

CREATE A ROUTE

Scope

The Tapestry system is a software suite developed by Navigation Laboratories Inc. to provide a user-friendly modeling and control gateway for the LABPRO GPS Constellation Simulator.

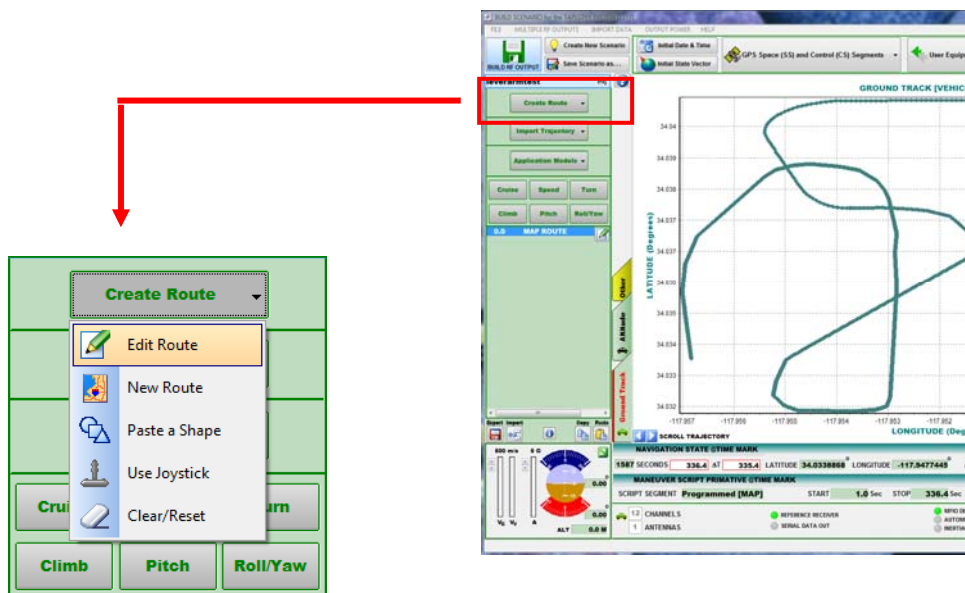
This document describes the use of the **Route Trajectory Generator [RouteMaker]**. RouteMaker is embedded within the ***Build Scenario*** Application as one of the choices available for generating a dynamic Vehicle Motion Trajectory.

In particular, RouteMaker is particularly suited for a Motion Trajectory that is best suited to a Street-map or Grid. This method is particularly well suited for the **Map-Matching** type systems.

