |
| 1785 | | 1783 | 1863 | 65.205 | airplane | MY_AIRPL | 49.65861 | 117.4263 | 8000 | 90 | 2 | 0 | |
| 1786 | | 1784 | 1863 | 65.205 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 1 | 90 | 0 | 0 | |
| 1787 | | 1785 | 1863 | 65.205 | bomb | MY_AIRPL | 49.65861 | 117.4263 | 100 | 90 | 2 | 0 | TRUE |
| 1788 | | 1786 | 1864 | 65.24 | airplane | MY_AIRPL | 49.65861 | 117.4263 | 8000 | 90 | 2 | 0 | |
| 1789 | | 1787 | 1864 | 65.24 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 1 | 90 | 0 | 0 | |
| 1790 | | 1788 | 1864 | 65.24 | bomb | MY_AIRPL | 49.65861 | 117.4263 | 0 | 90 | 2 | 0 | TRUE |
| 1791 | | 1789 | 1865 | 65.275 | airplane | MY_AIRPL | 49.65861 | 117.4262 | 8000 | 90 | 2 | 0 | |
| 1792 | | 1790 | 1865 | 65.275 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 1 | 90 | 0 | 0 | |
| 1793 | | 1791 | 1866 | 65.31 | airplane | MY_AIRPL | 49.65861 | 117.4262 | 8000 | 90 | 2 | 0 | |
| 1794 | | 1792 | 1866 | 65.31 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 1 | 90 | 0 | 0 | |
| 1795 | | 1793 | 1867 | 65.345 | airplane | MY_AIRPL | 49.65861 | 117.4262 | 8000 | 90 | 2 | 0 | |
| 1796 | | 1794 | 1867 | 65.345 | ship | MY_SHIP1 | 49.65861 | 117.4261 | 1 | 90 | 0 | 0 | |

6.
   a. This snippet from the output log shows the bomb approaching the target ship starting at an altitude of 600 while falling, until it reached sea level at the ship's location.
7. The results differed slightly from expectations, simply in the sense that no indication was given for the bomb hitting the ship. However, the numbers in the log file indicate that in a real-world scenario, the bomb would have indeed hit the ship (precision error of ~0.0002 in coordinates)
8. This test could be extended to test hitting a moving ship, rather than a ship with unspecified movement.

## Test 10: Bomb Drop, Low Speed, Miss

1. This test ensures that an airplane can drop a bomb from a given altitude.
2. An airplane is created at 8,000 feet, moving, and drops a bomb to sea level.
3. 
```
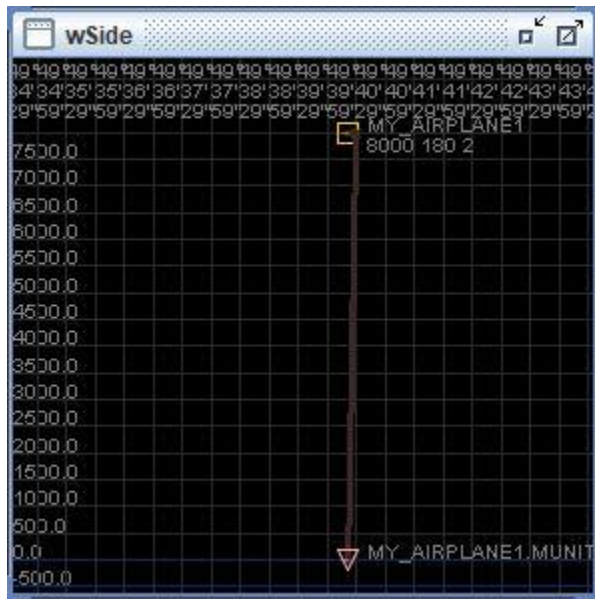define munition bomb MUNITION_BOMB

define airplane ACTOR_AIRPLANE1 with munition
(MUNITION_BOMB)
create actor MY_AIRPLANE1 from ACTOR_AIRPLANE1 at
49*40'30#/117*27'30#/8000 with course 180 speed 2

set MY_AIRPLANE1 load munition MUNITION_BOMB
```

```
set MY_AIRPLANE1 deploy munition
MY_AIRPLANE1.MUNITION_BOMB.1
```

4. `MY_AIRPLANE1` loads and deploys munition `MUNITION_BOMB`

5.

6.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	command	event_num	event_group	time	agent_type	agent_id	latitude	longitude	altitude	course	speed_horizontal	speed_vertical	deployed
2	deploy MY_AIRPLANE1.MUNITION_BOMB.1												
3		1	337	11.795	airplane	MY_AIRPLANE1	49.675	117.4583333	8000	180	2	0	
4		2	337	11.795	bomb	MY_AIRPLANE1.MUNITION_BOMB.1	49.675	117.4583333	8000	180	2	0	TRUE
5		3	338	11.83	airplane	MY_AIRPLANE1	49.67497222	117.4583333	8000	180	2	0	
6		4	338	11.83	bomb	MY_AIRPLANE1.MUNITION_BOMB.1	49.67497222	117.4583333	7900	180	2	0	TRUE
7		5	339	11.865	airplane	MY_AIRPLANE1	49.67494444	117.4583333	8000	180	2	0	
8		6	339	11.865	bomb	MY_AIRPLANE1.MUNITION_BOMB.1	49.67494444	117.4583333	7800	180	2	0	TRUE
9		7	340	11.9	airplane	MY_AIRPLANE1	49.67491667	117.4583333	8000	180	2	0	
10		8	340	11.9	bomb	MY_AIRPLANE1.MUNITION_BOMB.1	49.67491667	117.4583333	7700	180	2	0	TRUE
157		155	414	14.49	airplane	MY_AIRPLANE1	49.67286111	117.4583333	8000	180	2	0	
158		156	414	14.49	bomb	MY_AIRPLANE1.MUNITION_BOMB.1	49.67286111	117.4583333	300	180	2	0	TRUE
159		157	415	14.525	airplane	MY_AIRPLANE1	49.67283333	117.4583333	8000	180	2	0	
160		158	415	14.525	bomb	MY_AIRPLANE1.MUNITION_BOMB.1	49.67283333	117.4583333	200	180	2	0	TRUE
161		159	416	14.56	airplane	MY_AIRPLANE1	49.67280556	117.4583333	8000	180	2	0	
162		160	416	14.56	bomb	MY_AIRPLANE1.MUNITION_BOMB.1	49.67280556	117.4583333	100	180	2	0	TRUE
163		161	417	14.595	airplane	MY_AIRPLANE1	49.67277778	117.4583333	8000	180	2	0	
164		162	417	14.595	bomb	MY_AIRPLANE1.MUNITION_BOMB.1	49.67277778	117.4583333	0	180	2	0	TRUE

The output shows the bomb's altitude decreasing while the airplane continues on its trajectory

7. The actual results are consistent with the expected results.
8. Bombs could be dropped at "ground level" if not dropped over the sea.

Depth-Charge Tests

Test 11: Depth Charge, Acoustic Fuze, Hit

1. This test is to show the correct functionality of a depth charge with an acoustic fuze when it hits a submarine.
2. A ship with no speed is defined and a submarine with speed 10 is defined at depth -1190 slightly east of the ship.
3. `define sensor acoustic FUZE_ACOUSTIC1 with sensitivity 50`

```
define munition depth_charge DEPTH_CHARGE1 with fuze
FUZE_ACOUSTIC1
define ship ACTOR_SHIP1 with munition (DEPTH_CHARGE1)
define submarine ACTOR_SUB1 with munition (DEPTH_CHARGE1)

create actor MY_SHIP1 from ACTOR_SHIP1 at
49*38'30#/117*27'30#/0 with course 270 speed 0
create actor MY_SUB1 from ACTOR_SUB1 at
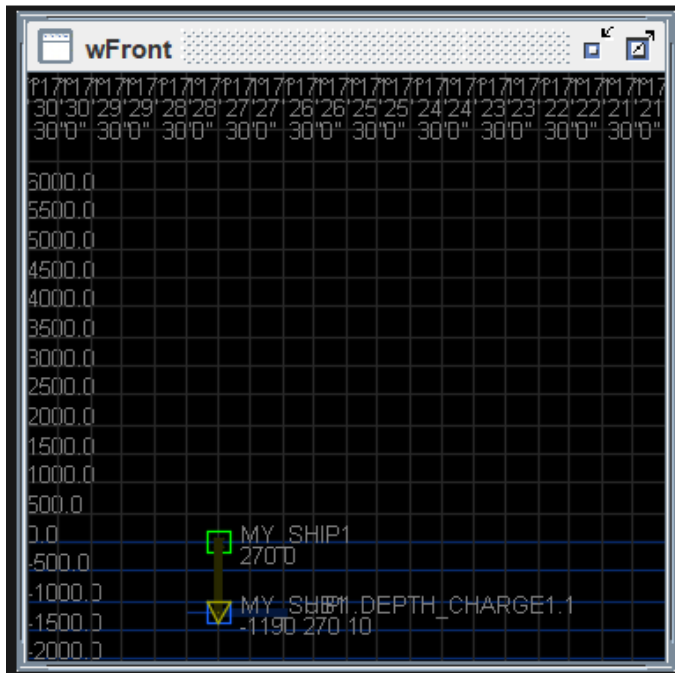49*38'30#/117*26'30#/-1190 with course 270 speed 10

set MY_SHIP1 load munition DEPTH_CHARGE1
set MY_SHIP1 deploy munition MY_SHIP1.DEPTH_CHARGE1.1
```

4. The expected behavior in this test is for the ship to drop the depth charge and for it to detonate when it comes in contact with the submarine.

