A Matrix-based Quick Programming Tool for Establishing Urban Road Network Topology User Manual

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# JMTS\_2202 Project 2023.9.1



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- 2 Install as a Matlab APP
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### Future Works





Install as a Matlab APP

3 Matlab Source Code





### Introduction

#### Motivation

For large-scale urban road networks, this tool aims at generating corresponding matrices that can be applied in establishing road network topology in an efficient approach. The generated matrices can capture upstream-downstream inter-queue relationships, traffic demand, and signal control scheme characteristics.

#### Contribution

The JMTS\_2202 Project was settled to develop such codes (or applications) that can help users to conveniently form up their own urban road network topological matrices. With these matrices, the modeling process of surrogate macroscopic traffic models for large-scale urban road networks (e.g., finite capacity queuing network model) can be partly simplified.

Note: Further details can refer to the JMTS\_2202 technical report.



The 1.0 version of the JMTS\_2202 tool is coded based on Matlab language. It provides two application approaches:

- Install as a Matlab APP
- Run Matlab source code

Both approaches need Matlab software (version: 2022a or later) installed on the user's computer.



For the convenience of the illustration, this manual uses Matlab R2022a installed on a Mac laptop. Detailed information for the example (default) urban road network is in Chapter 4 of the technical report.







3 Matlab Source Code





Step 0: Install:

0.1 Open Matlab, Click APPS - Install App.

**0.2** Select 'jmts\_2202.mlappinstall', then click 'Open' and 'Install'.

**0.3** User can find an app named "jmts\_2202" in the Matlab application list.









Step 1: Topology Information:

**1.0** Open 'jmts\_2202' Matlab APP. The network information of the example network has already been listed.

Create a new folder and set it as the current folder in the Matlab. All new output matrices (new \*.mat files) can be found in this folder in the future.

If users would like to edit their own network information, change the value of 'Total No. of Intersections' and 'Max No. of Queues within One Intersection', then click the 'New' button.

|                                      |   |                |        | MA    | TLAB App  |  |                      |                 |         |
|--------------------------------------|---|----------------|--------|-------|---|--|----------------------|-----------------|---------|
| Topology                             | Turn                                    | Signal 1       | Timing |       |   |  |                      |                 |         |
| Netwo                                | ork Inf                                 | o              |        | 1     | 2   | 3  | 4                    | 5               | 6       |
| queue_                               | channel                                 | ization        | 1      | 0     | 0   | 0  | 0                    | 0               |         |
| queue_                               | function                                |                | 2      | 0     | 0   | 1  | 1                    | 2               |         |
| queue_<br>queue_<br>queue_<br>segmen | anenum<br>phase<br>segmen<br>it_relatic | t<br>nship     |        | Note: |   |  |                      |                 |         |
| Total No                             | . of Inte                               | rsection       | 8 2    |       | Channelizatio<br>Queues on no<br>Queues for lef | n Values<br>mal lanes: 0<br>t-turn storage | Queue<br>lane: chann | s for right-tur | n<br>d: |
| Max No.<br>within O                  | of Que<br>ne Inter                      | ues<br>section | 14     |       | NOTE: User                                      | manual lists sc                            | me rules on la       | ne functions.   |         |
|                                      |   | N              | ew     | 1     |   |  |                      |                 |         |

**Note:** In this tool, the 'Intersections' refers to signalized intersections. Generally, one unsignalized intersection is set between two adjacent signalized intersections. (Section 2.1 of JMTS\_2202 technical report)



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Step 1: Topology Information: (example)

1.1 Channelization information for queues.

In the channelization information matrix, row *a* represents intersection *a*, and column *b* of row *a* represents  $b^{th}$  queue of intersection *a*.

