NAME

mbm_route2mission – Macro to convert an **mbgrdviz** route file into an MBARI AUV mission script.

VERSION

Version 5.0

SYNOPSIS

mbm_route2mission **–I***routefile* [**–A***altmin/altabort[/altdesired[/altdesired2[/altdesired3]]]* **–B***behavior* **–C***missiontime* **–D***depthconstant[/depthconstant2]* **–F***forwarddistance* **–G***gpsmode* **–J***depthprofilefile* **–L***approachdepth* **–M***[sensorlist]* **–N**[*spiraldescentaltitude*] **–O***missionfile* **–P***[startlon/startlat* | *startdistance]* **–R***transmitpower/receivegain[/rangeminfraction[/pulsewidth]]* **–S***speed* **–T***starttime* **–W***waypointspacing* **–V** **–H**]

DESCRIPTION

mbm_route2mission – Macro to convert an **mbgrdviz** route file into an MBARI AUV mission script.

MBARI Autonomous Underwater Vehicles, or AUVs, are controlled using a layered behavior system that is specified using a mission script. This macro generates an MBARI AUV mission script from an **MB-System** route file such as those generated interactively using **MBgrdviz**. The output MBARI AUV mission script is named using a ".cfg" suffix. A Winfrog waypoint file (ending in ".pts") is also output which mirrors the waypoints in the input route file.

The output AUV mission script includes safety behaviors that operate throughout a mission (e.g. missionTimer sets a mission timeout duration, and depthEnvelope sets depth and altitude limits). The script also includes the sequential behaviors required to take a vehicle from the start of a mission at the surface, obtaining the initial position from GPS, descent to depth, flying to the starting waypoint, running the desired survey lines with a desired depth or altitude profile, ascent to the surface, and reacquiring positioning from GPS. For seafloor mapping surveys, sonar settings and data logging are also controlled through the mission script.

The input route file specifies a survey mission as a set of sequential waypoints, and also includes the depth profile between those waypoints. Waypoints may be ordinary, the start of a survey line, or the end of a survey line (the start and end line waypoints are generated using the survey route planning feature of **MBgrdviz**). The spacing of the depth profile points between the waypoints derives from the bathymetric grid used to generate the route.

The output mission specifies a larger number of waypoints than the input route file. The mission waypoints are generated every *waypointspacing* meters (specified with the **–W** option), and the AUV is commanded to fly at particular depths (or depth profiles) between each waypoint. By default, the AUV will be flown using a control behavior called WaypointDepth in which the commanded vehicle depth follows a linearly interpolated profile between the depth at the starting waypoint and the depth at the ending waypoint. The simpler alternative waypoint behavior specifies a single vehicle depth while flying to the next mission; as it begins each segment the vehicle will ascend or descend sharply to the desired depth and then fly level until the next waypoint is reached.

The **–A** option allows the user to set the basic vehicle altitude control. The vehicle's vertical position will be simulatneously controlled in terms of both altitude above the bottom and depth below the sea surface. The commanded depth between each waypoint is calculated by **mbm_route2mission** (using the bathymetry profiles in the input route file) to produce a vehicle altitude that is *altdesired* meters above the shallowest depth looking *forwarddistance* meters ahead. The forward looking feature allows the vehicle to be commanded to ascend prior to reaching large scarps. As the mission commences, the AUV attempts to fly at the commanded depth unless that would result in an altitude less than *altmin* meters. In that circumstance, the vehicle flies in an altitude-following mode. Thus, for consistent bottom-following, a common approach is to set *altmin* to the desired altitude and to set *altdesired* to a value slightly smaller than *altmin*. This strategy allows the look-ahead feature to bring the vehicle safely over steep rises while otherwise maintaining a constant altitude.

The **−G** option allows the user to specify that the vehicle ascend to the surface and reset positioning with GPS at the beginning and/or end of survey lines.

The **−N** option allows the user to specify that the vehicle first move to the initial survey waypoint, and then follow a spiral descent to the desired survey depth. The **−L***approachdepth* option sets the vehicle depth as it approaches the first waypoint before the spiral descent. The optional *spiraldescentaltitude* parameter sets the altitude at which the spiral descent is terminated; if **−N** is given alone then *altdesired* from the **−A** option is used. These options are used for deepwater missions in which the vehicle navigation is updated by acoustic modem during the free inertial descents.

The mission script must also allow sufficient time for the vehicle to transit from its starting point to the first waypoint in the survey mission. The **−T** and **−P** options allow the user specify the AUV starting position, the distance to the first waypoint, or the time required to reach the first waypoint.