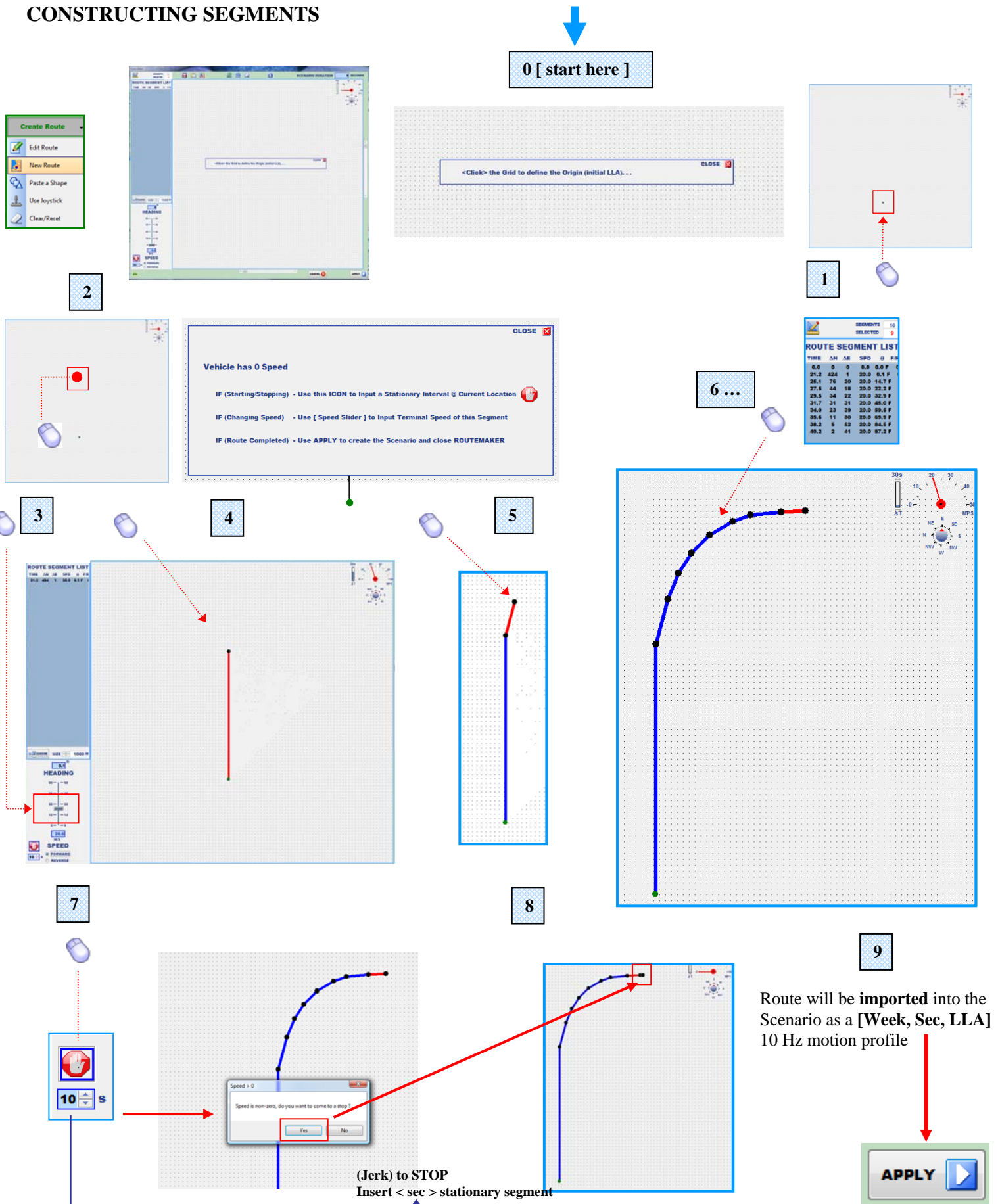
CREATING A ROUTE

The *Build Scenario Application* provides a method for creating *dynamic* vehicle motion profiles utilizing a Street-map or Grid. This method is particularly well suited for the map-matching type systems.

Start the Application from the *Build Scenario*
Main screen – select **CREATE ROUTE**



CONSTRUCTING SEGMENTS



MANUAL EDIT PANEL



Use this control to Display the
MANUAL EDIT PANEL

ROUTE SEGMENT LIST						
TIME	ΔN	ΔE	SPD	θ	F/R	
0.0	0	0	0.0	0.0	F	0
21.2	424	1	20.0	0.1	F	(
25.1	76	20	20.0	14.7	F	
27.5	44	18	20.0	22.2	F	
29.5	34	22	20.0	32.9	F	
31.7	31	31	20.0	45.0	F	
34.0	23	39	20.0	59.5	F	
35.6	11	30	20.0	69.9	F	
38.2	5	52	20.0	84.5	F	
40.2	2	41	20.0	87.2	F	
40.7	0	9	0.0	87.2	F	(
50.7	0	0	0.0	87.2	F	(

Select the Segment

SHOW SIZE 1000 M

INCREMENTAL SEGMENT

Δ NORTH 34 m
 Δ EAST 22 m
 Δ ALTITUDE 0 m
 SPEED ☒ F 20.0 m/s
☐ R

Enter desired values

COMPUTED (read only)
 DURATION 29.5 sec
 FINAL HEADING 32.9 °
 FINAL PITCH 0.0 °

Computed values based upon
Manual entries

INSERT REPLACE

☒ Show on Change
☒ Keep Visible

DELETE

Check **Keep Visible** to prevent the MANUAL EDIT PANEL from being closed after the Insert/Replace/Delete/Apply button is selected. This provides a way to manually enter values very quickly