- If queue (a,b) is on normal lanes (or doesn't exist), matrix (a,b) = 0.
- If queue (a,b) is related to channelization, matrix (a,b) = 1 for downstream queues and = 2 for upstream queues.

|     |                             |    |       |     |   | MATLAB AP | * |   |       |    |            |                |             |  |
|-----|-----------------------------|----|-------|-----|---|-----------|---|---|-------|----|------------|----------------|-------------|--|
|     | Topology Tars Signal Timing |    |       |     |   |           |   |   |       |    |            |                |             |  |
|     | Network info                | 1  | 2     | a.  | 4 |           |   | r |       | 10 | l m        | u              | 12          | м                                      |
|     | queue, channelization       |    |       |     | 0 |           |   | 0 | 4     | 8  |            | 1              | 0           |  |
|     | queue function              | 5  | 0     |     |   |           | 5 | 0 |       | 0  | - 0        |                | 0           | - a) - a                               |
| ies | Curve chase                 |    |       |     |   |           |   |   |       |    |            |                |             |  |
|     | queue,segment               |    |       |     |   |           |   |   |       |    |            |                |             |  |
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|     |                             |    |       |     |   |           |   |   |       |    |            |                |             |  |
| /   |                             |    |       |     |   |           |   |   |       |    |            |                |             |  |
|     |                             |    |       |     |   |           |   |   |       |    |            |                |             |  |
|     |                             |    |       |     |   |           |   |   |       |    |            |                |             |  |
|     |                             |    |       |     |   |           |   |   |       |    |            |                |             |  |
|     |                             |    |       |     |   |           |   |   |       |    |            |                |             |  |
|     |                             |    |       |     |   |           |   |   |       |    |            |                |             |  |
|     |                             |    |       |     |   |           |   |   |       |    |            |                |             |  |
|     |                             |    |       |     |   |           |   |   |       |    |            |                |             |  |
|     |                             |    |       |     |   |           |   |   |       |    |            |                |             |  |
|     |                             |    |       |     |   |           |   |   | <br>_ |    |            |                |             |  |
| - 1 | Save Connect Ma             | 1, | fate: |     |   |           |   |   |       |    |            |                |             |  |
| : I | Our content to              |    |       |     |   |           |   |   |       |    |            |                |             | _                                      |
| · • | Total No. of Intersections  |    |       |     |   |           |   |   |       |    | Conclust   | in Values      |             |  |
|     |                             |    |       |     |   |           |   |   |       |    | Queue de l | officer access | there: when | es for right turn<br>arlicution island |
| 0   | Non-No. of Commen           |    |       |     |   |           |   |   |       |    | F          |                |             | -                                      |
|     | within One Intersection     |    |       |     |   |           |   |   | 9     | 0  | WHEN IS    |                |             |  |
| -   |                             |    |       |     |   |           |   |   |       |    |            |                |             |  |
|     |                             |    |       |     |   |           |   |   |       |    |            |                |             |  |
|     |                             |    |       | Now |   |           |   |   |       |    |            |                |             |  |

**Remember** to click the 'Save Current Info' button before switching to another info.

Note: One segment can only have one type of channelization!



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**Step 1:** Topology Information: (example)

1.1 Channelization information for queues.

For different scenarios of the channelization, version 1.0 of 'jmts\_2202' has the following applicable and inapplicable circumstances.



Two downstream queues can change order from each other. **Note:** For inapplicable circumstances, if users wish to make them applicable, it is advised to simplify the channelization scheme.



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Step 1: Topology Information: (example)

**1.2** Function information for queues.

In the function information matrix, row *a* represents intersection *a*, and column *b* of row *a* represents  $b^{th}$  queue of intersection *a*.

- If queue (a,b) is on approaching lanes, matrix (a,b) = L, T, R, LT, LR, TR, or LTR according to the real-world function.
- If queue (a,b) is on exit (or receiving) lanes, matrix (a,b) = E.
- If queue (a,b) doesn't exist, matrix (a,b) is empty.

| • • •  |   |      |   |   |       | ATLAE App |     |   |    |    |    |    |      |    |
|--|---|------|---|---|-------|-----------|-----|---|----|----|----|----|------|----|
| Topology Turn Elignei Troing                             |   |      |   |   |       |           |     |   |    |    |    |    |      |    |
| Network Info   | _ | h    | 1 | 2 | la la |           |     |   |    | 18 | 11 | 12 | 12   | 14 |
| nunun chancelization                                     |   |      |   |   |       |           |     | T | (T |    |    |    |      |    |
| pueue function   | 2 | 1    | T | 1 | 0     | 18        | 170 |   | 6  |    | 0  |    | LTP. | 1  |
| sjone, fates<br>ingener, nærer (<br>jongster, nældorstig |   |      |   |   |       |           |     |   |    |    |    |    |      |    |
| Save Current Info  |   | Note |   |   |       |           |     |   | 2  |    | ų, |    | Ŧ    |    |
| within One Intersection                                  |   |      |   |   |       |           |     |   | 14 | L  |    |    | L.T  |    |

