MODELING FOR FLEXIBILITY AND CONSISTENCY: AN INTEGRATION CAPABILITY FOR MESOSCOPIC DTA AND MICROSCOPIC TRAFFIC SIMULATION MODELS

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TABLE OF CONTENTS

Page

List of Figures ... **ii**

List of Tables ... **ii**

Disclaimer and Acknowledgments ... **iii**

Abstract ... **iv**

Executive Summary ... **1**

Chapter 1: Introduction ... **2**

Chapter 2: Literature Review: Existing Integration Capabilities ... **4**

Chapter 3: Research Methodology and Framework ... **5**
- Dynamic Urban Systems for Transportation (DynusT) ... 7
- Sub-Area Analysis ... 8
- DynusT/VISSIM Conversion Tool ... 9
- VISUM ... 9
- VISSIM ... 9

Chapter 4: Consistency Issues ... **10**
- Vehicle Loading ... 10
- Link Geometry ... 10
- Time Resolution ... 11
- Traffic Dynamics ... 12

Chapter 5: Case Study ... **13**

Chapter 6: Results ... **15**

Chapter 7: Conclusion ... **17**

References ... **18**

LIST OF FIGURES

Page

Figure 1. Modeling Framework for Mesoscopic-Microscopic Integration. 5
Figure 2. General Algorithm Structure of the DynusT Model... 7
Figure 3. Sub-area Cut in DynusT. 8
Figure 4. Mesoscopic-Macroscopic-Microscopic Link Geometry. 11
Figure 5. DVC Conversion Process. 13
Figure 6. Flow-Density Relationship 14

LIST OF TABLES

Page

Table 1. Average Speed (7-11 am) 15
Table 2. Average Travel Time (7-11 am) 16

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ABSTRACT

The integration of mesoscopic and microscopic simulation models provides expanded dimensions of modeling capabilities for existing Dynamic Urban Systems for Transportation (DynusT) and VISSIM users to take advantage of the strengths of both models. A new integration tool was created with the use of a Python code to create a VISSIM model from a DynusT sub-area cut. The use of dynamic traffic assignment to generate links, nodes, vehicle paths, flows, and especially dynamic time-dependent routes tremendously improves transportation system operational planning analyses. The new integration tool alleviates the need to re-create the entire network from scratch again at the microscopic level. This offline conversion tool has advantages over real-time integration tools in that there is no need to create highly accurate microscopic models before the integration process. However, the conversion process is not without consistency issues. Microscopic models are designed to analyze traffic at a much higher level of fidelity than mesoscopic models. Mesoscopic models have different time resolutions, traffic dynamics, and link geometries. This report outlines the conversion process between DynusT, a mesoscopic simulation model, with a microscopic counterpart, VISSIM. In addition, the report addresses the many consistency issues that arose during the conversion process and attempts to alleviate many of these obstacles. A case study was also performed to analyze the outputs of both models for comparison. A comparison of output results was analyzed for consistency once the calibration process was completed.

Keywords: Mesoscopic/Microscopic Integration, Sub-area Analysis, Network Consistencies, Dynamic Traffic Assignment

EXECUTIVE SUMMARY

Many traffic analysts and transportation agencies rely on traffic-analysis tools to evaluate the performance of their transportation facilities. Simulation-based modeling software is an effective tool for analyzing and evaluating the current and future performance of transportation facilities. Traffic simulation models are classified according to level of resolution:

- macroscopic (large perspective) models, which describe traffic entities at an aggregate level;
- mesoscopic (middle perspective) models, which describe traffic entities at a high level of detail but their behavior and interactions at a low level of detail; or
- microscopic (fine perspective) models, which describe traffic entities and their behavior and interactions at a high level of detail.

Incorporating multiple levels of resolution often requires using different software models with both localized and system-wide analysis capabilities. With multilevel resolution comes sub-area analysis, which allows model results to be converted to a small sub-network in a microscopic model for further operational analysis.

This research had two main objectives. The first objective was to design and develop a new conversion tool that integrates a mesoscopic model (Dynamic Urban Systems for Transportation [DynusT]) into a microscopic model (VISSIM) counterpart. Most integration tools today use real-time hybrid models. The downside to this type of approach is that re-creating a smaller sub-area from the mesoscopic side to the microscopic side can be difficult and time consuming. When the smaller sub-area is being replicated, the geometry must match exactly. After a literature review to examine existing software, researchers created an offline integration tool that automatically converts the mesoscopic sub-area to a microscopic equivalent. This new DynusT/VISSIM Conversion tool (DVC) enables users to quickly convert and analyze networks at both the system-wide and local levels. This report documents the functionality of DVC and the modeling framework needed to perform the conversion process.

The second objective of this research was to identify the consistency issues that arise when converting a DynusT mesoscopic model (with dynamic traffic assignment [DTA]) to a VISSIM microscopic model using the newly created DVC. This report discusses consistency issues that occurred during the conversion process (concerning vehicle loading, link geometry, time resolution, and traffic dynamics) and mitigation strategies to combat these issues. A case study analyzed the output of the models for comparison, and the results identified measures to correct the inconsistencies.