5.

6.

command	event_num	event_grou	time	agent_type	agent_id	latitude	longitude	altitude	course	speed_hor	speed_ver	deployed	armed	target_id	power_rav	power_att	di
	1	493	17.255	submarine	MY_SUB1	49.64167	117.4417	-1190	270	10	0						
	2	493	17.255	ship	MY_SHIP1	49.64167	117.4583	0	270	0	0						
deploy MY_SHIP1.DEPTH_CHARGE1.1																	
	3	494	17.29	submarine	MY_SUB1	49.64167	117.4418	-1190	270	10	0						
	4	494	17.29	ship	MY_SHIP1	49.64167	117.4583	0	270	0	0						
	5	494	17.29	depth-cha	MY_SHIP1	49.64167	117.4583	0	270	0	0	TRUE					
	6	494	17.29	acoustic	MY_SHIP1	49.64167	117.4583	0	270	0	0			MY_SUB1	0	0	
	7	495	17.325	submarine	MY_SUB1	49.64167	117.4419	-1190	270	10	0						
	8	495	17.325	ship	MY_SHIP1	49.64167	117.4583	0	270	0	0						
	9	495	17.325	depth-cha	MY_SHIP1	49.64167	117.4583	-10	270	0	0	TRUE					
	10	495	17.325	acoustic	MY_SHIP1	49.64167	117.4583	-10	270	0	0			MY_SUB1	0	0	
	11	496	17.36	submarine	MY_SUB1	49.64167	117.4421	-1190	270	10	0						
	12	496	17.36	ship	MY_SHIP1	49.64167	117.4583	0	270	0	0						
	13	496	17.36	depth-cha	MY_SHIP1	49.64167	117.4583	-20	270	0	0	TRUE					
	14	496	17.36	acoustic	MY_SHIP1	49.64167	117.4583	-20	270	0	0			MY_SUB1	0	0	
	15	497	17.395	submarine	MY_SUB1	49.64167	117.4422	-1190	270	10	0						
	16	497	17.395	ship	MY_SHIP1	49.64167	117.4583	0	270	0	0						
	17	497	17.395	depth-cha	MY_SHIP1	49.64167	117.4583	-30	270	0	0	TRUE					

The above screenshot shows the submarine increasing in longitude, and the depth charge being deployed.

474	611	21.385	acoustic	MY_SHIP1	49.64167	117.4583	-1170	270	0	0		MY_SUB1	0	0
475	612	21.42	submarine	MY_SUB1	49.64167	117.4582	-1190	270	10	0				
476	612	21.42	ship	MY_SHIP1	49.64167	117.4583	0	270	0	0				
477	612	21.42	depth-cha	MY_SHIP1	49.64167	117.4583	-1180	270	0	0	TRUE			
478	612	21.42	acoustic	MY_SHIP1	49.64167	117.4583	-1180	270	0	0		MY_SUB1	0	0
479	613	21.455	submarine	MY_SUB1	49.64167	117.4583	-1190	270	10	0				
480	613	21.455	ship	MY_SHIP1	49.64167	117.4583	0	270	0	0				
481	613	21.455	depth-cha	MY_SHIP1	49.64167	117.4583	-1190	270	0	0	TRUE			
482	614	21.49	submarine	MY_SUB1	49.64167	117.4585	-1190	270	10	0				
483	614	21.49	ship	MY_SHIP1	49.64167	117.4583	0	270	0	0				
484	615	21.525	submarine	MY_SUB1	49.64167	117.4586	-1190	270	10	0				
485	615	21.525	ship	MY_SHIP1	49.64167	117.4583	0	270	0	0				

The above screenshot shows the point in which the depth charge hits the submarine and detonates.

7. The behavior is consistent with what was expected in this test.
8. This test could be extended by using a moving ship.

Test 13: Depth Charge, Depth Fuze

1. This test is to ensure correct functionality of a depth charge, using a depth fuze for triggering.
2. A ship is set at a constant speed, equipped with a depth charge with the aforementioned conditions.

```
3. define sensor depth DEPTH1 with trigger depth -300
   define munition depth_charge CHARGE1 with fuze DEPTH1
   define ship SHIP1 with munition (CHARGE1)
   create actor MY_SHIP1 from SHIP1 at 49*39'31#/117*25'34#/0
   with course 0 speed 5
   set MY_SHIP1 load munition CHARGE1
   @wait 5
   set MY_SHIP1 deploy munition MY_SHIP1.CHARGE1.1
```

4. From this test, I expect the ship to launch the equipped depth charge after the specified wait time, and for the depth fuze to trigger at the designated depth of 300.
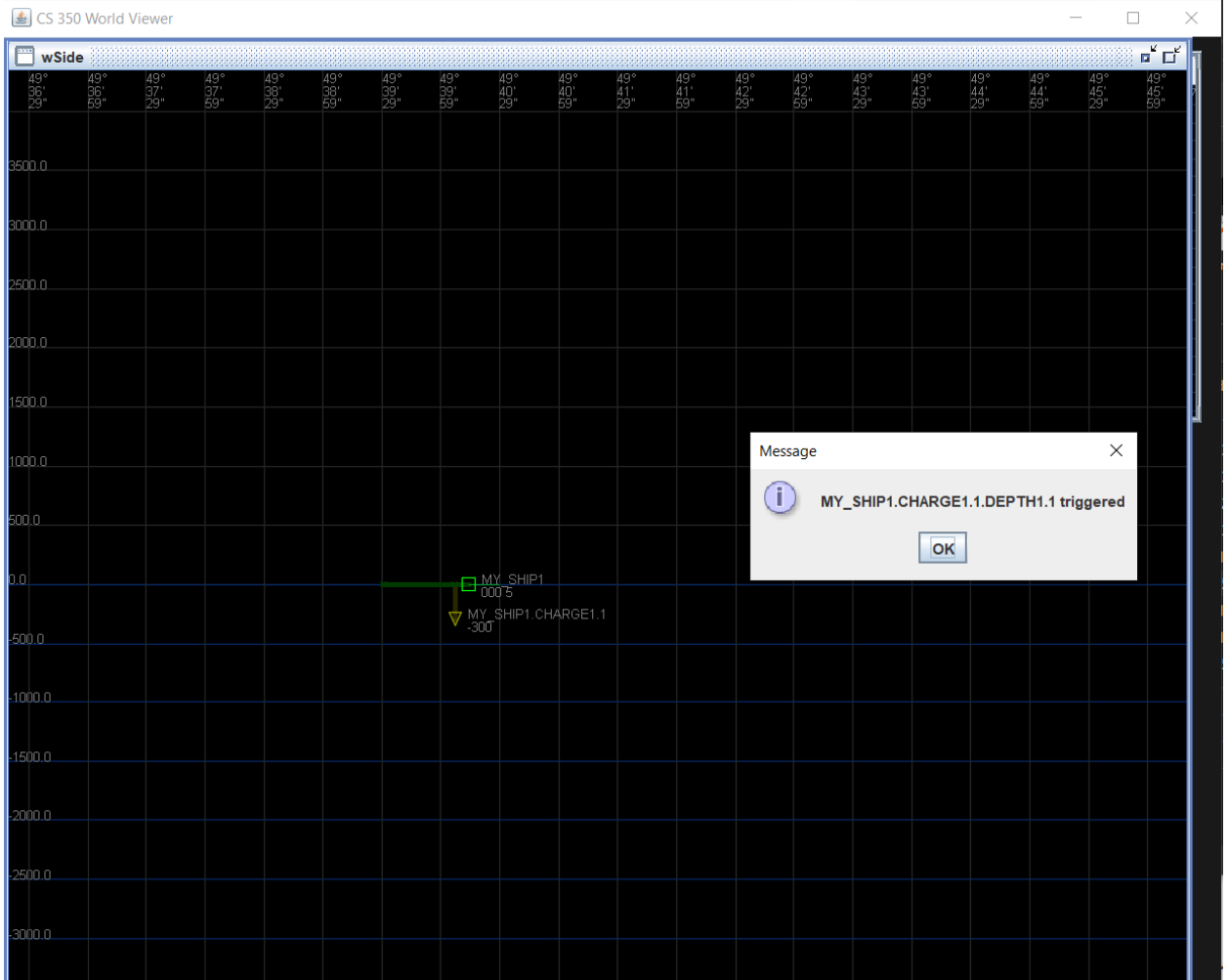
5.