**Remember** to click the 'Save Current Info' button before switching to another info.



Step 1: Topology Information: (example)

1.3 Lane numbers information for queues.

In the function information matrix, row *a* represents intersection *a*, and column *b* of row *a* represents  $b^{th}$  queue of intersection *a*.

- Users can refer to Section 3.3.1 of JMTS\_2202 technical report which demonstrates the reason and the process of determining the number of lanes for each queue.
- If queue (a,b) doesn't exist, matrix (a,b) = 0.

| •••   |   |     |   |     |   | MATLAE A | 9 |   |     |   |    |    |        |    |     |
|---|---|-----|---|-----|---|----------|---|---|-----|---|----|----|--------|----|-----|
| Topology Tam Eignei Timing  |   |     |   |     |   |          |   |   |     |   |    |    |        |    |     |
| Network Info  |   |     | 1 | 3   | 4 |          |   |   | 1   |   | 18 | 11 | 12     | 13 | 14  |
| eases, channelization   |   |     | 1 | ,   |   | 1        | , | 8 | 1   | 1 |    | 5  |        | 0  |     |
| pueue function  | 2 |     | 2 | 0   |   | . 1      |   | 2 | - 1 |   |    |    | 1      | 0  |     |
| eurous Janonumbers  |   |     |   |     | _ |          |   |   |     |   |    | _  |        |    |     |
| gana Jana<br>Ingana (jandonako<br>Ingana (jandonako   |   |     |   |     |   |          |   |   |     |   |    |    |        |    |     |
| Stree Current littlo Total No. of Intersections Main No. of Current within One Intersection |   | Not |   |     |   |          |   |   |     | 1 | 1  | ][ | et tit |    | 231 |
|   |   |     |   | New |   |          |   |   |     |   | 1  |    |        | _  |     |

**Remember** to click the 'Save Current Info' button before switching to another info.



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Step 1: Topology Information: (example)

1.4 Phase number information for queues.

In the function information matrix, row *a* represents intersection *a*, and column *b* of row *a* represents  $b^{th}$  queue of intersection *a*.

- If queue (a,b) is un-signalized, matrix (a,b) = 0.5;
- If queue (a,b) is controlled by a single phase numbered P<sub>i</sub>, matrix (a,b) = P<sub>i</sub>.
- If queue (a,b) is controlled by two phases numbered  $P_{i1}$  and  $P_{i2}$ , matrix (a,b) =  $[P_{i1} \ P_{i2}]$ .
- If queue (a,b) doesn't exist, matrix (a,b) = [].

| • • •                      |   |   |      |     |     | MTLAR App |     |   |     |    |     |  |  |  |                       |
|----------------------------|---|---|------|-----|-----|-----------|-----|---|-----|----|-----|--|--|--|-----------------------|
| perings Tara Signal Taring |   |   |      |     |     |           |     |   |     |    |     |  |  |  |                       |
| Network Info               |   | ) | 2    | 3   | 4   | 1         | 4   | 3 |     |    | -   | 11   | u  | 13   | 14                    |
| pese, channelization       | 1 |   | 0.5  | 8.5 | 2   | (2.5)     | 0.5 |   | 1.1 | 65 | 2.5 | 10   | 1  | 10   | 1                     |
| perce function             | 2 |   | 6    | 5   | 0.5 | 8.5       | 0.5 |   | 0.5 | 4  | 5   | 05   | 8.5  | 6  | 8.5                   |
| peue_lanenumbers           |   |   |      |     |     |           |     |   |     |    |     |  |  |  | -                     |
| prove phase                |   |   |      |     |     |           |     |   |     |    |     |  |  |  |                       |
|                            |   |   |      |     |     |           |     |   |     |    |     |  |  |  |                       |
|                            |   |   |      |     |     |           |     |   |     |    |     |  |  |  |                       |
| Save Current into          |   |   | the: |     |     |           |     |   |     | 2  |     | Phase Vok<br>For an up-  | es<br>cignalized e   | queue: 0.5   |                       |
| Save Current Into          |   |   | He:  |     |     |           |     |   |     | 2  |     | Phase Vale<br>For as up-<br>for a sign<br>i) Control<br>ii) Control<br>  Phase | es<br>eigenlized e<br>lized queue<br>ed by single<br>led by two<br>1.1 Flank | panac: 0.5<br>c:<br>phase: <u>P</u><br>phase:<br>Phase 2.8 | 000   10<br>1000   10 |