CHAPTER 1: INTRODUCTION

Traffic analysts and operating agencies increasingly rely on traffic analysis tools to analyze and evaluate the current and future performance of transportation facilities for various modes of transport. There are a variety of software-based analytical procedures and methodologies developed by public agencies, research organizations, and private consultants that support different aspects of traffic and transportation analyses. These analyses usually rely on simulation-based modeling software to assess the performance of transportation facilities. These simulation-based models are classified based upon their level of resolution and can be categorized as macroscopic, mesoscopic, or microscopic simulation tools. For a long-range planning project, macroscopic simulation tools analyze in a simplistic manner and at an aggregate level. However, this type of static representation of traffic fails to capture the intricate details of real-life conditions, such as the fluctuation of traffic build-up and dissipation during peak-hour congestion periods, and therefore cannot predict network performance temporally. Long-range planning models are geared for such applications because there is no need to analyze the interaction of vehicles at a more refined level.

Mesoscopic simulation and assignment models fill the gaps between the aggregate level approach of macroscopic models and the individual interactions of the microscopic ones. Mesoscopic models normally describe traffic entities at a high level of detail, but their behavior and interactions are described at a lower level of detail. A microscopic simulation model describes system entities and has a high level of detail. The details of microscopic models yield the flexibility to add many more modeling contexts and options than mesoscopic and macroscopic models *(1)*.

Incorporating multiple levels of resolution often includes the integration of models. Model integration is fast becoming a simulation modeling approach since it takes both the localized and system-wide analyses into consideration. In existing practice, these types of models are often used jointly in a traffic analysis; however, the actual practice and use of these models may vary widely among different analysts or regions. Practitioners often establish their standard practices through experience or, at times, the requirements of the transportation agency's clients. On the other hand, transportation agencies may or may not establish model-use guidelines, and if they do, the standards often vary.

Within the context of multilevel resolution comes the practice of sub-area analysis. Sub-area analysis has started to become an increasingly applied modeling technique. This type of new capability allows static or dynamic traffic assignment model results to be converted to a small sub-network in a microscopic model for further operational analysis. However, consistency issues arise when the sub-area from a macroscopic or mesoscopic model is converted to a microscopic model for further detailed analyses.

This research had two main objectives. The first objective was to outline a newly created conversion tool that integrates a mesoscopic model (Dynamic Urban Systems for Transportation [DynusT]) into a microscopic model (VISSIM) counterpart. Most integration tools today use real-time hybrid models. The downside to this type of approach is that users must re-create a smaller sub-area from the mesoscopic side to the microscopic side, which can be tiresome and time consuming. The models are usually connected by virtual links. Great care must be taken when replicating the smaller sub-area because the geometry must match exactly. Therefore, an offline integration tool was created that automatically converts the mesoscopic sub-area to a microscopic equivalent. This new DynusT/VISSIM Conversion tool (DVC) allows users to quickly convert and analyze networks at both the system-wide and local levels. Modelers can appreciate the ability to export links, nodes, and, more importantly, vehicle flow and path files.

The second objective of this research was to identify the consistency issues that arise when converting a DynusT model to a VISSIM microscopic model through the use of the newly created DVC. The process of using a fully functional mesoscopic model, generating a sub-area within that mesoscopic model, and then using a Python code to convert the network to a macroscopic model—which in turn converts the dataset to a microscopic model—is not without consistency issues. This report attempts to address these issues and determine how to resolve many of these problems.

Chapter 2 includes a review of the literature on existing model integration and model consistencies. Chapter 3 provides the research methodology and framework for the integration process of a mesoscopic model, DynusT, and microscopic model, VISSIM. Chapter 4 describes the consistency issues that arise when integrating mesoscopic and microscopic simulation. Chapter 5 reveals a case study utilizing both the sub-area and integration capabilities between the two described models. Chapter 6 details the results of the case study.

CHAPTER 2: LITERATURE REVIEW: EXISTING INTEGRATION CAPABILITIES

Several transportation software developers have already integrated modeling software, including Caliper® and Aimsun. TransModeler™ provides a hybrid simulation capability in which high fidelity microsimulation can be integrated with both its mesoscopic and macroscopic counterparts. Portions of the network of greatest interest can be simulated with microsimulation, and other portions of less concern can be simulated in less detail. This approach allows large networks to be simulated with reserved computational power *(2)*. Aimsun boasts the ability to integrate macro-, meso-, and microscopic as a single software application and network representation, a single database of modeling objects and support data, and one model file set *(3)*.

In addition, hybrid integration has come to the forefront of simulation modeling. Burghout Koutsopoulos & Andreasson have integrated MITSIM a microscopic traffic simulation model, with Mezzo, a newly developed mesoscopic model. The hybrid integration applies microscopic simulation to areas of specific interest while simulating a large surrounding network in less detail with the mesoscopic model *(4)*. Burghout and Wahlstedt also created hybrid integration with Mezzo and VISSIM that simulates the area of interest in great detail, while the surrounding areas are modeled with less fidelity *(5)*. This modeling approach also combines a number of recent advances in simulation modeling, such as discrete-event time resolution and combined queue-server and speed-density modeling, and integrates into a hybrid simulation model *(6)*.

