

VERGILIUS: User Manual

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I. INSTALLATION AND EXECUTION

VERGILIUS is written in C#, therefore to be able to run it you will need:

- **Windows:** download and install the .Net framework from: <http://www.microsoft.com/downloads/>
- **Linux/Mac:** download and install the mono framework from: <http://www.mono-project.com/>

VERGILIUS consists of two separated executables, VMF and QualnetTrace. You can download them at: <http://nrl.cs.ucla.edu/~egiordano/vergilius/downloads.html>

The download package contains sample configuration files. You can launch both VMF and QualnetTrace with the following command:

- **Windows:** VMF.exe ConfigurationFile
QualnetTrace.exe ConfigurationFile
- **Linux/Mac:** mono VMF.exe ConfigurationFile
mono QualnetTrace.exe ConfigurationFile

II. VMF

VMF can be run in several modes, each mode performs different operations, requires different inputs and produces different outputs. In the following we will provide detailed information about each operational mode.

You can add comments to the configuration file by adding a # sign at the beginning of the line.

A. Mode 1

Mode 1 extracts the map information from Tiger and generates output of nodes and links. It also builds CORSIM or SUMO output as an option. Here is an example of a configuration file for mode 1:

```
MODE 1
ORIGIN 45519500 -122676555
WIDTH 1000
HEIGHT 1000
INTERNAL_NODES YES
RT1 "TGR41051.RT1"
RT2 "TGR41051.RT2"
```

In the following we provide explanation for each possible option of mode1:

```
ORIGIN <Latitude> <Longitude>
```

ORIGIN represents the center of the map that will be extracted from TIGER. Latitude and Longitude must be represented in decimal and multiplied by 1000000.

```
WIDTH <Width in Meters>
```

```
HEIGHT <Height in Meters>
```

Dimensions of the map to be extracted

```
INTERNAL_NODES <YES/NO>
```

Roads in TIGER are stored as straight lines between intersections. With this option it is possible to choose to use or discard the information about road segments that are not straight. RT1 <RT1 TIGER county file>

```
RT2 <RT2 TIGER county file>
```

Tiger files to extract the map from. Use double quotes around filename if including the path.

It is possible to choose to build corsim output, then the CORSIM Simulation Time is mandatory

```
BUILD_CORSIM_OUTPUT <YES/NO>
```

```
CORSIM_SIMULATION_TIME <Simulation Time in Seconds>
```

CORSIM_SEED <Integer Seed>

It is possible to choose to build SUMO output, then the SUMO Simulation Time is mandatory

BUILD_SUMO_OUTPUT <YES/NO>

SUMO_SIMULATION_TIME <Simulation Time in Seconds>

SUMO_NODES_FILE <SUMO output nodes xml file name>

SUMO_EDGES_FILE <SUMO output edges xml file name>

SUMO_TURNS_FILE <SUMO output turns xml file name>

SUMO_FLOWS_FILE <SUMO output flows xml file name>

To generate either SUMO or CORSIM output a scenario must be built. It is possible to choose between TOPOLOGY_BASED or RANDOM Scenarios

SCENARIO <TOPOLOGY_BASED / RANDOM>

Topology based scenario possible options:

TB_INPUT_FLOW <Type> <Parameter1> <Parameter2>

Possible types for TB_INPUT_FLOW are CONSTANT , UNIFORM or POISSON

Constant Flows set to 20

TB_INPUT_FLOW CONSTANT 20

Flows uniformly distributed over [10,30]

TB_INPUT_FLOW UNIFORM 10 30

Flows Poisson distributed with mean 20

TB_INPUT_FLOW POISSON 20

Turning probabilities based on turning direction (ordered by difference from straight, probability decreases with exponent 4)

TURNING_PROBABILITIES DIRECTION 4

Turning probabilities based on street importance (ordered by decreasing importance, probability decreases with exponent 4)

TURNING_PROBABILITIES IMPORTANCE 4

Random Scenario Possible options:

SCENARIO RANDOM

Dijkstra weights can be set either to time or distance:

SCENARIO_DIJKSTRA_WEIGHT TIME

SCENARIO_DIJKSTRA_WEIGHT DISTANCE

For each random scenario you can define the kind of trips:

DETERMINISTIC means all routes entering from a given entry point will have the same destination (farthest from origin)

RANDOM means all routes will have a destination chosen randomly (where the random is an asymmetric distribution with 0 at the farthest exit point)

RANDOM_SCENARIO_DESTINATION_TYPE DETERMINISTIC

RANDOM_SCENARIO_DESTINATION_TYPE RANDOM 1

Average number of cars per hour entering the map

AVERAGE_ARRIVALS <Number of Cars>

You can also choose how to distribute the entry flows along the map, uniformly or using the importance of the streets

ENTRY_FLOW_MODE UNIFORM

ENTRY_FLOW_MODE WEIGHTED

Can change the impact of weight difference by elevating the weights (exponent can also be negative)