**Remember** to click the 'Save Current Info' button before switching to another info.

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#### Step 1: Topology Information: (example)

1.5 Segment numbers information for queues.

In the function information matrix, row *a* represents intersection *a*, and column *b* of row *a* represents  $b^{th}$  queue of intersection *a*.

- The setting and numbering rules for determining the segment number for each queue are on the next slide.
- If queue (a,b) doesn't exist, matrix (a,b) = 0.

|   |   |       |     |   | MATLAN AP | *   |   |   |   |               |     |       |           |              |   |
|---|---|-------|-----|---|-----------|-----|---|---|---|---------------|-----|-------|-----------|--------------|---|
| Tayongy Tara Signal Timing  |   |       |     |   |           |     |   |   |   |               |     |       |           |              |   |
| Network Info  |   | ja –  | 3   | 4 | 5         | 4   | 2 |   |   | 43            | 95  | 12    | a         | 64           | 1 |
| umas, daranaladar<br>umas, daraka<br>umas, daraka<br>umas, darak<br>umas, dara | 1 |       | 0 0 | 8 | 0         | 0 2 | 8 | 1 | 3 | <u>n</u><br>0 | 8   | 0 0   | 0         | 0            |   |
| Save Current Info   |   | Neter |     |   |           |     |   |   |   | 2             | _   |       | Segment 4 |              |   |
| Max No. of Queens<br>within One Intersection  |   |       |     |   |           |     |   |   | , | L             | Seg | ncet. | cgmoni    | Segment<br>3 |   |

**Remember** to click the 'Save Current Info' button before switching to another info.

Step 1: Topology Information: (example)

**1.5** Segment numbers information for queues.

Version 1.0 of 'jmts\_2202' accepts the following forms of intersections:



The above figure gives one kind of way to define segment numbers which can be considered as a generalized approach. Users can define their segment numbers in a customized way.

**Note:** Once the segment numbers are settled, they should remain unchanged throughout the project.



Step 1: Topology Information: (example)
1.6 Segment relationship information.
In the segment relationship information matrix, row *a* represents intersection *a*, and column *b* of row *a* represents the upstream segment of segment *b* of intersection *a*.

- If segment (a,b) has no upstream segment, matrix (a,b) = 0;
- If segment (a,b) 's upstream segment is the segment d of intersection c, matrix (a,b) = [c d].

| ••   |       | MATLAN App |         |  |
|--|-------|------------|---------|--|
| prology Tara Signal Taring   |       |            |         |  |
| Network Info   |       | 2          | 1       | 4  |
| yana, di wakaton<br>jana, function<br>jana, function<br>jana |       | 9<br>9     | 74<br>9 | 9<br>9   |
|  |       |            |         |  |
| Save Current Into  | Neter |            |         | Ljonnan Segnen al Segnen (Selami al Insectior i<br>el l'agont (al Insectior i las sequena agont i  |
| Save Current Info  | Neter |            | P       | Kjonnen Segnera al Segnera, (Colonni al Instantoro<br>o Eragones) al instantorio i las se operante regiones<br>"Eragones ( el instantorio ) contraste regiones<br>in ogenes i el instantorio ( ) contraste regiones      |
| Save Cummit Info   | Nets  |            | 2       | Connect Segment of Segment (Colonse) of Intervations<br>- Segment (Colonse) of Assessment (Sea segments argument<br>- Segment of Intervation (Colonse) (Colonse) (Segment<br>- 1 3 3 3 3 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 |