Developers from Northwestern University have developed a mesoscopic model entitled the Visual Interactive System for Transport Algorithms (VISTA), which also showcases dynamic traffic assignment (DTA) capabilities. VISTA has the ability to directly import existing network data from other software, such as TRANSPLAN, CORSIM, SYNCHRO, VISUM, or VISSIM, by use of the conversion tool provided (*7*).

CHAPTER 3: RESEARCH METHODOLOGY AND FRAMEWORK

Mesoscopic and microscopic models are complementary to each other, and with proper integration, both can jointly accomplish optimal modeling capabilities. However, the capability to integrate mesoscopic and microscopic models is still under extensive research. Translating the mesoscopic model and results to a microscopic model has been shown to be troublesome and time consuming without a streamlined process. Microscopic models have proven to be difficult to calibrate and apply because of their richness in parameters and their dependency on large sets of fine-grained, accurate input data. Microscopic models also require large amounts of computational memory and efficiency, and therefore large networks are both difficult to create. Mesoscopic models, on the other hand, have shown their ability to accurately model the dynamics of traffic demand in large-scale networks but lack the detailed resolution needed to analyze vehicle interactions.

This section describes the functionality of a newly developed tool that integrates a mesoscopic simulation tool (DynusT) with a microscopic simulation model (VISSIM) through the use of the VISUM COM interface. The conversion process takes the DynusT datasets and creates a sub-area to be converted to a VISUM network through a program written in Python. Upon completion, a VISSIM counterpart model is created using VISUM's "export to VISSIM" function embedded in the software. Figure 1 depicts the modeling framework needed to perform the conversion process.

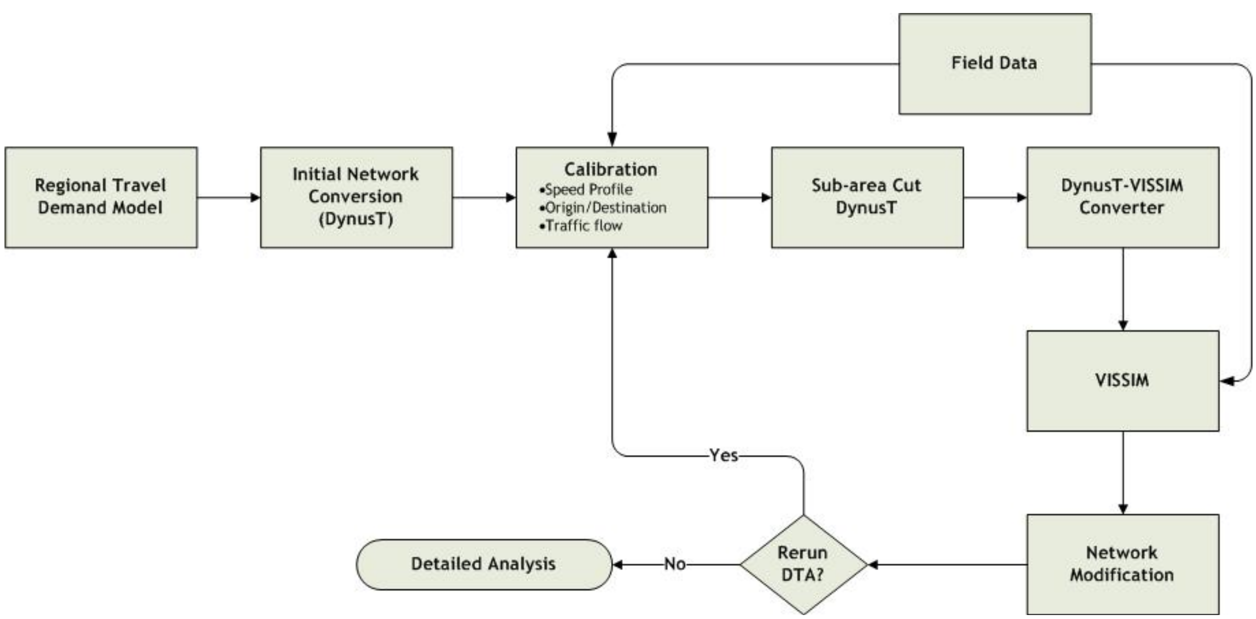

Figure 1. Modeling Framework for Mesoscopic-Microscopic Integration.

The initial step is to convert a regional travel demand model to mesoscopic format including the roadway network and demand matrices. Once the initial network conversion to DynusT is complete, a set of parameters must be calibrated with the mesoscopic model including a speed profile, traffic flow model and origin/destination (O-D) matrices. Upon completion of the calibration parameters, a base DynusT model is run to equilibrium conditions where the travel time between O-D pairs does not vary between various paths. A sub-area cut of the roadway network to be analyzed at the microscopic level is then performed. All paths and flows that travel through the sub-area are retained both spatially and temporally. The DVC tool is then used to convert the sub-area mesoscopic model to a VISUM model and ultimately a VISSIM counterpart. It must be noted that any network modifications in the VISSIM model that would change vehicle routes and subsequently change vehicle travel times (e.g., lane closure, signal timing optimization) must be reflected in the mesoscopic model. Any modifications that change driver behavior must be taken into consideration and therefore DTA must be run again. If network modifications do not change travel patterns, then a detailed analysis of the microscopic model can be performed.