The MBARI Mapping AUV is equipped with a 200 kHz multibeam sonar, a 2-16 kHz chirp subbottom profiler, a 110 kHz chirp sidescan, and a 410 kHz chirp sidescan. The **−M** option is used to enable these mapping sonars in the AUV mission script. If the route file contains waypoints identified as line start and line end points, the subbottom profiler (if enabled) will be turned on and off at these points. The waypoint type value can be set interactively within **mbgrdviz**.

The MBARI Benthic Imaging AUV is equipped with dual strobes and a downward pointed camera. The **−MC** option is used to enable control of the camera in the AUV mission script. If the route file contains waypoints identified as line start and line end points, the camera (if enabled) will be turned on and off at these points. The waypoint type value can be set interactively within **mbgrdviz**.

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OPTIONS

−A *altmin/altabort[/altdesired[/altdesired2[/altdesired3]]]*
Sets the AUV altitude control parameters. The missions generated by this script directly command the AUV's depth. However, the commanded depth will be overridden by the minimum altitude, or *altmin* value; the vehicle will adjust it's depth so that it does not fly any closer to the bottom than *altmin* meters. If the vehicle reaches an altitude equal to or less than *altabort* meters, then the mission will be aborted. The user may specify a desired altitude (*altdesired*) that is different than *altmin*, so that the commanded depths do not directly correspond to the minimum altitude. The user can also specify second or third desired altitude values *altdesired2 altdesired3* that are used between waypoints of type START2 and END2, or START3 and END3, respectively, as defined in **MBgrdviz** routes.

−B *behavior*
Sets the AUV behavior used to fly the mission. If *behavior* = 0, then the AUV uses the WayPoint behavior in which a single vehicle depth is specified for the approach to each waypoint. If *behavior* = 1, then the AUV uses the WayPointDepth behavior in which each mission segment has both a starting and an ending depth specified, and the vehicle is commanded to fly a depth profile that is a linear ramp between the two depths. Default: *behavior* = 1;

−C *missiontime*
Sets the maximum time allowed for the AUV mission. If the *missiontime* is exceeded, the AUV will transition to it's internal abort plan. Default: mission abort time calculated from mission parameters.

−D *depthconstant[/depthconstant2]*
Sets constant depth values that will be used between waypoints of typ START4 and END4 for *depthconstant* and START5 and END5 for *depthconstant2*. These are the waypoint types defined in **MBgrdviz** routes. While these waypoint types are active, the AUV is commanded to the specified constant depth value.

−F *forwarddistance*
The program looks *forwarddistance* m ahead for the shallowest bottom depth along the survey route, and then commands the vehicle to fly at least *altmin* above that depth.

−G *gpsmode*
Sets the frequency with which the AUV will surface between survey lines to get GPS fixes. By default, the vehicle only get GPS fixes at the surface at the beginning and end of the mission, and not surface during the mission. If *gpsmode* = 1, then the vehicle will ascend for gps fixes at the start of each survey line. If *gpsmode* = 2, then the vehicle will ascend for gps fixes at the end of each survey line. If *gpsmode* = 3, then the vehicle will ascend for gps fixes at the start and end of each survey line

−H This "help" flag cause the program to print out a description of its operation and then exit immediately.

−I *routefile*
Sets the filename of the input **mbgrdviz** route file. A route file specifies a desired survey route as a set of lines between waypoints. In addition to the waypoints, the file also includes the depth profiles along those lines.

−J *depthprofilefile*
Sets the filename of an input desired depth profile file. This is the depth profile that the vehicle should follow when flying the mission (as opposed to following the bottom at a particular altitude).

−L *approachdepth*
Sets the vehicle depth during the approach to the first waypoint when a spiral descent to depth at the first waypoint is specified using the **−N** option.

−M *[sensorlist]* This option enables control of the Mapping AUV's mapping sonars and other possible sensors. By default, the AUV mission is generated without turning on the mapping sonars. If **−M** is given alone, the multibeam, subbottom profiler, and both low and high frequency sidescan sonars will be enabled. The *sonarlist* parameter can optionally specify which sonars are enabled in addition to the multibeam (the multibeam serves as the ping timing master for all sonars, and thus must be enabled if any mapping sonars are enabled). The *sonarlist* value is made up of one or more of the following characters:

M	multibeam sonar
S	subbottom profiler (and multibeam)
L	low frequency sidescan (and multibeam)
H	high frequency sidescan (and multibeam)
B	multibeam beam (water column) data
C	benthic imaging camera and strobes

Thus, **−M***SL* will cause the multibeam, the subbottom profiler, and the low frequency sidescan to be enabled while leaving the high frequency sidescan off.