	A	B	C	D	E	F	G	H	I	J	K	L	M
504		502	502	17.57	ship	MY_SHIP1	49.67021	117.4261	0	0	5	0	
505		503	502	17.57	depth-cha	MY_SHIP1	49.66861	117.4261	-240	0	0	0	TRUE
506		504	502	17.57	depth	MY_SHIP1	49.66861	117.4261	-240	0	0	0	
507		505	503	17.605	ship	MY_SHIP1	49.67028	117.4261	0	0	5	0	
508		506	503	17.605	depth-cha	MY_SHIP1	49.66861	117.4261	-250	0	0	0	TRUE
509		507	503	17.605	depth	MY_SHIP1	49.66861	117.4261	-250	0	0	0	
510		508	504	17.64	ship	MY_SHIP1	49.67035	117.4261	0	0	5	0	
511		509	504	17.64	depth-cha	MY_SHIP1	49.66861	117.4261	-260	0	0	0	TRUE
512		510	504	17.64	depth	MY_SHIP1	49.66861	117.4261	-260	0	0	0	
513		511	505	17.675	ship	MY_SHIP1	49.67042	117.4261	0	0	5	0	
514		512	505	17.675	depth-cha	MY_SHIP1	49.66861	117.4261	-270	0	0	0	TRUE
515		513	505	17.675	depth	MY_SHIP1	49.66861	117.4261	-270	0	0	0	
516		514	506	17.71	ship	MY_SHIP1	49.67049	117.4261	0	0	5	0	
517		515	506	17.71	depth-cha	MY_SHIP1	49.66861	117.4261	-280	0	0	0	TRUE
518		516	506	17.71	depth	MY_SHIP1	49.66861	117.4261	-280	0	0	0	
519		517	507	17.745	ship	MY_SHIP1	49.67056	117.4261	0	0	5	0	
520		518	507	17.745	depth-cha	MY_SHIP1	49.66861	117.4261	-290	0	0	0	TRUE
521		519	507	17.745	depth	MY_SHIP1	49.66861	117.4261	-290	0	0	0	
522		520	508	17.78	ship	MY_SHIP1	49.67062	117.4261	0	0	5	0	
523		521	508	17.78	depth-cha	MY_SHIP1	49.66861	117.4261	-300	0	0	0	TRUE
524		522	509	17.815	ship	MY_SHIP1	49.67069	117.4261	0	0	5	0	
525		523	510	17.85	ship	MY_SHIP1	49.67076	117.4261	0	0	5	0	
526		524	511	17.885	ship	MY_SHIP1	49.67083	117.4261	0	0	5	0	
527		525	512	17.92	ship	MY_SHIP1	49.6709	117.4261	0	0	5	0	
528		526	513	17.955	ship	MY_SHIP1	49.67097	117.4261	0	0	5	0	
529		527	514	17.99	ship	MY_SHIP1	49.67104	117.4261	0	0	5	0	
530		528	515	18.025	ship	MY SHIP1	49.67111	117.4261	0	0	5	0	

6.
   a. The log snippet shows the depth charge sinking at a constant rate until it hits the desired depth where the fuze then triggers.
7. The test is consistent with expectations
8. A way to expand this test could be to attempt to hit a target submarine whose depth has been estimated.

Test 15: Depth Charge, Time Fuze

1. This test ensures that a depth fuze will detonate after a defined amount of time.
2. A ship drops a depth charge which detonates after 5 seconds.
3.
```
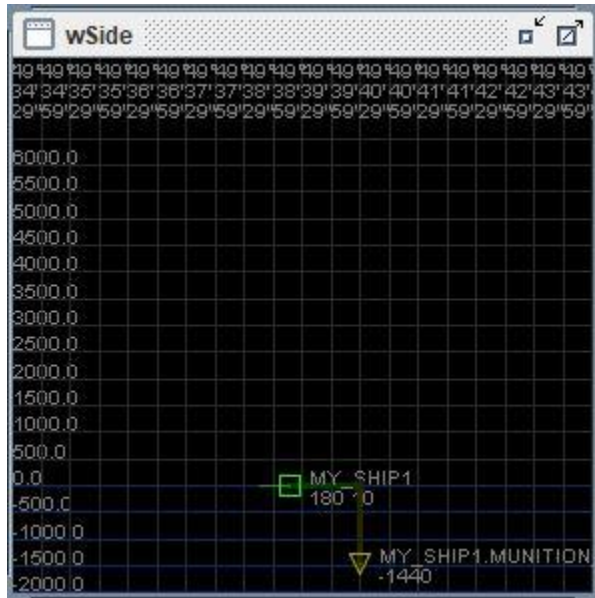define sensor time FUZE_TIME with trigger time 5
define munition depth_charge MUNITION_DEPTH_CHARGE with
fuze FUZE_TIME

define ship ACTOR_SHIP1 with munition
(MUNITION_DEPTH_CHARGE)
create actor MY_SHIP1 from ACTOR_SHIP1 at
49*40'30#/117*27'30#/0 with course 180 speed 10

set MY_SHIP1 load munition MUNITION_DEPTH_CHARGE
set MY_SHIP1 deploy munition
MY_SHIP1.MUNITION_DEPTH_CHARGE.1
```

4. After setting FUZE_TIME's trigger time to 5 seconds, MY_SHIP1 loads and deploys munition MUNITION_DEPTH_CHARGE

5.

6.

command	event_num	event_group	time	agent_type	agent_id	latitude	longitude	altitude	course	speed_horizontal	speed_vertical	deployed	time_elapsed
	1	1094	38.29	ship	MY_SHIP1		49.675	117.4583333	0	180	10	0	
deploy MY_SHIP1.MUNITION_DEPTH_CHARGE.1													
	2	1095	38.325	ship	MY_SHIP1	49.67486111	117.4583333	0	180	10	0	
	3	1095	38.325	depth-charge	MY_SHIP1.MUNITION_DEPTH_CHARGE.1	49.675	117.4583333	0	180	0	0	TRUE	
	4	1095	38.325	time	MY_SHIP1.MUNITION_DEPTH_CHARGE.1.FUZE_TIME.1	49.675	117.4583333	0	180	0	0		0
	5	1096	38.36	ship	MY_SHIP1	49.67472222	117.4583333	0	180	10	0	
	6	1096	38.36	depth-charge	MY_SHIP1.MUNITION_DEPTH_CHARGE.1	49.675	117.4583333	-10	180	0	0	TRUE	
	7	1096	38.36	time	MY_SHIP1.MUNITION_DEPTH_CHARGE.1.FUZE_TIME.1	49.675	117.4583333	-10	180	0	0		0.035
	8	1097	38.395	ship	MY_SHIP1	49.67458333	117.4583333	0	180	10	0	
	9	1097	38.395	depth-charge	MY_SHIP1.MUNITION_DEPTH_CHARGE.1	49.675	117.4583333	-20	180	0	0	TRUE	
	10	1097	38.395	time	MY_SHIP1.MUNITION_DEPTH_CHARGE.1.FUZE_TIME.1	49.675	117.4583333	-20	180	0	0		0.07
	11	1098	38.43	ship	MY_SHIP1	49.67444444	117.4583333	0	180	10	0	
	12	1098	38.43	depth-charge	MY_SHIP1.MUNITION_DEPTH_CHARGE.1	49.675	117.4583333	-30	180	0	0	TRUE	
	13	1098	38.43	time	MY_SHIP1.MUNITION_DEPTH_CHARGE.1.FUZE_TIME.1	49.675	117.4583333	-30	180	0	0		0.105
	424	1235	43.225	time	MY_SHIP1.MUNITION_DEPTH_CHARGE.1.FUZE_TIME.1	49.675	117.4583333	-1400	180	0	0		4.9
	425	1236	43.26	ship	MY_SHIP1	49.65527778	117.4583333	0	180	10	0	
	426	1236	43.26	depth-charge	MY_SHIP1.MUNITION_DEPTH_CHARGE.1	49.675	117.4583333	-1410	180	0	0	TRUE	
	427	1236	43.26	time	MY_SHIP1.MUNITION_DEPTH_CHARGE.1.FUZE_TIME.1	49.675	117.4583333	-1410	180	0	0		4.935
	428	1237	43.295	ship	MY_SHIP1	49.65513889	117.4583333	0	180	10	0	
	429	1237	43.295	depth-charge	MY_SHIP1.MUNITION_DEPTH_CHARGE.1	49.675	117.4583333	-1420	180	0	0	TRUE	
	430	1237	43.295	time	MY_SHIP1.MUNITION_DEPTH_CHARGE.1.FUZE_TIME.1	49.675	117.4583333	-1420	180	0	0		4.97
	431	1238	43.33	ship	MY_SHIP1	49.655	117.4583333	0	180	10	0	
	432	1238	43.33	depth-charge	MY_SHIP1.MUNITION_DEPTH_CHARGE.1	49.675	117.4583333	-1430	180	0	0	TRUE	
	433	1238	43.33	time	MY_SHIP1.MUNITION_DEPTH_CHARGE.1.FUZE_TIME.1	49.675	117.4583333	-1430	180	0	0		5.005
	434	1239	43.365	ship	MY_SHIP1	49.65486111	117.4583333	0	180	10	0	
	435	1239	43.365	depth-charge	MY_SHIP1.MUNITION_DEPTH_CHARGE.1	49.675	117.4583333	-1440	180	0	0	TRUE	

The output shows the charge's altitude decreasing while also incrementing time. When it reaches 5 seconds, it detonates.