Historically, multiple scenarios have been modeled in DynusT through the use of its DTA capabilities. DTA, a component of both advanced traveler information systems (ATIS) and advanced traffic management systems (ATMS), uses either historic or real-time data to estimate and predict network traffic conditions. DynusT allows the user to use either pre-trip or en-route information to model ATIS and ATMS strategies and has the ability to simulate multiple user classifications (MUCs). These MUCs (e.g., auto, truck, and high-occupancy vehicle/high-occupancy toll) can be further defined in terms of their responsiveness to available information.

However, previous conversions from mesoscopic to microscopic were done manually. Output data from DynusT, in the form of time-dependent shortest paths and flows, were then manually fed into VISSIM as model input parameters. Roadway networks had to be created by hand in VISSIM, and all input parameters for calibration were individually fed into the microscopic model. The most tedious and time-consuming part was converting dynamic routes from DynusT to static routes in VISSIM. Since DynusT runs DTA, hourly traffic volumes are continuously changing over time. Researchers and engineers are constantly scratching their heads about how to import dynamic path files to the microscopic level without compromising routing or traffic volumes. The new tool developed enables mesoscopic users to create microscopic models with high levels of resolution and detail without the lingering task of data transfer or network re-creation. Paths from the mesoscopic level are exported as time-dependent static routes, allowing for a more realistic time-based distribution of traffic. The end result is a tool that literally reduces the time to convert a mesoscopic model to the microscopic level. The capability of this new tool also allows for detailed intersection-level analyses based on the network-wide traffic assignment results. However, consistency issues occur when converting between the different levels of resolution. This report introduces a new conversion tool capable of converting DynusT mesoscopic datasets to VISSIM microscopic models. More importantly, the report addresses the many consistency issues that occurred during the conversion process.

DYNAMIC URBAN SYSTEMS FOR TRANSPORTATION (DYNUST)

As shown in

Figure 2, within DynusT the traffic assignment process involves the interplay of the simulation model and the time-dependent shortest path and flow redistribution component. During the iterative computational process, the time-dependent link travel time and intersection delays are input into the time-dependent shortest path algorithm. Based on the shortest path calculation results, the new flow distribution and routing policies are computed in a time-dependent traffic assignment procedure, and then input into the traffic simulator to assess the performance of the assignment results. The process is repeated until the convergence criterion or the maximum number of iterations is reached.

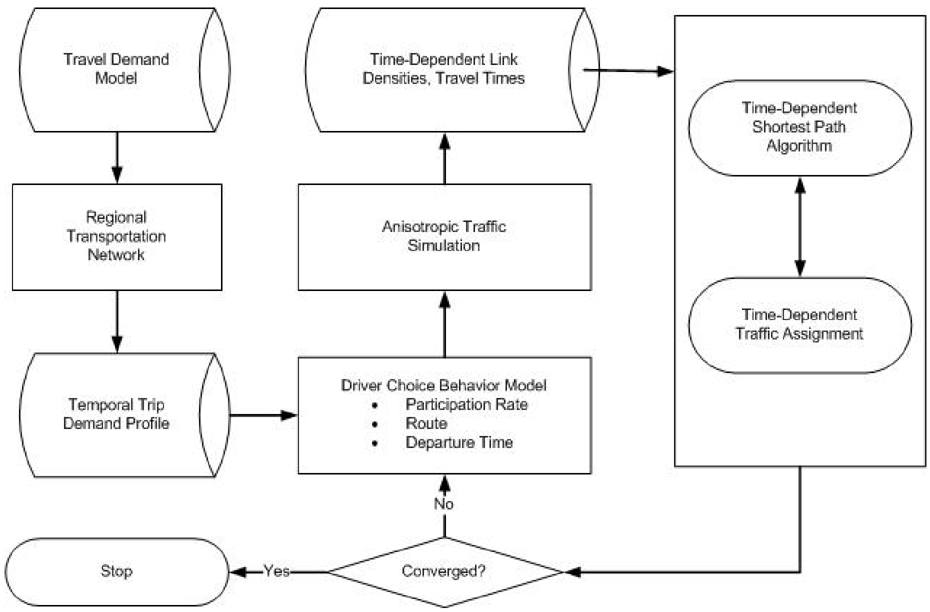

Figure 2. General Algorithm Structure of the DynusT Model.

The unique DTA features in DynusT include the following:

- The vehicle simulation mechanism follows the anisotropic mesoscopic simulation (AMS) logic in that vehicles are simulated following the speed-density relationship. Density here is defined as the density inside a certain region in front of each individual vehicle, called the speed-influencing region (SIR) *(8, 9).*
- A method of isochronal vehicle assignment (MIVA) scheme, in conjunction with the gap-function vehicle (GFV) dynamic traffic assignment approach, was employed in DynusT for rapid and robust assignment under various network and demand scenarios.