THE CONTROLS

Load a Route-File

Save the Route-

Load a Map

Refresh Display – not destructive

Erase the Route - destructive

Remove last segment

ROUTE SEGMENT LIST

TIME	AN	AE	SPD	0	F/R
0.0	0	0	0.0	0.0	F
19.4	199	-15	10.3	355.7	F
27.7	86	5	10.3	3.3	F
36.0	83	20	10.3	13.5	F
56.4	22	14	10.3	32.5	F
59.1	21	18	10.3	40.6	F
62.2	13	29	10.3	65.9	F
65.0	5	29	10.3	80.2	F
69.9	-8	50	10.3	99.1	F
73.2	-10	32	10.3	107.4	F
77.4	-31	20	10.3	135.9	F
80.3	-27	13	10.3	154.3	F
83.2	-29	8	10.3	164.6	F
87.3	-42	5	10.3	173.2	F
93.3	-61	8	10.3	172.5	F
98.8	-57	-3	10.3	163.0	F
104.3	-104	3	10.3	173.3	F
140.9	-329	-11	10.3	181.9	F
141.4	-5	0	0.0	181.9	F
151.4	0	0	0.0	181.9	F
156.5	-28	-6	5.7	192.1	F
160.1	-10	-18	5.7	240.9	F
165.5	-4	-30	5.7	262.4	F
173.0	2	-102	13.5	271.1	F
175.5	15	-23	11.0	303.1	F
180.2	30	-18	7.5	329.0	F
185.9	42	5	7.5	6.8	F
194.5	62	16	7.5	14.5	F
196.7	33	31	20.2	43.3	F
217.7	300	300	20.2	45.0	F
221.2	70	-9	20.2	352.7	F
224.2	51	-33	20.2	327.1	F
226.4	17	-41	20.2	292.5	F
228.5	6	-41	20.2	278.3	F
230.4	3	-39	20.2	274.4	F
233.1	-2	-54	20.2	267.9	F
243.1	0	-10	0.0	0.0	F

ROUTE DISPLAY PANEL

Segment KNOT

Line between KNOTS is extrapolated from the KNOT.

Enter / Modify dynamic parameters associated with the Selected Segment

Select Forward or Reverse

MANUAL EDIT PANEL

INCREMENTAL SEGMENT

NORTH -104 m

EAST 3 m

ALTITUDE 0 m

SPEED 10.3 m/s

COMPUTED (read only)

DURATION 108.9 sec

FINAL HEADING 178.3

FINAL PITCH 10.3

INSERT REPLACE

Show on Change Keep Visible DELETE

DYNAMICS

HEADING 178.3

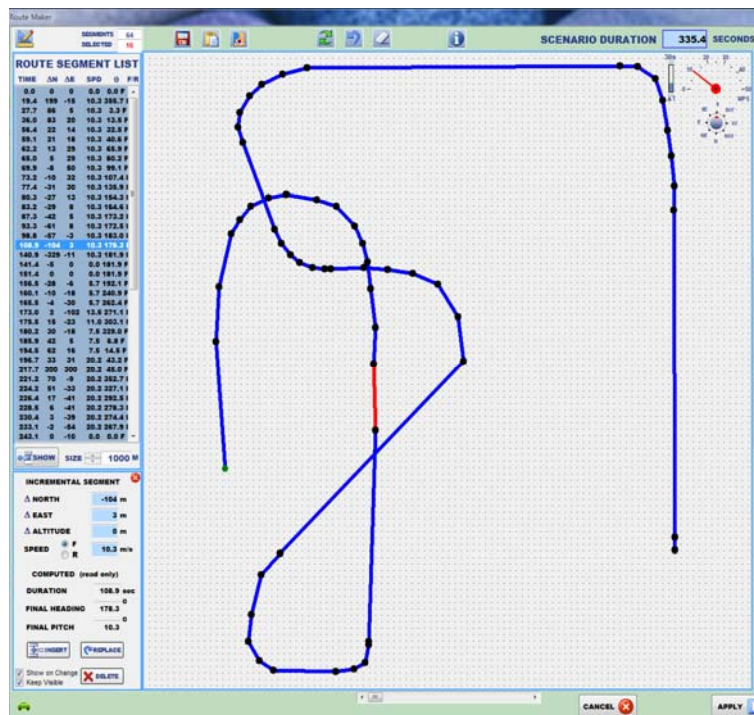
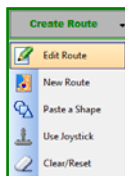
Pull to desired SPEED or enter the value into the control

SPEED 10.3 M/S

FORWARD REVERSE

Click this ICON to insert a Stationary (STOP) segment. For this example the STOP lasts for 10 seconds. If you have a non-zero speed, Tapestry will bring the vehicle to a stop using step JERK

MODIFYING A ROUTE



Click or select the desired Segment. Edit the parameters in the **MANUAL EDIT PANEL** select **REPLACE** to overwrite the segment



Enter **DELETE** to remove the Segment. Tapestry will automatically reprocess all of the maneuver segments (Knots) reconnecting the segment links as required.