−N *spiraldescentaltitude* Sets the mission to include a shallow transit to the first waypoint followed by a spiral descent to depth to start the survey. The descent is terminated at the altitude *spiraldescentaltitude* if specified here. Otherwise, the descent is terminated at the altitude *altdesired* from the **−A** option.

–O *missionfile*
Sets the filename of the output MBARI AUV mission script.

–P *lon/lat*
This sets the expected starting position (*lon* longitude and *lat* latitude) of the Mapping AUV so that the expected time to run to the first waypoint can be estimated. If neither the **–P** or **–T** options are specified, a distance of 500 meters to the first waypoint is assumed.

–R *transmitpower/receivegain[/rangeminfraction[/pulsewidth]]*
This sets the key multibeam sonar parameters. Here *transmitpower* is the transmit power of the multibeam in dB, with a range of 0-220 dB. The multibeam receive gain has a range of 0-83 dB. The *rangeminfraction* variable sets the minimum range at which the multibeam will make bottom picks; this prevents the multibeam from picking on nearfield arrivals usually reflecting interference from other sonars. If the sonar is operating with an altitude of 50 m and *rangeminfraction* = 0.2, then the range gating minimum range will be 0.2 * 50 m = 10 m. The *pulsewidth* variable sets the multibeam sonar transmit pulse width in microseconds. Default: *transmitpower* = 220, *receivegain* = 220, *rangeminfraction* = 0.2, *pulsewidth* = 60.

–S *speed*
This sets the commanded AUV speed in meters/second. Default: *speed* = 1.5 m/s.

–T *starttime*
This sets the expected time required for the AUV to reach the first waypoint in the survey mission. If neither the **–P** or **–T** options are specified, a distance of 500 meters to the first waypoint is assumed.

–W *waypointspacing*
Sets the spacing in meters of the waypoints output to the mission script.

–V The **–V** option causes **mbm_route2mission** to print out status messages.

EXAMPLES

Suppose you are going to run the MBARI Mapping AUV on the Coaxial Segment of the Juan de Fuca Ridge. You have created a route file called Coaxial2009_1v3.rte using **mbgrdviz**. In order to create an MBARI AUV mission script for mission beginning with a spiral descent to an altitude of 50 m, followed by a survey run at a 75 m altitude, the following will suffice:

mbm_route2mission –I Coaxial2009_1v3.rte -A75/30/75 –B1 -G0 –MSL –N50 –R220/83/0.3 -O Coaxial2009_1v3.cfg -S1.5 –L30 –W100 –V