For this study, a complete, fully functional DynusT model is needed for the conversion process. Any modifications to the network, including geometric design, traveler information, or traffic management, are implemented before the conversion process. Once the network has been configured to the conditions acceptable by the modeler, a regional DTA algorithm is initiated. This is known as the user equilibrium (UE) condition where all the routes chosen by trip makers between the same origin-destination (O-D) pair exhibit the same travel time. DynusT establishes the UE condition through the deterministic time-dependent shortest path and method of successive average (MSA) or path switching algorithm *(10)*. This is one of the most fundamental steps needed since time-dependent path files are used in the conversion process. Creating path files at the microscopic level is both tedious and time consuming and often does not take into consideration the impact of the surrounding areas. Even with field data collection processes in place, there is still some apprehension in using output data when routes are coded manually. Therefore, O-D calibration, through the use of screen line counts, is conducted with data collected in the field. Once the model is calibrated at acceptable levels, a sub-area cut is performed.

SUB-AREA ANALYSIS

Within the DynusT modeling software resides the capability to reduce the size of the mesoscopic model while still retaining all the routes, flows, and geometric configuration of the remaining portion. This function is called the "sub-area" analysis. The graphical user interface (GUI) is used to cut away unwanted sections of the network and preserve the remaining sub-area. In order to utilize the sub-area cut function in DynusT, output files from the original network need to exist. This is because the vehicle trajectories will need to be processed to create the new demand data for the sub-area. Once the sub-area has been cut to satisfaction, DynusT automatically creates new demand matrices, zonal definitions, and vehicle and path files, thus reducing the size of the overall network files. Figure 3 shows a sub-area cut from a larger network.

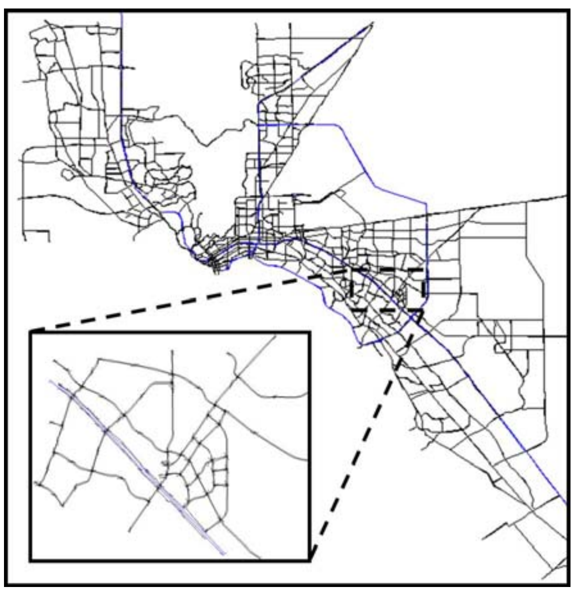

Figure 3. Sub-area Cut in DynusT.

DYNUST/VISSIM CONVERSION TOOL

DVC converts a working DynusT dataset into a VISUM network file and a time-based route information file using the VISUM COM interface. DVC uses the node, link, and zone information from DynusT to generate the corresponding network elements in VISUM. Also, the vehicle route information and the time details from DynusT are used to generate the time-dependent route information for VISUM. The vehicle generation links from DynusT are split at the center to create new vehicle loading links in VISUM. The time-dependent route information file is then imported into VISUM to add vehicle and routing information to the VISUM network. This network, along with the vehicle and routing information, is then exported to VISSIM using the VISSIM export functionality in VISUM. Currently, up to two different types of transportation systems can be exported from DynusT to VISSIM.

VISUM

VISUM was used as a bridge between DynusT and VISSIM since VISUM has the ability to export network datasets directly to VISSIM. The dynamic, time-dependent path files from the mesoscopic model are converted to static routes in the macroscopic model. Paths and flows are temporally distributed in 5-minute intervals for the duration of the simulation period. Separate transportation systems were needed to reflect multiple user classes (auto and truck). This is necessary since the mesoscopic model incorporates both auto and truck O-D matrices. Users can use only one O-D matrix array and define a certain percentage of trucks within the vehicle mix. However, this will result in trucks and autos traveling the same paths. In reality, this is not the case because major trip attraction centers (e.g., central business districts, universities, major shopping malls, etc.) do not have a large percentage of truck traffic. VISUM also has the ability to create separate directional links in VISSIM from a single bidirectional link at the macroscopic level.

VISSIM

Once the VISUM export function has created a VISSIM dataset, final calibration is performed. It is at this point that additional operational strategies are input for final detailed analysis. Additional modification to the existing microscopic model can be edited, including traffic control, speed distributions, speed limits, and speed reduction areas. In addition, vehicle types can be further defined by assigning specific vehicle classes with specific weight and power distributions, as well as minimum and maximum acceleration/deceleration. Link information such as grades and driver behavior is also defined at this stage. If any of the additional operational strategies will cause a redistribution of traffic flow, then this will need to be reflected in the DynusT model where DTA is rerun and the conversion process is repeated. The end result is a high-fidelity microscopic model that reflects the sub-area cut from the mesoscopic model.