INSERT will add the manual segment following the selected segment. The downstream links will be reconnected automatically as required

Note

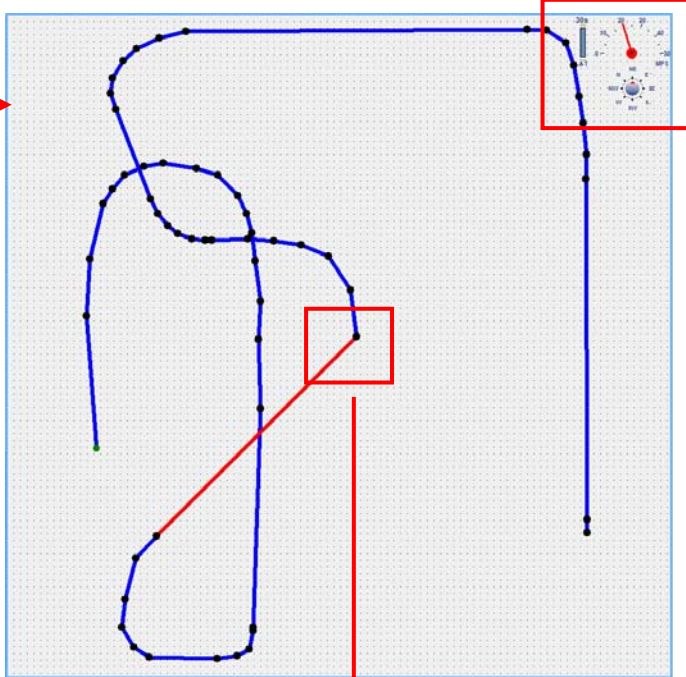
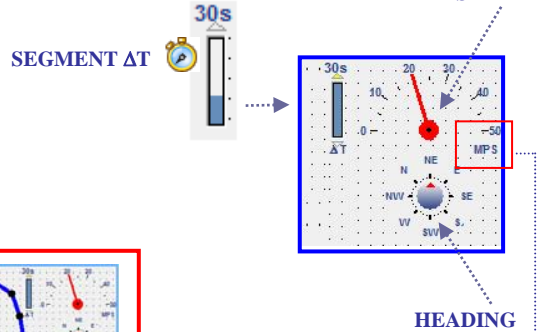
Occasionally a deleted/Replace/Inserted segment will create a downstream error (for example removing a change of speed). Tapestry will inform the user of the problem and restore the Segment list to its state before the Delete/Replace action.

If you want to DELETE segments, start from the bottom of the list to avoid inconsistencies.

ROUTE MODELING

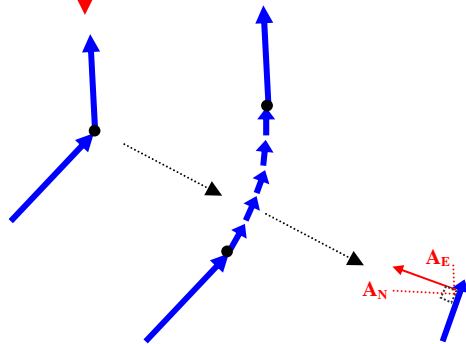


Use this control to Display the MANUAL EDIT PANEL



ROUTE SEGMENT LIST

TIME	ΔN	ΔE	SPD	θ	F/R
0.0	0	0	0.0	0.0	F
19.4	199	-15	10.3	355.7	F
27.7	86	5	10.3	3.3	F
36.0	83	20	10.3	13.5	F
56.4	22	14	10.3	32.5	F
59.1	21	18	10.3	40.6	F
62.2	13	29	10.3	65.9	F
65.0	5	29	10.3	80.2	F
69.9	-8	50	10.3	99.1	F
73.2	-10	32	10.3	107.4	F
77.4	-31	30	10.3	135.9	F
80.3	-27	13	10.3	164.3	F
83.2	-29	8	10.3	164.6	F
87.3	-42	5	10.3	173.2	F
93.3	-61	8	10.3	172.5	F
98.8	-57	-3	10.3	183.0	F
108.9	-104	3	10.3	178.3	F
140.9	-329	-11	10.3	181.9	F
141.4	-5	0	0.0	181.9	F
151.4	0	0	0.0	181.9	F
155.5	-28	-4	5.7	192.1	F
160.1	-10	-18	5.7	240.9	F
165.5	-4	-30	5.7	282.4	F
173.0	2	-102	13.5	271.1	F
175.5	15	-23	11.0	303.1	F
180.2	30	-18	7.5	329.0	F
185.9	42	5	7.5	6.8	F
194.5	62	-16	7.5	-14.5	F
196.7	33	31	20.2	43.2	F
217.7	300	300	20.2	45.0	F
221.2	70	-9	20.2	352.7	F
224.2	51	-33	20.2	327.1	F
226.4	17	-41	20.2	292.5	F
228.5	6	-41	20.2	278.3	F
230.4	3	-39	20.2	274.4	F
233.1	-2	-84	20.2	267.9	F
243.1	0	-10	0.0	0.0	F