7. The actual results are consistent with the expected results.
8. Timed fuze could be tested in proximity to a submarine.

Missile Tests

Test 16: Missile, Radar Sensor, Depth Fuze

1. This test is to show the behavior of a missile with a radar sensor and depth/altitude fuze.
2. There is an airplane with speed 10 and altitude 100 facing west with a ship with no speed facing west at sea level. They start at the same coordinates.

3. ```
   define sensor radar SENSOR_RADAR with field of view 50
   power 50 sensitivity 10
   define sensor depth SENSOR_DEPTH with trigger depth 1000
   define munition missile MUNITION_MISSILE1 with sensor
   SENSOR_RADAR fuze SENSOR_DEPTH arming distance 0.5
   define ship ACTOR_SHIP1 with munition (MUNITION_MISSILE1)
   define airplane ACTOR_AIRPLANE1 with munition
   (MUNITION_MISSILE1)

   create actor MY_SHIP1 from ACTOR_SHIP1 at
   49*38'30#/117*26'30#/0 with course 270 speed 0
   create actor MY_PLANE1 from ACTOR_AIRPLANE1 at
   49*38'30#/117*26'30#/100 with course 270 speed 10

   set MY_SHIP1 load munition MUNITION_MISSILE1
   @wait 3
   set MY_SHIP1 deploy munition MY_SHIP1.MUNITION_MISSILE1.1
   ```
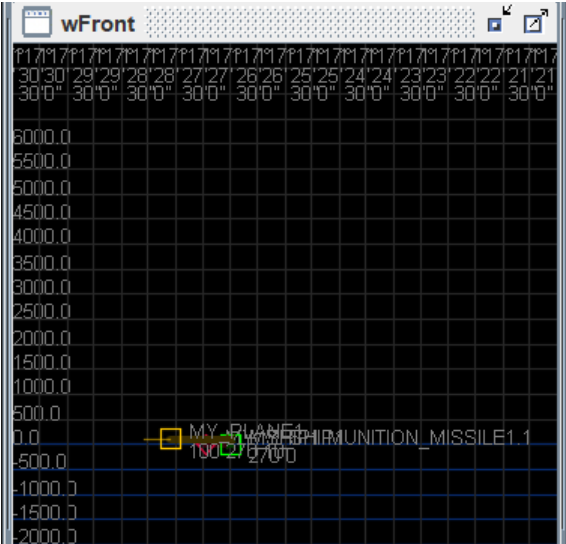4. The ship should deploy the missile, which should then hit the airplane.

5.

6.

646	817	28.595 ship	MY_SHIP1	49.64167	117.4417	0	270	0	0			
647	817	28.595 airplane	MY_PLANI	49.64167	117.4596	100	270	10	0			
648	817	28.595 missile	MY_SHIP1	49.64167	117.4487	0	270	4	0	TRUE	FALSE	
649	817	28.595 depth	MY_SHIP1	49.64167	117.4487	0	270	4	0			
650	817	28.595 radar	MY_SHIP1	49.64167	117.4487	0	270	4	0			0	0
651	818	28.63 ship	MY_SHIP1	49.64167	117.4417	0	270	0	0			
652	818	28.63 airplane	MY_PLANI	49.64167	117.4597	100	270	10	0			
653	818	28.63 missile	MY_SHIP1	49.64167	117.4488	0	270	4	0	TRUE	FALSE	
654	818	28.63 depth	MY_SHIP1	49.64167	117.4488	0	270	4	0			
655	818	28.63 radar	MY_SHIP1	49.64167	117.4488	0	270	4	0			0	0
656	819	28.665 ship	MY_SHIP1	49.64167	117.4417	0	270	0	0			
657	819	28.665 airplane	MY_PLANI	49.64167	117.4599	100	270	10	0			
658	819	28.665 missile	MY_SHIP1	49.64167	117.449	0	270	4	0	TRUE	TRUE	
659	820	28.7 ship	MY_SHIP1	49.64167	117.4417	0	270	0	0			
660	820	28.7 airplane	MY_PLANI	49.64167	117.46	100	270	10	0			
661	821	28.735 ship	MY_SHIP1	49.64167	117.4417	0	270	0	0			
662	821	28.735 airplane	MY_PLANI	49.64167	117.4601	100	270	10	0			

The above screenshot shows the point when the missile hits the submarine and detonates.

7. The actual results do not differ from the expected results.
8. This test could be extended by using a moving ship or a more complicated movement pattern for the airplane.

Test 20: Missile, Radar Sensor, Time Fuze

1. This test ensures that a missile detonates after a set amount of time.
2. An airplane with an altitude of 100 and a ship at sea level.
3. ```
define sensor radar FUZE_RADAR with field of view 30 power
50 sensitivity 10
define sensor time FUZE_TIME with trigger time 5
define munition missile MUNITION_MISSILE with sensor
FUZE_RADAR fuze FUZE_TIME arming distance 0.5

define ship ACTOR_SHIP with munition (MUNITION_MISSILE)
define airplane ACTOR_AIRPLANE with munition
(MUNITION_MISSILE)
create actor MY_SHIP1 from ACTOR_SHIP at
49*40'30#/117*27'30#/0 with course 180 speed 0
create actor MY_AIRPLANE1 from ACTOR_AIRPLANE at
49*39'3#/117*27'30#/100 with course 180 speed 0

set MY_SHIP1 load munition MUNITION_MISSILE
set MY_SHIP1 deploy munition MY_SHIP1.MUNITION_MISSILE.1
```
4. After setting FUZE_TIME's trigger time to 5 seconds, MY_SHIP1 loads and deploys munition MUNITION_MISSILE towards MY_AIRPLANE1



5.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | command | event_num | event_group | time | agent_type | agent_id | latitude | longitude | altitude | course | speed_horizontal | speed_vertical | deployed | armed | time_elapsed |
| 2 | deploy MY_SHIP1.MUNITION_MISSILE.1 | | | | | | | | | | | | | | |
| 3 | | 1 | 925 | 32.375 | airplane | MY_AIRPLANE1 | 49.6508333 | 117.458333 | 100 | 180 | 0 | 0 | | | |
| 4 | | 2 | 925 | 32.375 | ship | MY_SHIP1 | 49.675 | 117.458333 | 0 | 180 | 0 | 0 | | | |
| 5 | | 3 | 925 | 32.375 | missile | MY_SHIP1.MUNITION_MISSILE.1 | 49.675 | 117.458333 | 0 | 180 | 0 | 0 | TRUE | FALSE | |
| 6 | | 4 | 925 | 32.375 | time | MY_SHIP1.MUNITION_MISSILE.1.FUZE_TIME.2 | 49.675 | 117.458333 | 0 | 180 | 0 | 0 | | | 0 |
| 7 | | 5 | 925 | 32.375 | radar | MY_SHIP1.MUNITION_MISSILE.1.FUZE_RADAR.1 | 49.675 | 117.458333 | 0 | 180 | 0 | 0 | | | |
| 8 | | 6 | 926 | 32.41 | airplane | MY_AIRPLANE1 | 49.6508333 | 117.458333 | 100 | 180 | 0 | 0 | | | |
| 9 | | 7 | 926 | 32.41 | ship | MY_SHIP1 | 49.675 | 117.458333 | 0 | 180 | 0 | 0 | | | |
| 10 | | 8 | 926 | 32.41 | missile | MY_SHIP1.MUNITION_MISSILE.1 | 49.675 | 117.458333 | 0 | 180 | 4 | 0 | TRUE | FALSE | |
| 11 | | 9 | 926 | 32.41 | time | MY_SHIP1.MUNITION_MISSILE.1.FUZE_TIME.2 | 49.675 | 117.458333 | 0 | 180 | 4 | 0 | | | 0.035 |
| 12 | | 10 | 926 | 32.41 | radar | MY_SHIP1.MUNITION_MISSILE.1.FUZE_RADAR.1 | 49.675 | 117.458333 | 0 | 180 | 4 | 0 | | | |
| 13 | | 11 | 927 | 32.445 | airplane | MY_AIRPLANE1 | 49.6508333 | 117.458333 | 100 | 180 | 0 | 0 | | | |
| 14 | | 12 | 927 | 32.445 | ship | MY_SHIP1 | 49.675 | 117.458333 | 0 | 180 | 0 | 0 | | | |
| 715 | | 713 | 1067 | 37.345 | missile | MY_SHIP1.MUNITION_MISSILE.1 | 49.6515 | 117.458333 | 0 | 180 | 4 | 0 | TRUE | TRUE | |
| 716 | | 714 | 1067 | 37.345 | time | MY_SHIP1.MUNITION_MISSILE.1.FUZE_TIME.2 | 49.6515 | 117.458333 | 0 | 180 | 4 | 0 | | | 4.97 |
| 717 | | 715 | 1067 | 37.345 | radar | MY_SHIP1.MUNITION_MISSILE.1.FUZE_RADAR.1 | 49.6515 | 117.458333 | 0 | 180 | 4 | 0 | | | |
| 718 | | 716 | 1068 | 37.38 | airplane | MY_AIRPLANE1 | 49.6508333 | 117.458333 | 100 | 180 | 0 | 0 | | | |
| 719 | | 717 | 1068 | 37.38 | ship | MY_SHIP1 | 49.675 | 117.458333 | 0 | 180 | 0 | 0 | | | |
| 720 | | 718 | 1068 | 37.38 | missile | MY_SHIP1.MUNITION_MISSILE.1 | 49.6513333 | 117.458333 | 0 | 180 | 4 | 0 | TRUE | TRUE | |
| 721 | | 719 | 1068 | 37.38 | time | MY_SHIP1.MUNITION_MISSILE.1.FUZE_TIME.2 | 49.6513333 | 117.458333 | 0 | 180 | 4 | 0 | | | 5.005 |
| 722 | | 720 | 1068 | 37.38 | radar | MY_SHIP1.MUNITION_MISSILE.1.FUZE_RADAR.1 | 49.6513333 | 117.458333 | 0 | 180 | 4 | 0 | | | |
| 723 | | 721 | 1069 | 37.415 | airplane | MY_AIRPLANE1 | 49.6508333 | 117.458333 | 100 | 180 | 0 | 0 | | | |
| 724 | | 722 | 1069 | 37.415 | ship | MY_SHIP1 | 49.675 | 117.458333 | 0 | 180 | 0 | 0 | | | |

6.