CHAPTER 4: CONSISTENCY ISSUES

Consistency between models is essential in order to develop a reliable conversion tool for integration between DynusT and VISSIM. This chapter describes the consistency issues that occurred during the conversion process and mitigation strategies to combat these issues.

VEHICLE LOADING

Vehicle loading has presented several issues when converting a mesoscopic model to a microscopic counterpart. First, mesoscopic models generate vehicles directly on the links (i.e., generation links). This includes the generation of vehicles at both the upstream and downstream nodes and anywhere in between. Since the mesoscopic models do not have as high a fine-grained resolution as microscopic models, generating vehicles randomly on the links is allowable. However, at the microscopic level, vehicles need to be generated at a fixed point usually on a local side street or parking lot. In addition, the mesoscopic models usually do not have as much detailed representation of roadway infrastructure. So how does a modeler that converts a mesoscopic model to a microscopic counterpart overcome this pending issue? One solution is to split the links during the conversion process and have a new generation link that represents either a parking lot or smaller local road where vehicles can be generated at a fixed point. This gives a more realistic representation of traffic conditions at the microscopic level, thus removing the randomness of vehicle generation on the links. The downside to creating new generation links is the additional distance vehicles must travel to get from origin to destination. As a result, travel time is slightly increased for each vehicle generated or destined for these newly introduced links. The tradeoff is a more realistic representation of traffic flow at the microscopic level.

The second issue is the loading of vehicles at the boundary areas where a sub-area cut is made. If a section of freeway is part of the boundary sub-area cut, care must be taken when modeling at congested levels. Vehicles traveling on the left inner lane of a freeway often must weave over several lanes of traffic when trying to exit at the next freeway ramp. High congestion means that adequate gaps are not available for merging over to the rightmost lanes. As a result, vehicles in the microscopic model stop while waiting for acceptable gap clearance, and unrealistic queues form. VISSIM has the ability to dissipate (i.e., remove them from the network) vehicles that stop for a certain defined time period. However, this creates a situation where many vehicles are lost in the simulation. A possible solution was to extend the length of the boundary link, thus giving vehicles an extended distance to find acceptable gaps to merge over multiple lanes of congested traffic. In addition, the exact positioning of vehicles that are randomly generated in DynusT is not known when the sub-area cut is made.

LINK GEOMETRY

When using a sub-area from a mesoscopic model and converting to a microscopic counterpart, geometric issues arise in the form of how links are positioned and how links are represented. DynusT uses two directional links to represent roadways, whereas VISUM uses only one bidirectional link. During the conversion process, DynusT models must first be converted to VISUM. Then VISUM's export capability can convert the models to a microscopic model. The link coordinates in the DynusT mesoscopic model do not need to be highly accurate. DynusT mesoscopic models use one node to connect two directional links as shown in Figure 4. The conversion tool takes into consideration the coordinates of both links and disregards the coordinates of one link. This is necessary since VISUM only uses one bidirectional link. To further complicate matters, the converted VISSIM microscopic models use two links to represent direction. VISUM's export function to VISSIM automatically takes this into consideration and converts the macroscopic bidirectional links into two separate links.

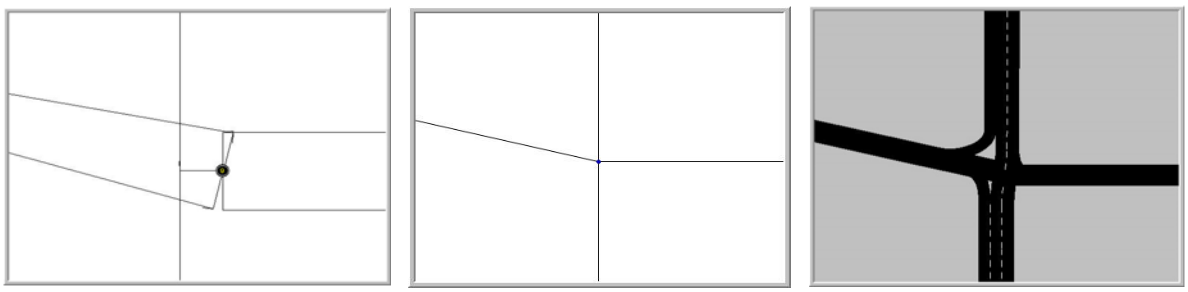

Figure 4. Mesoscopic-Macroscopic-Microscopic Link Geometry.

Consistency issues arise when the coordinates of links between mesoscopic-macroscopic-microscopic models are converted. Both DynusT and VISUM do not need high accuracy and can be off by a few decimal points. The VISSIM model, however, needs high precision when defining the coordinates of the links. Several of the VISSIM links and connectors lie on top of one another, resulting in inconsistent connectors. As a result, many imported paths are broken when converting from mesoscopic to microscopic. To combat this problem, modifications to the DynusT program were made that included the removal of offsets between links and nodes. This allowed the converted microscopic model to have continuous link connectivity, resulting in no broken paths.