Transition from segment-to-segment
< N (0.1 s) > Constant Acceleration Segments

HEADING

SPEED

196.7	33	31	20.2	43.2	F
217.7	300	300	20.2	45.0	F
221.2	70	-9	20.2	352.7	F

TIME STEP

ΔN ORTH (x)

ΔE AST (y)

FORWARD/REVERSE

CREATING SHAPES

Shapes are provided in Tapestry as a method for subjecting the **Receiver Under Test** to a deterministic dynamic profile with precisely controlled Acceleration and Jerk. This is an excellent method to study navigation software under stress.

To select SHAPES, from the main Build Scenario form select **Create Route | Paste a Shape**;

The image shows the Tapestry software interface for creating navigation shapes. A red arrow points from the 'Create Route' menu to the 'Paste a Shape' option. Another red arrow points from 'Paste a Shape' to the 'PROGRAMMABLE SHAPES' dialog. The 'PROGRAMMABLE SHAPES' dialog has four options: STATIONARY, CIRCLE, HARMONIC, and RANDOM WALK. Red arrows point from each of these options to their respective configuration windows.

STATIONARY ROUTE

- LATITUDE: 34.00000
- LONGITUDE: -118.00000
- ALTITUDE: 0 Meters
- STATIONARY DURATION: 1 Seconds
- APPLY

CIRCLE ROUTE

- RADIUS: 2500 Meters
- SPEED: 1 Meters/Sec
- ACCELERATION: $4.00e-4 \text{ m/s}^2$
- PERIOD: 15707.9 Seconds
- ROLL ANGLE: 0
- TOTAL DURATION: 15708 Seconds
- APPLY

HARMONIC MOTION

NORTH ☒ ENABLE

ASSOCIATED PEAK VALUES

Parameter	Value
AMPLITUDE	5 Meters
PERIOD	120 Seconds
DURATION	120 Seconds
PHASE OFFSET	90
VELOCITY	0.262 M/S
ACCELERATION	$1.37e-2 \text{ m/s}^2$
JERK	$7.18e-4 \text{ m/s}^3$

EAST ☒ ENABLE

ASSOCIATED PEAK VALUES

Parameter	Value
AMPLITUDE	5 Meters
PERIOD	120 Seconds
DURATION	120 Seconds
PHASE OFFSET	90
VELOCITY	0.262 M/S
ACCELERATION	$1.37e-2 \text{ m/s}^2$
JERK	$7.18e-4 \text{ m/s}^3$

VERTICAL ☐ ENABLE

ASSOCIATED PEAK VALUES

Parameter	Value
AMPLITUDE	5 Meters
PERIOD	120 Seconds
DURATION	120 Seconds
PHASE OFFSET	180
VELOCITY	0.262 M/S
ACCELERATION	$1.37e-2 \text{ m/s}^2$
JERK	$7.18e-4 \text{ m/s}^3$

TOTAL DURATION: 120 Seconds

APPLY

RANDOM WALK

- STEP SIZE: 5 Meters
- STEP TIME-INTERVAL: 1 Seconds
- TOTAL DURATION: 120 Seconds
- APPLY