WEIGHTED_FLOWS_EXPONENT 2

B. Mode 2

Mode 2 Generates a set of scenarios, possible options are:

NUMBER_OF_SCENARIOS <Integer>

Example of mode 2 configuration file:

MODE 2

ORIGIN 45519500 -122676555

WIDTH 1000

HEIGHT 1000

INTERNAL_NODES NO

RT1 "TGR41051.RT1"

RT2 "TGR41051.RT2"

NUMBER_OF_SCENARIOS 10

```
AVERAGE_ARRIVALS 9000
ENTRY_FLOW_MODE UNIFORM
```

C. Mode 3

Mode 3 reads the topology from 3 files: LINKS, NODES, TURNS and the incoming flows from INPUT_FLOWS, and generates the output for corsim.

Example of mode 3 configuration file:

```
MODE 3
NODES nodes.data
LINKS streets.data
TURNS turnProbabilities.data
INPUT_FLOWS incomingFlows.data
CORSIM_SIMULATION_TIME 200
CORSIM_SEED 1234
CORSIM_OUTPUT_FILE scenario.trf
CORRESPONDENCE_FILE corr.data
```

D. Mode 4

Mode 4 performs the translation of a CORSIM output into a QualNet input

Example of mode 3 configuration file:

```
MODE 4
CORRESPONDENCE_FILE corr.data
CORSIM_TRF scenario.trf
CORSIM_TSI scenario.tsi
CORSIM_TSD scenario.tsd
QUALNET YES
```

CORRESPONDENCE_FILE specifies a set of road segments for which you want to extract the traffic flow.

CORSIM_TRF, CORSIM_TSI, CORSIM_TSD specify the 3 output files of the CORSIM simulator.

With QUALNET YES VMF builds the the qualnet mobility file and saves it as out.mobility.

DRAW_MAP YES Builds a bitmap representation of the map and saves it in output.bmp.

NODE_REUSE <Integer Number of seconds>

Sets the minimum time to wait before reusing a node id when a car goes out of the map. Reusing the node ids help reducing the number of nodes in the simulation.

It is possible to build a QualNet application file with CBR flows, a possible set of option is:

```
QUALNET_APP YES
QUALNET_APP_PACKET_LENGTH <Integer number of bytes>
QUALNET_APP_AVERAGE_CONNECTIONS <Sequence of Integer percentages of nodes>
QUALNET_APP_PACKETS_PER_SECOND <Integer>
QUALNET_APP_CONNECTION_DURATION <Integer number of seconds>
```

As an option you can build the QualNet Pathloss matrix file:

```
BUILD_PATHLOSS_MATRIX YES
PATH_LOSS_FILE PathLoss.data
```

It is also possible to extract just a mobility snapshot of a given time slot, here is a sample set of options:

```
QUALNET_SNAPSHOT <YES/NO> <Time Slot of snapsot>
QUALNET_SNAPSHOT_SIM_TIME 200
QUALNET_APP YES
QUALNET_APP_PACKET_LENGTH 512
QUALNET_APP_AVERAGE_CONNECTIONS 3 6 9 12 15 18 21 24
QUALNET_APP_PACKETS_PER_SECOND 8
QUALNET_APP_CONNECTION_DURATION 20
BUILD_PATHLOSS_MATRIX YES
PATH_LOSS_FILE PathLoss.data
```

E. Modes 5 and 6

Modes 5 and 6 are still under development use at your own risk :)

Mode 5 Generates Random Waypoint mobility

Sample configuration file:

```
MODE 5
RANDOM_WAYPOINT_NUMBER_OF_NODES 20
RANDOM_WAYPOINT_MAP_WIDTH 1000
RANDOM_WAYPOINT_MAP_HEIGHT 1000
RANDOM_WAYPOINT_SIMULATION_TIME 200
RANDOM_WAYPOINT_AVERAGE_SPEED 10
RANDOM_WAYPOINT_SPEED_STANDARD_DEVIATION 2
RANDOM_WAYPOINT_AVERAGE_STOP_TIME 10
RANDOM_WAYPOINT_STOP_TIME_STANDARD_DEVIATION 2
RANDOM_WAYPOINT_OUTPUT_FILE_NAME rwOut.mobility
RANDOM_WAYPOINT_SEED 1234
```

Mode 6 generates Constraint Random Waypoint mobility using either an input map or a synthetic map.

```
MODE 6
TOPOLOGY_TYPE MANHATTAN
MANHATTAN_BLOCKS 9
MANHATTAN_BLOCKS_SIZE 100
MANHATTAN_SPEED 10
CRW_NUMBER_OF_NODES 30
CRW_SIMULATION_TIME 100
CRW_SPEED_STANDARD_DEVIATION 2
CRW_AVERAGE_STOPTIME 10
CRW_STOP_TIME_STANDARD_DEVIATION 2
CRW_OUTPUT_FILE_NAME crwOut.mobility
CRW_SEED 1234
```