The link geometry associated with the converted microscopic model also creates situations where speed reduction zones are automatically assigned in the VISUM to VISSIM export. This situation usually occurs on turns where vehicles would normally reduce their speeds to safely turn. However, this also occurs in merge areas (e.g., freeway entrance/exit ramps) and bends in the roadway. To overcome areas where this feature is not warranted, speed reduction zones are manually removed from the network.

TIME RESOLUTION

All three types of models have different time resolutions. Macroscopic model time resolutions usually are for 24-hour periods, mesoscopic models are several to tens of seconds, and microscopic models are 0.1 to 1 second. When data (traffic assignment route and flow data) are passed from macroscopic or mesoscopic models to microscopic models, the flow/route generated from a coarser-resolution model needs to go through certain assumptions and verification processes to ensure that the data passed maintain sufficient consistency from a temporal standpoint. The conversion tool uses a timestamp of 5 minutes, so paths and flows passed to VISSIM are in 5-minute intervals (i.e., paths and flows are updated every 5 minutes). The conversion could be set to 1-minute intervals; however, the conversion process time increases dramatically due to the additional computational memory needed to generate the increased number of paths and flows.

TRAFFIC DYNAMICS

These models are different in how traffic dynamics are represented. Macroscopic models use volume-delay function (VDF), a nonlinearly increasing function that maps the link volume to link travel time. Mesoscopic DTA models use mesoscopic simulation approaches that apply speed-density relations in moving vehicles along the link, and microscopic models apply an even wider variety of modeling approaches, including the stimulus-response (e.g., CORSIM) or psycho-physical (e.g., VISSIM). Microscopic models often produce different results when integrated with other macroscopic or mesoscopic models.

There were also situations where vehicles were lost in the conversion process due to intrazonal routes. These were routes that traveled from origin to destination all within the same zone. VISUM characterizes these types of trips as “offline” routes and automatically deletes them from the network. In addition, the distribution of speeds that are assigned to vehicles varies from DynusT to VISSIM. The mesoscopic model assigns a predefined speed for various types of links (e.g., 60 mph for freeway links). VISSIM allows much more flexibility in defining and assigning speeds on links. The microscopic model can define a range of speeds for vehicles, which is a much more robust approach.

CHAPTER 5: CASE STUDY

A case study using model integration was performed using the El Paso network as the base case dataset. The purpose of the case study was to be able to perform analyze the possibility of restricting trucks from the left lane on the freeway. This operational study was to be performed with VISSIM's lane closure capability function. However, creating a section of freeway in microscopic model format with static routes input manually was time consuming. Moreover, generating static routes of vehicles entering and exiting freeway ramps without the use of DTA is somewhat unreliable. Therefore, there was a growing need to model these types of situations where both mesoscopic and microscopic models worked together to accomplish optimal modeling capabilities.

The DynusT mesoscopic model was loaded with 4 hours of demand (7-11 AM) and run through the UE assignment algorithm. A sub-area cut of the Interstate 10 freeway approximately 22 miles in length was used for the conversion process. Vehicle path and flow files as well as zonal information were renumbered to reflect the changes in the new sub-area. DVC was then used to create a VISUM network, which in turn was exported to a VISSIM microscopic model. Figure 5 reflects the process from mesoscopic to sub-area to macroscopic to microscopic. Once the conversion process was complete, a series of calibration tests was performed. This was an attempt to calibrate the DynusT and VISSIM model sets against one another.

Figure 5. DVC Conversion Process.

The speed profile was calibrated from actual field data collection in terms of both traffic volumes and speeds on the freeway corridor. This was needed to calculate the queue lengths for freeway facilities based upon an assumed linear relationship between density and flow. The density at capacity is determined based upon the capacity flow rate and the mean speed at capacity. The capacity and the speed at capacity are taken from the basic freeway section speed-flow (v-k) curves in the highway capacity manual (HCM). They vary according to the free-flow speed for the freeway. The mesoscopic traffic flow model was calibrated using the v-k relationship as shown in Figure 6. Once paths and flows were verified in the mesoscopic model, the speed profile was calibrated in the microscopic simulation model based upon the simulated freeway speeds.