EXAMPLES

TWO AXIS MOTION

RANDOM WALK

STEP SIZE

5 Meters

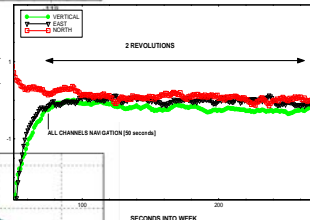
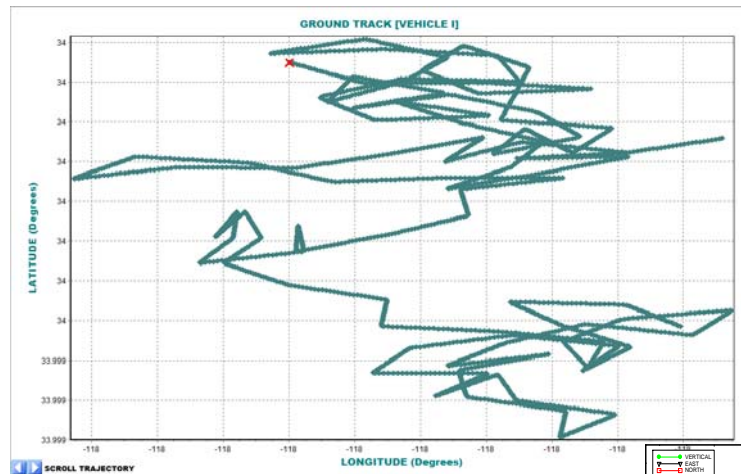
STEP TIME-INTERVAL