The output shows the missile moving in latitude and after the trigger time of 5 seconds it detonates.

7. The actual results are consistent with the expected results.
8. Missile could also vary in altitude/depth.

# Test 21: Missile, Thermal Sensor, Radar Fuze

1. This test is to show correct launching capabilities of a missile, specifically armed with a thermal sensor and radar fuze.
2. An airplane at an altitude of 200 is loaded with a missile with the aforementioned conditions. A ship at sea level traveling slower in the same direction as the airplane. The airplane is approaching the ship.
3. 
```
define sensor thermal THERMAL1 with field of view 30
sensitivity 10
define sensor radar RADAR1 with field of view 30 power 10
sensitivity 10
define munition missile MISSILE1 with sensor THERMAL1 fuze
RADAR1 arming distance 10
define ship SHIP1 with munition (MISSILE1)
define airplane AIRPLANE1 with munition (MISSILE1)
create actor MY_SHIP1 from SHIP1 at 49*39'31#/117*25'34#/0
with course 180 speed 5
create actor MY_AIRPLANE1 from AIRPLANE1 at
49*34'31#/117*25'34#/200 with course 0 speed 5
set MY_AIRPLANE1 load munition MISSILE1
@wait 5
set MY_AIRPLANE1 deploy munition MY_AIRPLANE1.MISSILE1.1
```
4. From this test I expect the missile to be launched behind the ship and in the direction of the ship, and for the sensors to trigger when it comes in range of the ship.
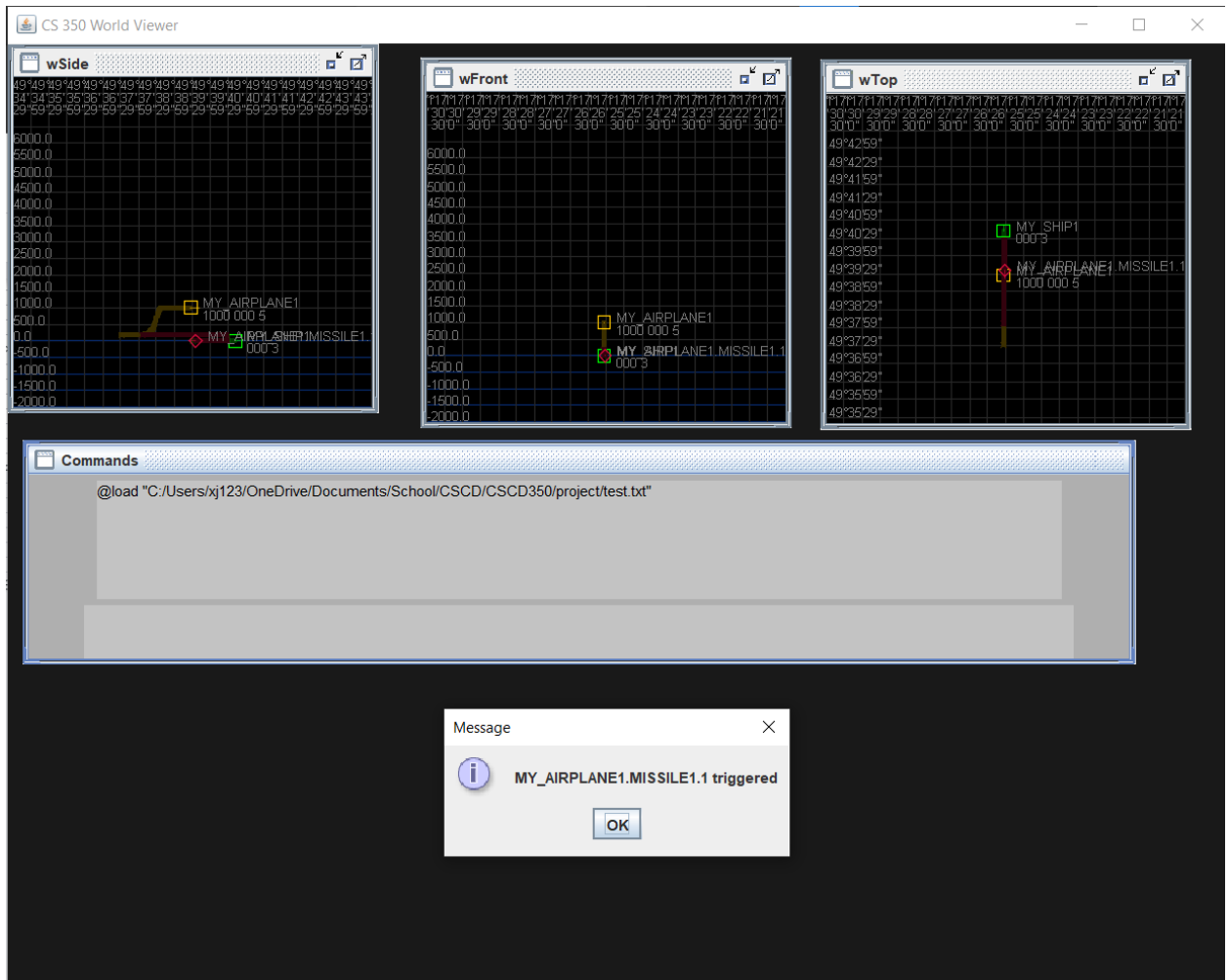
5.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1913 | | 1910 | 10779 | 377.265 | radar | MY_AIRPL | 49.67466 | 117.4257 | 0 | 120 | 4 | 0 | | | | 0 | 0 |
| 1914 | | 1911 | 10780 | 377.3 | airplane | MY_AIRPL | 49.65181 | 117.4261 | 1000 | 0 | 5 | 0 | | | | | |
| 1915 | | 1912 | 10780 | 377.3 | ship | MY_SHIP1 | 49.67453 | 117.4261 | 0 | 0 | 3 | 0 | | | | | |
| 1916 | | 1913 | 10780 | 377.3 | missile | MY_AIRPL | 49.67455 | 117.4255 | 0 | 150 | 4 | 0 | TRUE | TRUE | | | |
| 1917 | | 1914 | 10780 | 377.3 | thermal | MY_AIRPL | 49.67455 | 117.4255 | 0 | 150 | 4 | 0 | | | | 0.45 | 12.05598 |
| 1918 | | 1915 | 10780 | 377.3 | radar | MY_AIRPL | 49.67455 | 117.4255 | 0 | 150 | 4 | 0 | | | | 0 | 0 |
| 1919 | | 1916 | 10781 | 377.335 | airplane | MY_AIRPL | 49.65187 | 117.4261 | 1000 | 0 | 5 | 0 | | | | | |
| 1920 | | 1917 | 10781 | 377.335 | ship | MY_SHIP1 | 49.67457 | 117.4261 | 0 | 0 | 3 | 0 | | | | | |
| 1921 | | 1918 | 10781 | 377.335 | missile | MY_AIRPL | 49.6744 | 117.4255 | 0 | 165 | 4 | 0 | TRUE | TRUE | | | |
| 1922 | | 1919 | 10781 | 377.335 | thermal | MY_AIRPL | 49.6744 | 117.4255 | 0 | 165 | 4 | 0 | | | | 0.75 | 0.431337 |
| 1923 | | 1920 | 10781 | 377.335 | radar | MY_AIRPL | 49.6744 | 117.4255 | 0 | 165 | 4 | 0 | | | | 0.282354 | 0.162386 |
| 1924 | | 1921 | 10782 | 377.37 | airplane | MY_AIRPL | 49.65194 | 117.4261 | 1000 | 0 | 5 | 0 | | | | | |
| 1925 | | 1922 | 10782 | 377.37 | ship | MY_SHIP1 | 49.67461 | 117.4261 | 0 | 0 | 3 | 0 | | | | | |
| 1926 | | 1923 | 10782 | 377.37 | missile | MY_AIRPL | 49.67424 | 117.4254 | 0 | 172.5 | 4 | 0 | TRUE | TRUE | | | |
| 1927 | | 1924 | 10782 | 377.37 | thermal | MY_AIRPL | 49.67424 | 117.4254 | 0 | 172.5 | 4 | 0 | | | | 0.75 | 0.435748 |
| 1928 | | 1925 | 10782 | 377.37 | radar | MY_AIRPL | 49.67424 | 117.4254 | 0 | 172.5 | 4 | 0 | | | | 0.301416 | 0.175122 |
| 1929 | | 1926 | 10783 | 377.405 | airplane | MY_AIRPL | 49.65201 | 117.4261 | 1000 | 0 | 5 | 0 | | | | | |
| 1930 | | 1927 | 10783 | 377.405 | ship | MY_SHIP1 | 49.67465 | 117.4261 | 0 | 0 | 3 | 0 | | | | | |
| 1931 | | 1928 | 10783 | 377.405 | missile | MY_AIRPL | 49.67408 | 117.4254 | 0 | 176.25 | 4 | 0 | TRUE | TRUE | | | |
| 1932 | | 1929 | 10783 | 377.405 | thermal | MY_AIRPL | 49.67408 | 117.4254 | 0 | 176.25 | 4 | 0 | | | | 0.75 | 0.440322 |
| 1933 | | 1930 | 10783 | 377.405 | radar | MY_AIRPL | 49.67408 | 117.4254 | 0 | 176.25 | 4 | 0 | | | | 0.312832 | 0.183662 |
| 1934 | | 1931 | 10784 | 377.44 | airplane | MY_AIRPL | 49.65208 | 117.4261 | 1000 | 0 | 5 | 0 | | | | | |
| 1935 | | 1932 | 10784 | 377.44 | ship | MY_SHIP1 | 49.67469 | 117.4261 | 0 | 0 | 3 | 0 | | | | | |
| 1936 | | 1933 | 10784 | 377.44 | missile | MY_AIRPL | 49.67391 | 117.4254 | 0 | 178.125 | 4 | 0 | TRUE | TRUE | | | |
| 1937 | | 1934 | 10784 | 377.44 | thermal | MY_AIRPL | 49.67391 | 117.4254 | 0 | 178.125 | 4 | 0 | | | | 0.75 | 0.445013 |
| 1938 | | 1935 | 10784 | 377.44 | radar | MY_AIRPL | 49.67391 | 117.4254 | 0 | 178.125 | 4 | 0 | | | | 0.320365 | 0.190089 |
| 1939 | | 1936 | 10785 | 377.475 | airplane | MY_AIRPL | 49.65215 | 117.4261 | 1000 | 0 | 5 | 0 | | | | | |
| 1940 | | 1937 | 10785 | 377.475 | ship | MY_SHIP1 | 49.67474 | 117.4261 | 0 | 0 | 3 | 0 | | | | | |
| 1941 | | 1938 | 10785 | 377.475 | missile | MY_AIRPL | 49.67374 | 117.4254 | 0 | 179.0625 | 4 | 0 | TRUE | TRUE | | | |
| 1942 | | 1939 | 10785 | 377.475 | thermal | MY_AIRPL | 49.67374 | 117.4254 | 0 | 179.0625 | 4 | 0 | | | | 0.75 | 0.449812 |
| 1943 | | 1940 | 10785 | 377.475 | radar | MY_AIRPL | 49.67374 | 117.4254 | 0 | 179.0625 | 4 | 0 | | | | 0.325965 | 0.195497 |
| 1944 | | 1941 | 10786 | 377.51 | airplane | MY_AIRPL | 49.65222 | 117.4261 | 1000 | 0 | 5 | 0 | | | | | |
| 1945 | | 1942 | 10786 | 377.51 | ship | MY_SHIP1 | 49.67478 | 117.4261 | 0 | 0 | 3 | 0 | | | | | |
| 1946 | | 1943 | 10786 | 377.51 | missile | MY_AIRPL | 49.67358 | 117.4254 | 0 | 180 | 4 | 0 | TRUE | TRUE | | | |
| 1947 | | 1944 | 10786 | 377.51 | thermal | MY_AIRPL | 49.67358 | 117.4254 | 0 | 180 | 4 | 0 | | | | 0.75 | 0.454718 |
| 1948 | | 1945 | 10786 | 377.51 | radar | MY_AIRPL | 49.67358 | 117.4254 | 0 | 180 | 4 | 0 | | | | 0.330415 | 0.200327 |