The resulting mission script has the following header:

```
# This MBARI Mapping AUV mission file has been generated
# by the MB-System program mbm_route2mission run by
# user <caress> on cpu <shepard> at <Thu Jul 30 11:36:47 PDT 2009>
#
# Mission Summary:
#    Route File:            Coaxial2009_1v3.rte
#    Mission File:          Coaxial2009_1v3.cfg
#    Distance:              79501.503455 (m)
#    Estimated Time:        57203 (s)  15.890 (hr)
#    Abort Time:            60067 (s)
#    Max battery life:      64800 (s)
#    Safety margin:         1800 (s)
#    Ascend time:           2932 (s)
#    Way Points:            44
#    Route Points:          550
#    Survey behavior:       WaypointDepth
#    Descent style:         Spiral descent
#    Mapping sonar control enabled:
```

```
#                       Multibeam enabled
#                         Multibeam receive gain:        83
#                         Multibeam transmit gain:       220
#                         Multibeam minimum range fraction: 0.3
#                       Subbottom enabled
#                       Low sidescan enabled
#                       High sidescan disabled
#
# Mission Parameters:
#     Vehicle Speed:            1.500000 (m/s) 2.915769 (knots)
#     Desired Vehicle Altitude: 75 (m)
#     Minimum Vehicle Altitude: 75 (m)
#     Abort Vehicle Altitude:   30 (m)
#     Maximum Vehicle Depth:    2525.307922 (m)
#     Abort Vehicle Depth:      2562.807922 (m)
#     Descent Vehicle Depth:    3 (m)
#     Spiral descent depth:     2324.917643 m
#     Spiral descent altitude:  50 m
#     Forward Looking Distance:  (m)
#     Waypoint Spacing:         100 (m)
#     GPS Duration:             600 (s)
#     Descend Rate:             0.417 (m/s)
#     Ascend Rate:              1 (m/s)
#     Initial descend Duration: 300 (s)
#     Setpoint Duration:        30 (s)
#
# The primary waypoints from the route file are:
#   <number> <longitude (deg)> <latitude (deg)> <topography (m)> <distance (m)> <type>
#   0 –129.588618 46.504590 –2384.917643 0.000000 3
#   1 –129.583151 46.507559 –2412.977865 533.709482 3
#   2 –129.569223 46.503420 –2548.389974 1697.143568 1
#   3 –129.566359 46.501080 –2494.963053 2037.557099 3
#   4 –129.548611 46.529852 –2539.510864 5512.537193 4
#   5 –129.551250 46.530628 –2562.807922 5732.537193 3
#   6 –129.568962 46.501924 –2531.034424 9199.497998 4
#   7 –129.571600 46.502699 –2519.138489 9419.497998 3
#   8 –129.553889 46.531404 –2547.114624 12886.458803 4
#   9 –129.556529 46.532180 –2514.533569 13106.458803 3
#   10 –129.574238 46.503475 –2470.815735 16573.419607 4
#   11 –129.576876 46.504250 –2444.596313 16793.419607 3
#   12 –129.559168 46.532956 –2521.781921 20260.380412 4
#   13 –129.561807 46.533732 –2537.382141 20480.380412 3
#   14 –129.579514 46.505026 –2429.459961 23947.341216 4
#   15 –129.582152 46.505801 –2412.764343 24167.341217 3
#   16 –129.564447 46.534508 –2545.397705 27634.302021 4
#   17 –129.567086 46.535284 –2534.068665 27854.302021 3
#   18 –129.584791 46.506576 –2398.283020 31321.262826 4
#   19 –129.587429 46.507352 –2390.671509 31541.262826 3
#   20 –129.569726 46.536059 –2489.889282 35008.223630 4
#   21 –129.572365 46.536835 –2465.280823 35228.223630 3
#   22 –129.590068 46.508127 –2389.067017 38695.184435 4
#   23 –129.592706 46.508902 –2409.290771 38915.184435 3
#   24 –129.575005 46.537610 –2466.533142 42382.145240 4
#   25 –129.577645 46.538386 –2491.371094 42602.145240 3
```

```
#   26 −129.595345 46.509677 −2397.609253 46069.106044 4
#   27 −129.597984 46.510452 −2413.315918 46289.106044 3
#   28 −129.580285 46.539161 −2499.048889 49756.066849 4
#   29 −129.582925 46.539937 −2523.030640 49976.066849 3
#   30 −129.600622 46.511227 −2443.481018 53443.027653 4
#   31 −129.603261 46.512002 −2419.008240 53663.027653 3
#   32 −129.585565 46.540712 −2518.522400 57129.988458 4
#   33 −129.588205 46.541487 −2498.521301 57349.988458 3
#   34 −129.605900 46.512777 −2450.386536 60816.949263 4
#   35 −129.608539 46.513552 −2473.623230 61036.949263 3
#   36 −129.590845 46.542262 −2487.422180 64503.910067 4
#   37 −129.593485 46.543038 −2491.040466 64723.910067 3
#   38 −129.611178 46.514327 −2472.610657 68190.870872 3
#   39 −129.606711 46.517999 −2485.114583 68723.704236 3
#   40 −129.557338 46.509809 −2488.398743 72619.152031 3
#   41 −129.550415 46.521262 −2545.285828 73998.189601 3
#   42 −129.600724 46.536447 −2470.920736 78209.372536 3
#   43 −129.606972 46.525648 −2443.988281 79501.503455 4
#
# A total of 550 mission points have been defined.
#
# Define Mission parameters:
#define MISSION_SPEED      1.500000
#define MISSION_DISTANCE   79501.503455
#define MISSION_TIME       57203
#define MISSION_TIMEOUT    60067
#define DEPTH_MAX          2525.307922
#define DEPTH_ABORT        2562.807922
#define ALTITUDE_DESIRED   75.000000
#define ALTITUDE_MIN       75.000000
#define ALTITUDE_ABORT     30.000000
#define GPS_DURATION       600
#define DESCENT_DEPTH      3.000000
#define SPIRAL_DESCENT_DEPTH      2324.917643
#define SPIRAL_DESCENT_ALTITUDE   50.000000
#define DESCEND_DURATION   300
#define SETPOINT_DURATION  30
#define GPSMINHITS         10
#define ASCENDRUDDER       3.000000
#define ASCENDPITCH        45.000000
#define ASCENDENDDEPTH     2.000000
#define DESCENDRUDDER      3.000000
#define DESCENDPITCH       −30.000000
#define MAXCROSSTRACKERROR 30
#define RESON_DURATION     6
#q
```

SEE ALSO

mbsystem(1), **mbgrdviz**(1)

BUGS

Perhaps.