5 Seconds

TOTAL DURATION

500 Seconds

APPLY



HARMONIC MOTION

NORTH

☒ ENABLE

AMPLITUDE

500 Meters

PERIOD

120 Seconds

DURATION

1000 Seconds

PHASE OFFSET

0°

ASSOCIATED PEAK VALUES

VELOCITY

26.180 M/S

ACCELERATION

1.37e+0 M/S²

JERK

7.18e-2 M/S³

EAST

☒ ENABLE

AMPLITUDE

500 Meters

PERIOD

120 Seconds

DURATION

1000 Seconds

PHASE OFFSET

90°

ASSOCIATED PEAK VALUES

VELOCITY

26.180 M/S

ACCELERATION

1.37e+0 M/S²

JERK

7.18e-2 M/S³

VERTICAL

☐ ENABLE

AMPLITUDE

500 Meters

PERIOD

120 Seconds

DURATION

1000 Seconds

PHASE OFFSET

180°

ASSOCIATED PEAK VALUES

VELOCITY

0.262 M/S

ACCELERATION

1.37e+0 M/S²

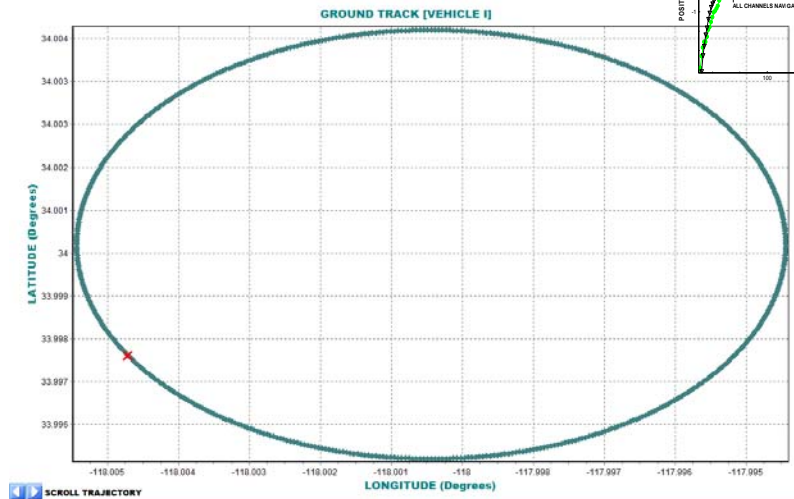
JERK

7.18e-4 M/S³

TOTAL DURATION

1000 Seconds

APPLY



HARMONIC MOTION

NORTH

☒ ENABLE

AMPLITUDE

500 Meters

PERIOD

120 Seconds

DURATION

1000 Seconds

PHASE OFFSET

0°

ASSOCIATED PEAK VALUES

VELOCITY

26.180 M/S

ACCELERATION

1.37e+0 M/S²

JERK

7.18e-2 M/S³

EAST

☒ ENABLE

AMPLITUDE

500 Meters

PERIOD

120 Seconds

DURATION

1000 Seconds

PHASE OFFSET

90°

ASSOCIATED PEAK VALUES

VELOCITY

26.180 M/S

ACCELERATION

1.37e+0 M/S²

JERK

7.18e-2 M/S³

VERTICAL

☒ ENABLE

AMPLITUDE

100 Meters

PERIOD

120 Seconds

DURATION

1000 Seconds

PHASE OFFSET

180°

ASSOCIATED PEAK VALUES

VELOCITY

5.236 M/S

ACCELERATION

2.74e-1 M/S²

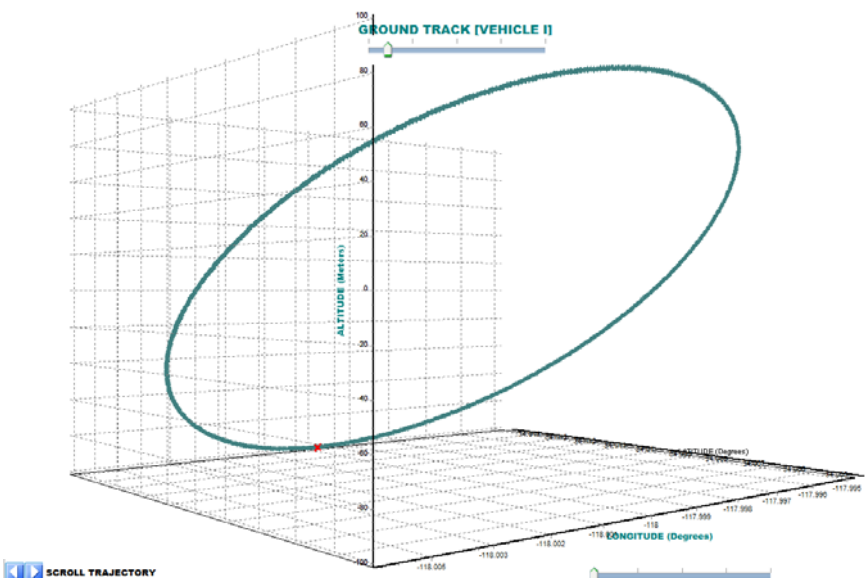
JERK

1.44e-2 M/S³

TOTAL DURATION

1000 Seconds

APPLY



THREE AXIS MOTION

TWO DIMENSIONAL VIEW

HARMONIC MOTION

NORTH ☒ **ENABLE**

AMPLITUDE: 100 Meters
PERIOD: 120 Seconds
DURATION: 1000 Seconds
PHASE OFFSET: 0

ASSOCIATED PEAK VALUES

VELOCITY: 5.236 M/S
ACCELERATION: $2.74 \times 10^{-1} \text{ M/S}^2$
JERK: $1.44 \times 10^{-2} \text{ M/S}^3$

EAST ☒ **ENABLE**

AMPLITUDE: 100 Meters
PERIOD: 200 Seconds
DURATION: 1000 Seconds
PHASE OFFSET: 90

ASSOCIATED PEAK VALUES

VELOCITY: 3.142 M/S
ACCELERATION: $9.87 \times 10^{-2} \text{ M/S}^2$
JERK: $3.10 \times 10^{-3} \text{ M/S}^3$

VERTICAL ☒ **ENABLE**

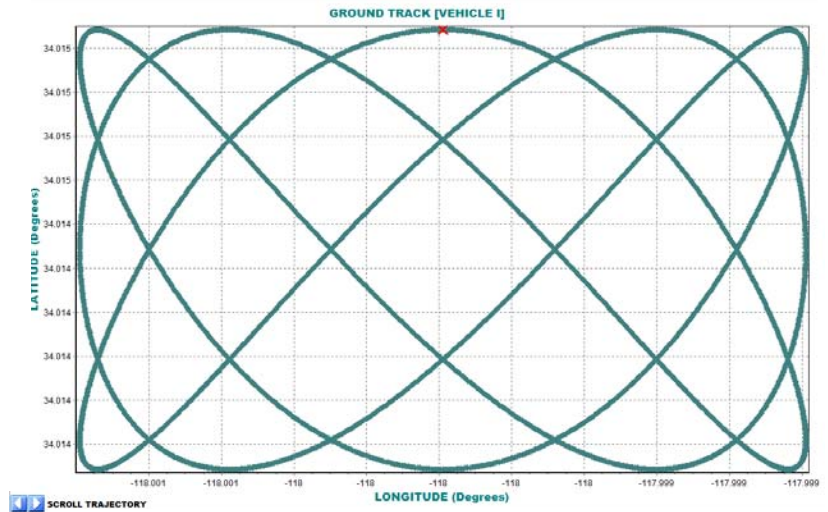
AMPLITUDE: 20 Meters
PERIOD: 60 Seconds
DURATION: 1000 Seconds
PHASE OFFSET: 180