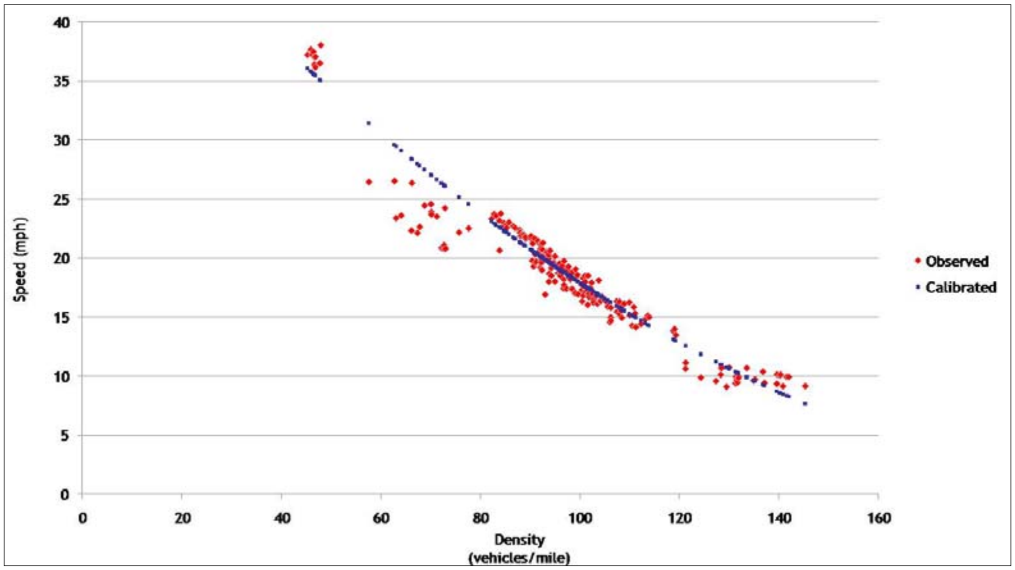

Figure 6. Flow-Density Relationship

Data collection points were placed on the links in several locations on the microscopic model. Speed profiles and acceleration/deceleration patterns were collected, averaged and analyzed. Network performance measures of effectiveness were also collected including total travel time, total stop time and total distance traveled. A comparative analysis of the simulation outputs for both the mesoscopic and microscopic models were then performed.

CHAPTER 6: RESULTS

The morning peak hour simulation model was run for 4-hours from 7-11 am. The model had 122 static routing decisions[1] and 2144 routes created for both auto and trucks. Traffic volumes and routes were updated every 15 minutes for the entire simulation period. Simulation outputs were calculated every 5 minutes and included average speed, acceleration/decelerations, and travel time for both the eastbound and westbound directions. Data collection points were determined based upon areas of recurring traffic congestion. Average speeds (mph) were collected for both the left and right lanes respectively as shown in Table 1. Speeds were also averaged over all lanes for the same time periods

Table 1. Average Speed (7-11 am)

	Left Lane		Right Lane	
	Base (mph)	**Restricted (mph)**	**Base (mph)**	**Restricted (mph)**
Yarbrough (WB)	61.6	63.2	58.6	58.7
Paisano (WB)	55.4	55.7	52.9	52.1
Cotton (WB)	64.4	65.2	60.6	60.5
Resler (EB)	61.8	62.5	58	57.5
Sunland Park	62.2	63.2	60.4	60.3

Simulation results showed increased speeds on the left lane on I-10 that ranged from 0.3 to 1.6 mph in most locations. Right lane speed decreased slightly after the restrictions with the Paisano area experiencing the highest average speed decrease at -0.8 mph. Travel time was also calculated for both the east and west bound directions of I-10. For vehicles traveling on I-10 eastbound, travel time was averaged from N. Mesa St (SH 20) to Schuster Ave (exit ramp18A) and N. Mesa St (SH 20) to N. Lee Trevino Dr (exit ramp 29). For vehicles traveling on I-10 westbound, travel time was averaged from Lee Trevino Blvd to E. Missouri Ave (exit ramp 19B) and N. Lee Trevino Dr to Redd Rd (exit ramp 10). Travel times were almost identical for both the base and restricted scenarios in the east and westbound directions as shown in Table 2.

[1] *Static routing decisions refer to origins (ramps) on the entire 22-mile corridor of I-10 for both the eastbound and westbound directions. Auto and truck origins are counted separately.*

Table 2. Average Travel Time (7-11 am)

Location	Base (minutes)	Restricted (minutes)
N. Mesa St to Schuster Ave (EB)	6.6	6.7
N. Mesa St to Lee Trevino Dr (EB)	17.3	17.4
Lee Trevino Dr to Missouri Ave (WB)	10.9	10.9
Lee Trevino Dr to Redd Rd (WB)	19.1	19.2

Simulation results showed that restricting trucks from using the left-most fast lane had an overall improvement of speeds by approximately 1 -2 miles per hour in most locations. For morning peak hours, the highest increase in average speed on the left lane was +1.6 mph at Yarbrough Dr westbound. Restricting trucks had an adverse affect on average speeds on the right-most lane during morning rush hour with Paisano Dr experiencing a decline on average speed by -0.8 mph.

CHAPTER 7: CONCLUSION

The integration of DynusT and VISSIM provides expanded dimensions of modeling capabilities for existing DynusT and VISSIM users to take advantage of the modeling strengths of both models. The results from the model integration show great promise for integrating mesoscopic and microscopic simulation models. The new integration tool alleviates the need to re-create the entire network from scratch at the microscopic level. In addition, automatically exporting dynamic routes reduces conversion time and gives a much more reliable representation of routing. Also, the ability to differentiate separate paths between cars and trucks produces a dataset more realistic to real-world conditions.

Mesoscopic models are not designed to analyze corridor-specific locations in great detail. DynusT is designed to have a coarser resolution over a wider area. VISSIM is designed for operational analyses over a smaller area in great detail. The integration between mesoscopic and microscopic overcomes the limitations of the individual models. However, the integration conversion process is not without inconsistencies between the mesoscopic and microscopic models. Several steps were needed to overcome the consistency issues during the conversion process. Moreover, once the conversion process is complete without errors in coding, situation still arise where output results vary between datasets. Additional calibration steps are needed to have comparable models.

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