6.
   a. The log and visual output shows very strange behavior. The missile seems to lock onto and stay with the ship, but it gets turned around, yet the sensor/fuze combo still triggers as it's leaving.
7. The results are not consistent with expectations. The strange movement and behavior of the missile is not what was expected.
8. One way to expand this test would be to attempt to have the ship attempt to dodge the trigger range of the missile.

# Torpedo Tests

## Test 26: Torpedo, Sonar Sensor, Acoustic Fuze, Slow-Target Miss

1. This test verifies that a submarine can launch a torpedo, even if it misses
2. A ship at sea level and a submarine with a depth of -100.
3. 
```
define sensor sonar active FUZE_SONAR with power 50
sensitivity 10
define sensor acoustic FUZE_ACOUSTIC with sensitivity 10
define munition torpedo MUNITION_TORPEDO with sensor
FUZE_SONAR fuze FUZE_ACOUSTIC arming time 1
```

```
define submarine ACTOR_SUBMARINE with munitions
(MUNITION_TORPEDO)
define ship ACTOR_SHIP with munitions (MUNITION_TORPEDO)
create actor MY_SUBMARINE1 from ACTOR_SUBMARINE at
49*40'30#/117*27'30#/-100 with course 75 speed 0
create actor MY_SHIP from ACTOR_SHIP at
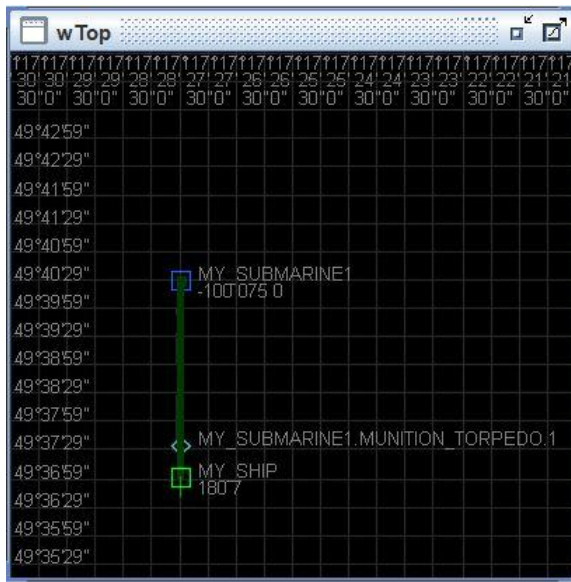49*40'30#/117*27'30#/0 with course 180 speed 7

set MY_SUBMARINE1 load munition MUNITION_TORPEDO
set MY_SUBMARINE1 deploy munition
MY_SUBMARINE1.MUNITION_TORPEDO.1
```

4. `MY_SUBMARINE1` **loads and deploys munition** `MUNITION_TORPEDO` **towards**
   `MY_SHIP1`

5.

6.

	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	event_num	event_group	time	agent_type	agent_id	latitude	longitude	altitude	course	speed_horizontal	speed_vertical	deployed	armed	target_id
2														
3	1	3948	138.18	submarine	MY_SUBMARINE1	49.675	117.4583333	-100	75	0	0			
4	2	3948	138.18	ship	MY_SHIP	49.675	117.4583333	0	180	7	0			
5	3	3948	138.18	torpedo	MY_SUBMARINE1.MUNITION_TORPEDO.1	49.675	117.4583333	-100	75	0	0	TRUE	FALSE	
6	4	3948	138.18	acoustic	MY_SUBMARINE1.MUNITION_TORPEDO.1.FUZE_ACOUSTIC.2	49.675	117.4583333	-100	75	0	0			MY_SHIP
7	5	3948	138.18	active-sonar	MY_SUBMARINE1.MUNITION_TORPEDO.1.FUZE_SONAR.1	49.675	117.4583333	-100	75	0	0			MY_SHIP
2993	2991	4546	159.11	submarine	MY_SUBMARINE1	49.61686111	117.4583333	-100	75	0	0			
2994	2992	4546	159.11	ship	MY_SHIP	49.61686111	117.4583333	0	180	7	0			
2995	2993	4546	159.11	torpedo	MY_SUBMARINE1.MUNITION_TORPEDO.1	49.62606427	117.4582867	0	171.5068352	2	0	TRUE	TRUE	
2996	2994	4546	159.11	acoustic	MY_SUBMARINE1.MUNITION_TORPEDO.1.FUZE_ACOUSTIC.2	49.62606427	117.4582867	0	171.5068352	2	0			MY_SHIP
2997	2995	4546	159.11	active-sonar	MY_SUBMARINE1.MUNITION_TORPEDO.1.FUZE_SONAR.1	49.62606427	117.4582867	0	171.5068352	2	0			

The output shows that the torpedo was launched toward the ship; however, by the end of
the output, the torpedo had never reached the ship

7. The actual results are consistent with the expected results.
8. The torpedo could have a failsafe to detonate after a set amount of time after missing,
   similar to a time fuze.