ASSOCIATED PEAK VALUES

VELOCITY: 2.094 M/S
ACCELERATION: $2.19 \times 10^{-1} \text{ M/S}^2$
JERK: $2.30 \times 10^{-2} \text{ M/S}^3$

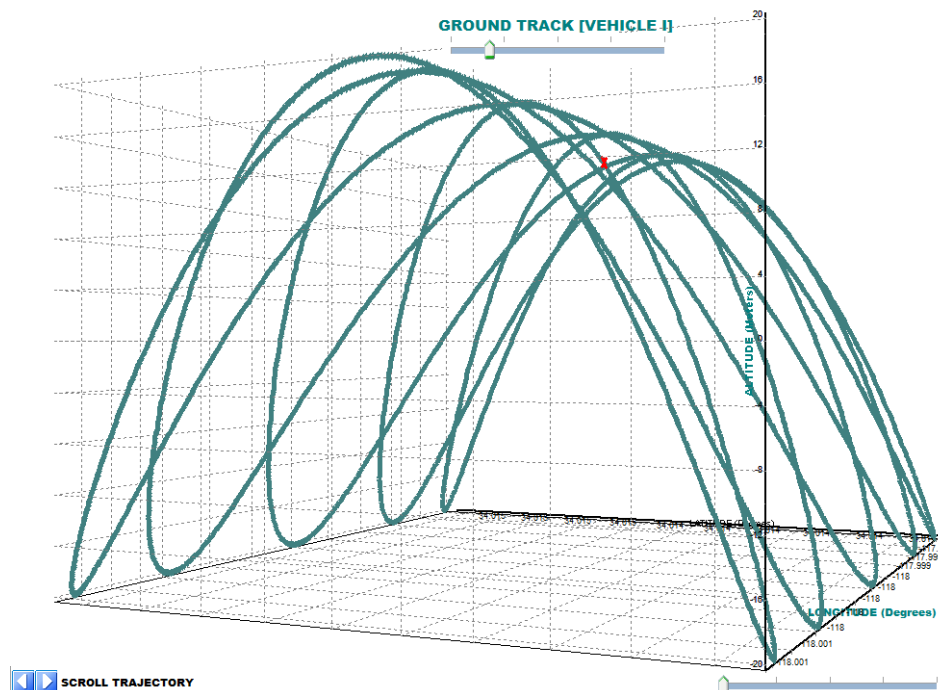
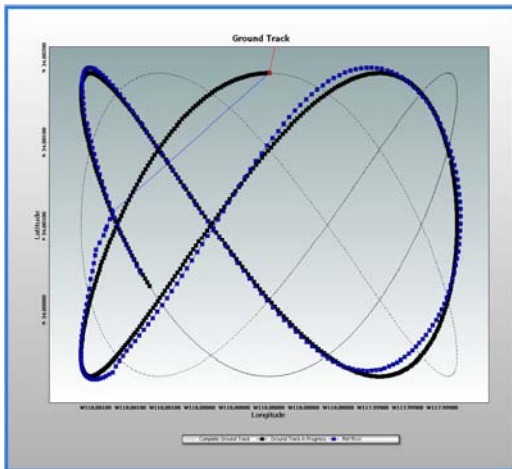
TOTAL DURATION 1000 Seconds

APPLY



THREE DIMENSIONAL VIEW

RUN-TIME with REF-RCVR OVERLAY



Shapes provide the best way to subject the Receiver Under Test into a deterministic acceleration profile. This is extremely useful if Time to First Fix (TFF) is desired under dynamics.

ROUTE MAKER SETUP



PREFERENCES

MAXIMUM SPEED 50 M/S

DISTANCE UNITS METERS

SMOOTHING POINTS 5

☒ **CREATE [WEEK,SEC GEO] 10Hz TXT FILE**

CANCEL **APPLY**

This controls the transition model from one segment to the next. The acceleration required is divided by the # and applied of the interval that lasts # x 0.1 seconds

This creates a [Week, Seconds, GEO (LLA)] 10 Hz text file IMPORTEDTRAJECTORY.TXT that is automatically imported into the Scenario when the Route Form is closed through the APPLY control.