**Streamlined modeling process V1.**

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| Steps | Basic data element | File input and output, data flow (GMNS) | Description of Process in DTALite and GMNS packages (common features in other packages too) | References | (External) Tools | Analysis Model | Optimization and simulation algorithm |
| 1. Data sources | Openstreetmap, survey data, population, census data, |  |  |  | QGIS |  |  |
| 1. Network preparation | Node, link, (link type, capacity, multimodal uses, free-flow travel time, volume-delay function) | Osm-> node, link, POI | Osm2gmns does?  Routable network,  intersection consolidation  multi-level network in net2cell |  | QGIS, osm2gmns | Use GAMS to model transportation problem. | Shortest path problem and algorithm such as label correcting |
| 1. Zone creation | Zone, grid cells, accessibility | Node->zone |  |  | QGIS | Hierarchical mapping between zones and nodes, clustering | Multimodal-Space-time accessibility based on travel time budgets |
| 1. Trip generation | Trip generation rates based on population, social-demographical data | node->Zone  (aggregate node level production and attraction to zone-based trips)  Trip generation rate table |  |  | Grid2demand | Cross-category trip generation, Linear regression | Cumulative logit model |
| 1. Trip distribution | OD demand matrix, Trip length distribution, | Node, link->accessibility, demand |  |  |  | Gravity model | Trip generation with attraction-end, trip length considerations |
| 1. Mode choice | Auto, bus, walk, bike, rail, CAV, TNC | Demand file with mode options |  |  |  | Mode choice model (discrete choice) | Calibration through maximum likelihood |
| 1. Traffic assignment | Link performance | Demand, network-> link performance |  |  | GAMS | **Flow mapping**: OD->path-> link  **Travel time mapping:**  Link-> path -> OD  User equilibrium consideration | Assignment model formulation for UE, SO, side constraints |
| 1. Sensor data mapping | TMC road sensors, GPS data | Route->trace,  TMC reading->measurement |  |  |  | Map matching methods | Traffic congestion and Bottleneck identification |
| 1. OD estimation | Measurement data  Iterative solution process | Measurement->OD and path |  |  |  | OD estimation model | Gradient based adjustment process |
| 1. Traffic flow and Queuing analysis | Capacity, cut-off speed and density,  Dynamic queue profile | Time-dependent link performance |  |  |  | Traffic fundamental diagram | Traffic flow model selection and calibration, queueing for overcongested conditions |
| 1. Traffic Control data preparation | Movement, phase, timing | Movement-> signal\_phasing, signal\_timing |  |  |  | Queueing model and capacity allocation |  |
| 1. Discrete event simulation | Trajectory | OD, path -> trajectory |  |  |  | Vehicle generation and queueing model |  |
| 1. Visualization and analysis |  |  |  |  |  |  |  |
| 1. Supply-side scenario preparation | Incident, work zone |  |  |  |  |  |  |
| 1. demand-side scenario preparation | Toll/incentives, departure time adjustment |  |  |  |  |  |  |
| 1. CAV modeling |  |  |  |  |  |  |  |
| 1. Transit modeling |  |  |  |  |  |  |  |