**Remember** to click the 'Save Current Info' button before switching to another info.



# Step 1: Topology Information: (example) Summary: After step 1, users can generate the following \*.mat files:

Name

| 愉 rel_seg1.mat    | $\rightarrow$ Step 1.6 |
|-------------------|------------------------|
| 1 info_queseg.mat | $\rightarrow$ Step 1.5 |
| 1 info_quepha.mat | $\rightarrow$ Step 1.4 |
| 1 info_quenml.mat | $\rightarrow$ Step 1.3 |
| 愉 info_quefun.mat | $\rightarrow$ Step 1.2 |
| 愉 info_quecha.mat | $\rightarrow$ Step 1.1 |



Step 2: Volume Information: (example)

While clicking the 'Turn' tab, this tool can automatically recognize the total number of intersections and the total number of queues based on these files generated from step 1.

For each intersection, please input volume on a segment-directional basis:

- If a segment doesn't exist, all directional volumes of this segment are 0.
- If a segment is a one-way segment without approaching lanes, all directional volumes of this segment are 0.



**Remember** to click the 'Save Current Intersection Volumes' button before switching to another intersection.



Step 2: Volume Information: (example)

After inputting and saving all volumes of all intersections of the network, click the 'Generate Topology & Demand Matrices' button





Summary: After step 2, users can obtain the TDM.mat file.

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# **Step 2:** Volume Information: (example) **Summary:** In TDM.mat file:

| Variable name | Matrix structure        | Symbol in technical report |
|---------------|-------------------------|----------------------------|
| dwnprbind     | $I \times B_I$ double   | $P^B$                      |
| dwnqueind     | $I \times B_I$ double   | $B^0$                      |
| extarrind     | I 	imes 1 double        | $\Gamma^{T}$               |
| info_queind   | $I_n \times i_n$ double | -                          |
| quenmlind     | I 	imes 1 double        | $N'^{T}$                   |
| totarr        | $I_n 	imes i_n$ double  | -                          |
| upprbind      | $I \times A_I$ double   | $P^{A}$                    |
| upsqueind     | $I \times A_I$ double   | $A^0$                      |

Notations of symbols refer to Chapter 1 of JMTS\_2202 technical report.



#### **Step 3:** Signal Control Information: (example)

While clicking the 'Signal Timing' tab, this tool can automatically recognize the total number of intersections, the total number of queues, the maximum number of queues within one intersection, the total number of phases, the maximum number of corresponding phases for one queue, and the maximum number of phases within one intersection based on these files generated from step 1.

In the signal timing matrix, row *a* represents intersection *a*, and column *b* of row *a* represents the  $b^{th}$  signal phase of intersection *a*.

- If a phase doesn't exist, matrix (a,b) = 0.
- If a phase exists, matrix (a,b) = corresponding duration of the signal phase.

| ; Inb | ersection #   → Signa   | Phase # for Each I | ntersection                                      |  |           |
|-------|---|--------------------|--|--|-----------|
|       | 1   | 2                  | 3  | 4  |           |
| 1     | 37  | 10                 | . 4  | 7  |           |
| 2     | 13  | 44                 |  | 9  |           |
| ∕ Eff | fective Green Time (s)  | Report Signal Timi | igs] [Save Adjuste                               | d Effective Green '  | Tirr      |
| ∕ En  | fective Green Time (s)  | Repet Signal Time  | rgs] [Save Adjuste<br>Total No.                  | d Effective Green <sup>*</sup><br>of Phases 7                  | Tier      |
| ≥ Eu  | fective Green Time (s)<br>Total No. of Intersec<br>Total No. of Q | Reset Signal Time  | rgs) Save Adjuste<br>Total No.<br>Max No. of Com | d Effective Green <sup>1</sup><br>of Phases 7<br>seponding 2   | Tirr<br>2 |
| 2 Eu  | fective Green Time (s)<br>Total No. of Intersec<br>Total No. of Q | Preset Signal Time | Total No.<br>Max No. of Com<br>Phases for C      | d Effective Green T<br>of Phases 7<br>seponding 2<br>the Queue | Tirr<br>2 |



**Step 3:** Signal Control Information: (example)

For a new network customized by users, users should click the 'Reset

Signal Timings' button before filling in the signal timing matrix.