Test 27: Torpedo, Sonar Sensor, Sonar Fuze

1. This test is to test the ability for a launched torpedo with a sonar sensor/fuze to detect a fast ship.
2. A stationary submarine is equipped with the specified torpedo. A ship at speed 10 is moving perpendicular to the direction the submarine is facing.
3. ```
define sensor sonar active SONAR1 with power 10 sensitivity 10
define munition torpedo TORPEDO1 with sensor SONAR1 fuze SONAR1 arming time 10
define submarine SUBMARINE1 with munition (TORPEDO1)
define ship SHIP1 with munition (TORPEDO1)
create actor MY_SUBMARINE1 from SUBMARINE1 at 49*40'31#/117*23'34#/-1 with course 270 speed 0
create actor MY_SHIP1 from SHIP1 at 49*37'31#/117*25'34#/0 with course 0 speed 10
set MY_SUBMARINE1 load munition TORPEDO1
@wait 1
set MY_SUBMARINE1 deploy munition MY_SUBMARINE1.TORPEDO1.1
```
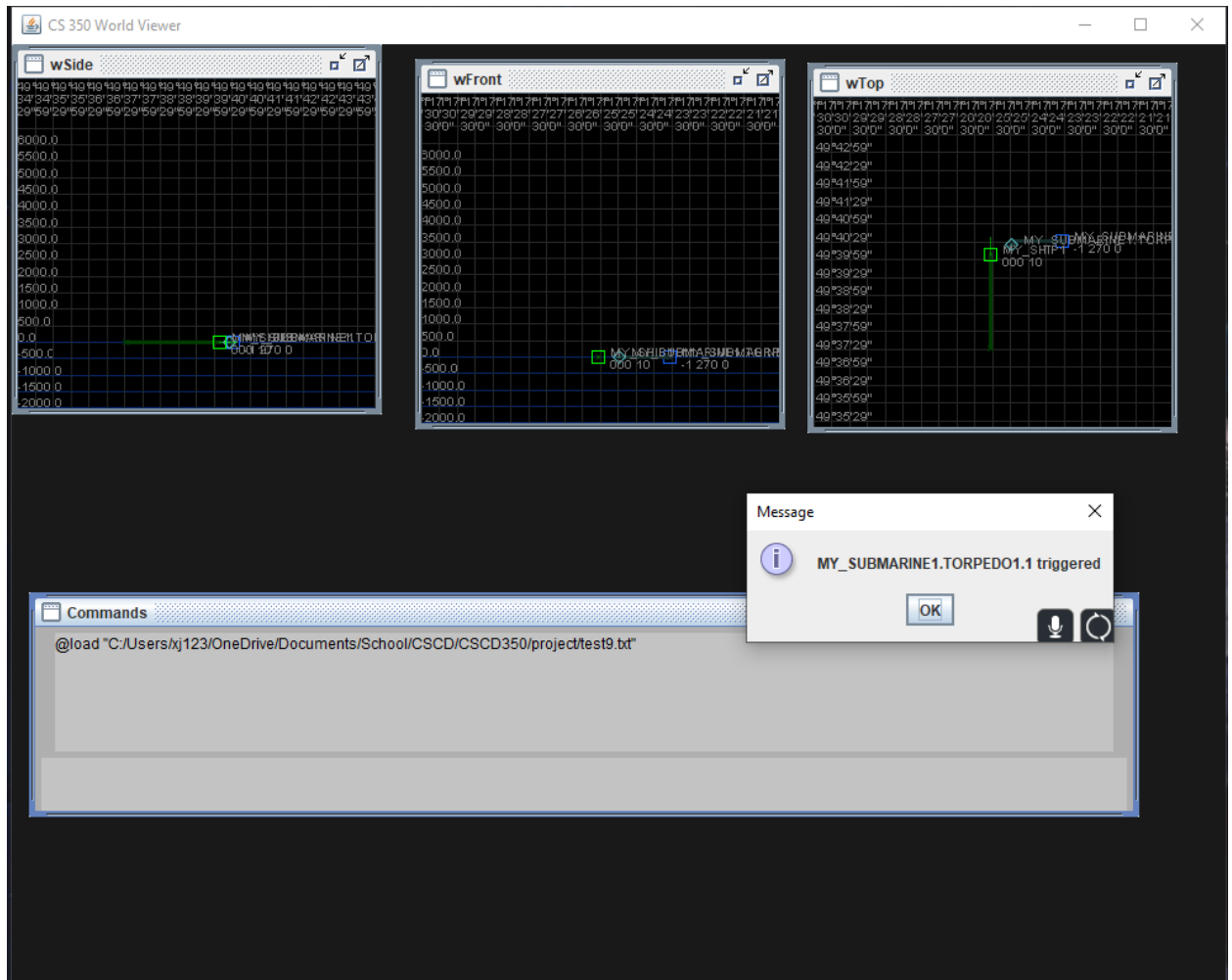4. From this test I expect the torpedo launched to be able to detect the ship and start to follow it.

5.

| 1542 | 1540 | 510 | 17.85 | active-sor | MY_SUBM | 49.67444 | 117.4156 | 0 | 237.5854 | 2 | 0 | | | MY_SHIP1 | 12.73897 | 14.19207 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1543 | 1541 | 510 | 17.85 | active-sor | MY_SUBM | 49.67444 | 117.4156 | 0 | 237.5854 | 2 | 0 | | | MY_SHIP1 | 12.73897 | 14.19207 |
| 1544 | 1542 | 511 | 17.885 | submarine | MY_SUBM | 49.67528 | 117.3928 | -1 | 270 | 0 | 0 | | | | | |
| 1545 | 1543 | 511 | 17.885 | ship | MY_SHIP1 | 49.66806 | 117.4261 | 0 | 0 | 10 | 0 | | | | | |
| 1546 | 1544 | 511 | 17.885 | torpedo | MY_SUBM | 49.67439 | 117.4157 | 0 | 238.1318 | 2 | 0 | TRUE | FALSE | | | |
| 1547 | 1545 | 511 | 17.885 | active-sor | MY_SUBM | 49.67439 | 117.4157 | 0 | 238.1318 | 2 | 0 | | | MY_SHIP1 | 12.81532 | 14.45988 |
| 1548 | 1546 | 511 | 17.885 | active-sor | MY_SUBM | 49.67439 | 117.4157 | 0 | 238.1318 | 2 | 0 | | | MY_SHIP1 | 12.81532 | 14.45988 |
| 1549 | 1547 | 512 | 17.92 | submarine | MY_SUBM | 49.67528 | 117.3928 | -1 | 270 | 0 | 0 | | | | | |
| 1550 | 1548 | 512 | 17.92 | ship | MY_SHIP1 | 49.66819 | 117.4261 | 0 | 0 | 10 | 0 | | | | | |
| 1551 | 1549 | 512 | 17.92 | torpedo | MY_SUBM | 49.67435 | 117.4158 | 0 | 238.6885 | 2 | 0 | TRUE | FALSE | | | |
| 1552 | 1550 | 512 | 17.92 | active-sor | MY_SUBM | 49.67435 | 117.4158 | 0 | 238.6885 | 2 | 0 | | | MY_SHIP1 | 12.89187 | 14.73344 |
| 1553 | 1551 | 512 | 17.92 | active-sor | MY_SUBM | 49.67435 | 117.4158 | 0 | 238.6885 | 2 | 0 | | | MY_SHIP1 | 12.89187 | 14.73344 |
| 1554 | 1552 | 513 | 17.955 | submarine | MY_SUBM | 49.67528 | 117.3928 | -1 | 270 | 0 | 0 | | | | | |
| 1555 | 1553 | 513 | 17.955 | ship | MY_SHIP1 | 49.66833 | 117.4261 | 0 | 0 | 10 | 0 | | | | | |
| 1556 | 1554 | 513 | 17.955 | torpedo | MY_SUBM | 49.67431 | 117.4158 | 0 | 239.2558 | 2 | 0 | TRUE | FALSE | | | |
| 1557 | 1555 | 513 | 17.955 | active-sor | MY_SUBM | 49.67431 | 117.4158 | 0 | 239.2558 | 2 | 0 | | | MY_SHIP1 | 12.96858 | 15.01281 |
| 1558 | 1556 | 513 | 17.955 | active-sor | MY_SUBM | 49.67431 | 117.4158 | 0 | 239.2558 | 2 | 0 | | | MY_SHIP1 | 12.96858 | 15.01281 |
| 1559 | 1557 | 514 | 17.99 | submarine | MY_SUBM | 49.67528 | 117.3928 | -1 | 270 | 0 | 0 | | | | | |
| 1560 | 1558 | 514 | 17.99 | ship | MY_SHIP1 | 49.66847 | 117.4261 | 0 | 0 | 10 | 0 | | | | | |
| 1561 | 1559 | 514 | 17.99 | torpedo | MY_SUBM | 49.67426 | 117.4159 | 0 | 239.8339 | 2 | 0 | TRUE | FALSE | | | |
| 1562 | 1560 | 514 | 17.99 | active-sor | MY_SUBM | 49.67426 | 117.4159 | 0 | 239.8339 | 2 | 0 | | | MY_SHIP1 | 13.0454 | 15.29803 |
| 1563 | 1561 | 514 | 17.99 | active-sor | MY_SUBM | 49.67426 | 117.4159 | 0 | 239.8339 | 2 | 0 | | | MY_SHIP1 | 13.0454 | 15.29803 |
| 1564 | 1562 | 515 | 18.025 | submarine | MY_SUBM | 49.67528 | 117.3928 | -1 | 270 | 0 | 0 | | | | | |
| 1565 | 1563 | 515 | 18.025 | ship | MY_SHIP1 | 49.66861 | 117.4261 | 0 | 0 | 10 | 0 | | | | | |
| 1566 | 1564 | 515 | 18.025 | torpedo | MY_SUBM | 49.67422 | 117.416 | 0 | 240.423 | 2 | 0 | TRUE | FALSE | | | |
| 1567 | 1565 | 515 | 18.025 | active-sor | MY_SUBM | 49.67422 | 117.416 | 0 | 240.423 | 2 | 0 | | | MY_SHIP1 | 13.12227 | 15.58913 |
| 1568 | 1566 | 515 | 18.025 | active-sor | MY_SUBM | 49.67422 | 117.416 | 0 | 240.423 | 2 | 0 | | | MY_SHIP1 | 13.12227 | 15.58913 |
| 1569 | 1567 | 516 | 18.06 | submarine | MY_SUBM | 49.67528 | 117.3928 | -1 | 270 | 0 | 0 | | | | | |
| 1570 | 1568 | 516 | 18.06 | ship | MY_SHIP1 | 49.66875 | 117.4261 | 0 | 0 | 10 | 0 | | | | | |
| 1571 | 1569 | 516 | 18.06 | torpedo | MY_SUBM | 49.67418 | 117.4161 | 0 | 241.0234 | 2 | 0 | TRUE | FALSE | | | |
| 1572 | 1570 | 516 | 18.06 | active-sor | MY_SUBM | 49.67418 | 117.4161 | 0 | 241.0234 | 2 | 0 | | | MY_SHIP1 | 13.19913 | 15.88614 |
| 1573 | 1571 | 516 | 18.06 | active-sor | MY_SUBM | 49.67418 | 117.4161 | 0 | 241.0234 | 2 | 0 | | | MY_SHIP1 | 13.19913 | 15.88614 |
| 1574 | 1572 | 517 | 18.095 | submarine | MY_SUBM | 49.67528 | 117.3928 | -1 | 270 | 0 | 0 | | | | | |
| 1575 | 1573 | 517 | 18.095 | ship | MY_SHIP1 | 49.66889 | 117.4261 | 0 | 0 | 10 | 0 | | | | | |
| 1576 | 1574 | 517 | 18.095 | torpedo | MY_SUBM | 49.67414 | 117.4161 | 0 | 241.6354 | 2 | 0 | TRUE | FALSE | | | |
| 1577 | 1575 | 517 | 18.095 | active-sor | MY_SUBM | 49.67414 | 117.4161 | 0 | 241.6354 | 2 | 0 | | | MY_SHIP1 | 13.27591 | 16.18906 |
| 1578 | 1576 | 517 | 18.095 | active-sor | MY_SUBM | 49.67414 | 117.4161 | 0 | 241.6354 | 2 | 0 | | | MY_SHIP1 | 13.27591 | 16.18906 |
| 1579 | 1577 | 518 | 18.13 | submarine | MY_SUBM | 49.67528 | 117.3928 | -1 | 270 | 0 | 0 | | | | | |
| 1580 | 1578 | 518 | 18.13 | ship | MY_SHIP1 | 49.66903 | 117.4261 | 0 | 0 | 10 | 0 | | | | | |
| 1581 | 1579 | 518 | 18.13 | torpedo | MY_SUBM | 49.6741 | 117.4162 | 0 | 242.259 | 2 | 0 | TRUE | TRUE | | | |

6.

    a. From the log file it can be seen that the armed variable changes to true, meaning the torpedo has successfully detected the ship. At that moment the course value of the torpedo changes slightly, indicating that its pathing has changed to follow the ship.

7. The results are consistent with the expectations.
8. A way to expand on this test would be to specify a depth that the torpedo would be launched at, to test its detection capabilities at depth as well as horizontal distance.

# Test 30: Torpedo, Acoustic Sensor, Thermal Fuze

1. This test is to show the behavior of a torpedo with an acoustic sensor and thermal fuze.
2. There is a submarine at altitude -500 with no speed, and a ship facing west at sea level with speed 5.
3. 
```
define sensor acoustic SENSOR_ACOUSTIC with sensitivity 10
define sensor thermal SENSOR_THERMAL with field of view 30
sensitivity 10
define munition torpedo MUNITION_TORPEDO1 with sensor
SENSOR_ACOUSTIC fuze SENSOR_THERMAL arming time 5
```