**Remember** to click the 'Save Adjusted Effective Green Time' button after completing the signal timing matrix.

|          |  | MATLAB                | App                                |                                 |
|----------|--|-----------------------|------------------------------------|---------------------------------|
| Topology | Turn Signal Timir                      | 9                     |                                    |                                 |
| ↓ Inte   | rsection # $  \rightarrow$ Signa       | I Phase # for Each Ir | ntersection                        |                                 |
|          | 1                                      | 2                     | 3                                  | 4                               |
| 1        | 37                                     | 16                    | 47                                 | 0                               |
| 2        | 13                                     | 44                    | 9                                  | 9                               |
| ∕* Effe  | ective Green Time (s                   | Reset Signal Timin    | ngs Save Adjusted                  | Effective Green Time            |
|          | Total No. of Interse                   | tions 2               | Total No. o                        | f Phases 7                      |
|          | Total No. of Q                         | Jeues 24              | Max No. of Corres<br>Phases for Or | sponding 2<br>le Queue          |
|          | Max No. of Queue<br>within One Interse | ection 14             | Max No. of Ph<br>within One Inte   | ases 4                          |
| 1        |  |                       | Ger<br>Cor                         | nerate Signal<br>htrol Matrices |

Finally, users can obtain the SCM.mat file by clicking the 'Generate Signal Control Matrices' button.



**Step 3:** Signal Control Information: (example) **Summary:** In SCM.mat file:

| Variable name | Matrix structure          | Symbol in technical report   |
|---------------|---------------------------|------------------------------|
| intsgtind     | $P_M 	imes 1$ double      | $\mathcal{P}^{D}$            |
| stsum         | $I_n \times P_m$ double   | $ar{\mathcal{P}}^{c}$        |
| quesrrind     | I 	imes 1 double          | $M^{T}$                      |
| TC0           | 1 	imes I double          | $\mathcal C$                 |
| sgm           | $I \times S_{max}$ double | $\mathcal{S}^1_{ij}$         |
| shm           | $I \times S_{max}$ double | $\bar{\mathcal{S}}_{ii}^{0}$ |
| stm           | $I \times S_{max}$ double | $\bar{\mathcal{S}}^{1}$      |
| fhm           | $I 	imes S_{max}$ double  | $\mathcal{S}^{01}$           |
| stsumh        | $I 	imes P_m$ logical     | $ar{\mathcal{P}}^1$          |

Notations of symbols refer to Chapter 1 of JMTS\_2202 technical report.





Install as a Matlab APP



#### 4 Future Works



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For those users who are familiar with Matlab, they can directly run source codes in the Matlab editor.

Step 0: Edit following variables from \*.mat files in the Matlab workspace:

Rules of editing can refer to step 1.1 - step 1.6 and step 3 in the last section.

**Remember** to replace old files with edited \*.mat files while keeping the file names unchanged.



### Run Matlab Source Code

#### Step 1: Run JMTS\_2202\_1\_0\_1A.m: (example)

#### 1.1

Input an intersection number in the command window (after the # symbol), then press 'Enter'.

#### 1.2

Input the volume matrix for each segment in the command window (after the # symbol), then press 'Enter'.

Two input matrix formats are as follows: (Veh/h)

- [left-turn-volume through-volume right-turn-volume]
- [left-turn-volume,through-volume,right-turn-volume]



#### Command Window

>> JMTS\_2202\_1\_0\_1A The volume group of intersection #1 fx The volume group of intersection #1segment1

#### Step 1: Run JMTS\_2202\_1\_0\_1A.m: (example)

#### 1.3

After finishing all segments in the intersection, press 'Enter' and repeat the step 1.1 and 1.2.