```
define submarine ACTOR_SUB1 with munition
(MUNITION_TORPEDO1)
define ship ACTOR_SHIP1 with munition (MUNITION_TORPEDO1)

create actor MY_SUB1 from ACTOR_SUB1 at
49*38'30#/117*26'30#/-500 with course 270 speed 0
create actor MY_SHIP1 from ACTOR_SHIP1 at
49*38'30#/117*26'30#/0 with course 270 speed 5

set MY_SUB1 load munition MUNITION_TORPEDO1
@wait 2
set MY_SUB1 deploy munition MY_SUB1.MUNITION_TORPEDO1.1
```

4. The submarine launches the torpedo at the ship, the torpedo collides with the ship and detonates.

5.

6.
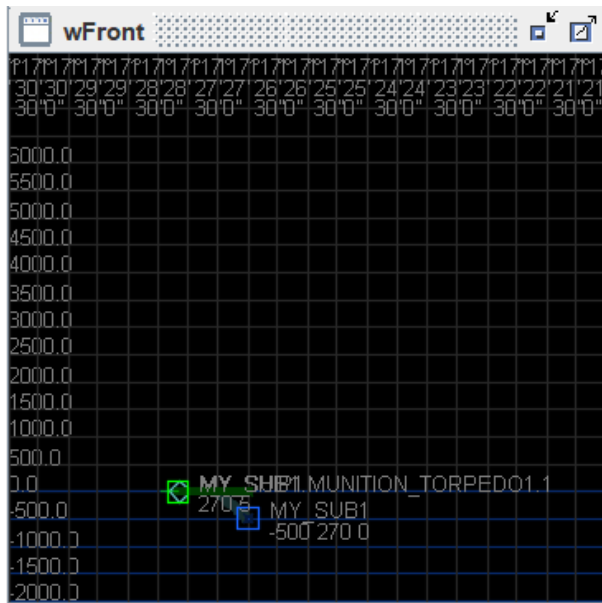
	282	448	15.68	ship	MY_SHIP1	49.64167	117.4456	0	270	5	0			
	283	448	15.68	torpedo	MY_SUB1.	49.64167	117.4417	-500	270	0	0	FALSE	FALSE	
	284	448	15.68	thermal	MY_SUB1.	49.64167	117.4417	-500	270	0	0			0.75 2.40349
	285	448	15.68	acoustic	MY_SUB1.	49.64167	117.4417	-500	270	0	0		MY_SHIP1	0.5 1.602327
	286	449	15.715	submarine	MY_SUB1	49.64167	117.4417	-500	270	0	0			
	287	449	15.715	ship	MY_SHIP1	49.64167	117.4456	0	270	5	0			
	288	449	15.715	torpedo	MY_SUB1.	49.64167	117.4417	-500	270	0	0	FALSE	FALSE	
	289	449	15.715	thermal	MY_SUB1.	49.64167	117.4417	-500	270	0	0			0.75 2.364857
	290	449	15.715	acoustic	MY_SUB1.	49.64167	117.4417	-500	270	0	0		MY_SHIP1	0.5 1.576571
deploy MY_SUB1.MUNITION_TORPEDO1.1														
	291	450	15.75	submarine	MY_SUB1	49.64167	117.4417	-500	270	0	0			
	292	450	15.75	ship	MY_SHIP1	49.64167	117.4457	0	270	5	0			
	293	450	15.75	torpedo	MY_SUB1.	49.64167	117.4417	-500	270	0	0	TRUE	FALSE	
	294	450	15.75	thermal	MY_SUB1.	49.64167	117.4417	-500	270	0	0			0.75 2.327392
	295	450	15.75	acoustic	MY_SUB1.	49.64167	117.4417	-500	270	0	0		MY_SHIP1	0.5 1.551595
	296	451	15.785	submarine	MY_SUB1	49.64167	117.4417	-500	270	0	0			
	207	451	15.785	ship	MY_SHIP1	49.64167	117.4458	0	270	5	0			

The above screenshot shows the point when the torpedo deploys.

7. The actual results do not differ from the expected results.
8. To extend this test, we could use a moving submarine.