#### Command Window

|    | >> : | MTS_220 | 92_1_0 | _1A |              |                           |         |
|----|------|---------|--------|-----|--------------|---------------------------|---------|
|    | The  | volume  | group  | of  | intersection | #1                        |         |
|    | The  | volume  | group  | of  | intersection | #1segment1[0,55           | 50,400] |
|    | The  | volume  | group  | of  | intersection | #1segment2[700            | 0 650]  |
|    | The  | volume  | group  | of  | intersection | #1segment3[200            | 400 0]  |
|    | The  | volume  | group  | of  | intersection | <pre>#1segment4[0 0</pre> | 0]      |
| fx | The  | volume  | group  | of  | intersection | #2                        |         |

#### 1.4

After finishing all intersections, press 'Enter' and users will see '»' symbol in the Matlab command window, which shows the completion of the volume input process. The volgrp.mat file is generated.

#### Command Window

|    | >> : | MTS_220 | 92_1_0 | 1A |              |                          |
|----|------|---------|--------|----|--------------|--------------------------|
|    | The  | volume  | group  | of | intersection | #1                       |
|    | The  | volume  | group  | of | intersection | #1segment1[0,550,400]    |
|    | The  | volume  | group  | of | intersection | #1segment2[700 0 650]    |
|    | The  | volume  | group  | of | intersection | #1segment3[200 400 0]    |
|    | The  | volume  | group  | of | intersection | #1segment4[0 0 0]        |
|    | The  | volume  | group  | of | intersection | #2                       |
|    | The  | volume  | group  | of | intersection | #2segment1[400 2100 300] |
|    | The  | volume  | group  | of | intersection | #2segment2[50 40 30]     |
|    | The  | volume  | group  | of | intersection | #2segment3[200 800 100]  |
|    | The  | volume  | group  | of | intersection | #2segment4[30 40 50]     |
| fx | >>   |         |        |    |              |                          |



Step 2: Run JMTS\_2202\_1\_0\_2A.m.

Step 3: Run JMTS\_2202\_1\_0\_4A.m.

**Finally**, all matrices mentioned above (including topology, demand, and signal control matrices) are generated and can be found in the Matlab workspace.

| • • •         | Workspace                |
|---------------|--------------------------|
| Name 🔺        | Value                    |
| 🔠 dwnprbind   | 24x3 double              |
| 🗄 dwnqueind   | 24x3 double              |
| 🔠 extarr      | 2x14 double              |
| 🗄 extarrind   | 24x1 double              |
| 🔠 fhm         | 24x2 double              |
| 🔠 h           | 3                        |
| 🔠 i           | 2                        |
| 🖶 info_intsgt | [37,16,47,0;13,44,9      |
| 🔠 info_quecha | 2x14 double              |
| 🚺 info quefun | 2x14 cell                |
| info queind   | 2x14 double              |
| info auenml   | 2x14 double              |
| 🚺 info quepha | 2x14 cell                |
| info quesea   | 2x14 double              |
| H intsatind   | [37:16:47:13:44:9:9]     |
| 1             | 14                       |
| m             | 25                       |
| n             | 8                        |
| num maxin     | 4                        |
| num maxque    | 14                       |
| num maxq      | 2                        |
| num totint    | 2                        |
| num totoha    | 7                        |
| num totaue    | 24                       |
| 0 nrb         | 2x14 cell                |
| auenmlind     | 24x1 double              |
| questrind     | 24x1 double              |
|               | 2v4 cell                 |
|               | 4x3x2 double             |
| sam           | 24x2 double              |
| shm           | 24x2 double              |
| stm           | 24x2 double              |
| stsum         | [1 2 3 1 4 5 6 7]        |
| stsumh        | 2x4 logical              |
| TCO           | 1v24 double              |
| tatvol        | 2800                     |
| totintnum     | 2000                     |
|               | 24x4 double              |
|               | 2v14 coll                |
| upsque        | 2X14 Cell<br>2Av4 double |
| upsqueind     | 24X4 UUUDIe              |
| upsvol        | 1200                     |
|               | 2x14 double              |
| T volarn      | 4x4xz double             |





2) Install as a Matlab APP

3 Matlab Source Code

### 4 Future Works



- **①** This tool would be considered to be reprogrammed via Python.
- **②** Overcome intersection type limitations.
- **Overcome one-segment-one-channelization limitation.**
- One queue would be controlled by more than 2 phases.
- **Overcome inapplicable channelization limitation.**
- **Optimal signal timings would be calculated automatically.**
- Extend more connectors with different kinds of macroscopic traffic models for large-scale traffic signal control.

