

**PANDUAN PENGGUNAAN IDEAL FLOW NETWORK REVOLEDU 2024
LABORATORIUM TEKNIK LALU LINTAS DAN PERENCANAAN TRANSPORTASI
UNIVERSITAS KRISTEN PETRA**

Dosen :

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PROGRAM STUDI TEKNIK SIPIL



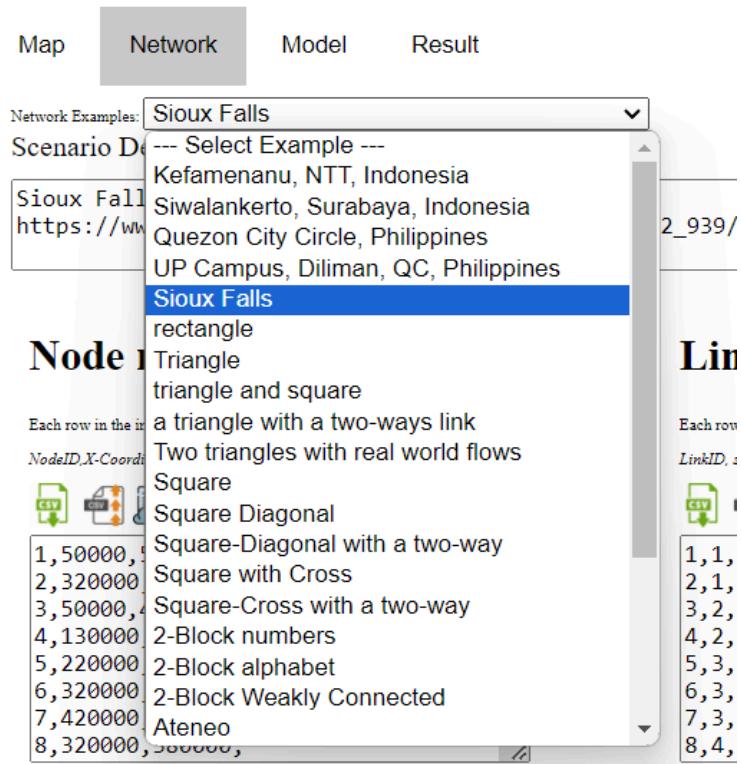
**FAKULTAS TEKNIK SIPIL DAN PERENCANAAN
UNIVERSITAS KRISTEN PETRA
SURABAYA
2024**

KATA PENGANTAR

Panduan ini bertujuan untuk memberikan petunjuk mengenai penggunaan program IFN Transport yang ada di website <https://people.revoledu.com/kardi/tutorial/IFN/IFN-transport.html>. Program ini digunakan untuk menganalisa *Base Scenario* serta skenario lainnya yang diusulkan sebagai solusi untuk mengurangi kemacetan. Panduan ini pertama kali diterjemahkan oleh Angel (asisten laboratorium Teknik Lalu Lintas dan Perencanaan Transportasi 2023/2024). Apabila setelah membaca panduan ini pembaca masih kebingungan, pembaca dapat bertanya kepada Asisten Laboratorium Teknik Lalu Lintas mengenai cara penggunaan program IFN. Apabila terdapat tambahan informasi, panduan ini dapat dilengkapi sesuai dengan kebutuhan Laboratorium Teknik Lalu Lintas dan Perencanaan Transportasi Universitas Kristen Petra.

Langkah langkah membuat IFN transport

1. Melalui **Website** : <https://people.revoledu.com/kardi/tutorial/IFN/IFN-transport.html>
2. Menu **Network**: Terdapat beberapa contoh Network Skenario yang dapat digunakan.



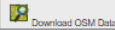


Gambar Menu Network bagian Network Example.

- a. Jika ingin menganalisa jaringan jalan lain secara Makroskopik dapat diakses melalui website Open Street Map (OSM) untuk mencari Node dan Link jalan yang diinginkan: <https://www.openstreetmap.org/export#map=14/14.6480/121.0765>. Setelah itu dapat di export dan diimpor ke website IFN Transport melalui Menu **Map** atau dengan mengganti *Bounding Box* yang tersedia. Di menu ini kita juga memilih jenis jalan *Road type* yang ingin dianalisa dan bisa mengisi data jalan '*Data Imputation Settings*'.

OpenStreetMap Data Processor

Go to [OSM web page](https://osm.org) to get the bounding box of your place of interest.
Zoom the map close enough (zoom level 13-19) such that the max data to be downloaded is less than 1 MB. Change the road type to be only major roads to accommodate (zoom level 13-14).
Then copy and paste the bounding box coordinates.

When you click "Download OSM Data" to download the data, it would convert, impute and clean the data and put into link matrix and node matrix in [Network Data](#) Tab.

Road Type	Bounding Box	
<input checked="" type="checkbox"/> Motorway	<input type="text" value="-9.4407"/>	<input checked="" type="checkbox"/> Clean to Largest Strongly Connected Component
<input checked="" type="checkbox"/> Trunk	<input type="text" value="124.4608"/> <input type="text" value="124.5214"/>	  
<input checked="" type="checkbox"/> primary	<input type="text" value="-9.4796"/>	
<input checked="" type="checkbox"/> Secondary		
<input checked="" type="checkbox"/> Tertiary		
<input type="checkbox"/> Service		
<input type="checkbox"/> Residential		
<input type="checkbox"/> Living Street		
<input type="checkbox"/> Unclassified		

Data Imputation Settings

Show Settings



These are the default values to be imputed when the data from OSM does not have these values. If you want to use different settings, you must change the settings first before downloading data from OSM.

Default Road Width (meter):	<input type="text" value="3"/>
One Way Road Width (meter):	<input type="text" value="2,75"/>
Two Ways Road Width (meter):	<input type="text" value="4"/>
Gradient Capacity to Road Width (pcu/hour/meter):	<input type="text" value="500"/>
Intercept Max Speed (km/hour) for the lanes:	<input type="text" value="20"/>
Gradient Max Speed (km/hour/lane):	<input type="text" value="15"/>
Gradient capacity to Number of Lane (pcu/hour/lane):	<input type="text" value="1500"/>
One Way Number of Lane (lane):	<input type="text" value="1"/>
Two Ways Number of Lane (lanes):	<input type="text" value="2"/>

Simulate Imputation
Number of lanes: <input type="text" value="N/A"/>
Road Width (meters): <input type="text" value="N/A"/>
One Way: <input type="text" value="N/A"/>

Gambar Menu Map.

- b. Jika ingin menganalisa jaringan jalan secara Mikroskopik dapat langsung mengubah node matrix dan link matrix sesuai dengan yang di inginkan

Node matrix

Each row in the input Node Matrix consists of the following data:

NodeID, X-Coordinate, Y-Coordinate;



```
1, 50000, 510000;  
2, 320000, 510000;  
3, 50000, 440000;  
4, 130000, 440000;  
5, 220000, 440000;  
6, 320000, 440000;  
7, 420000, 380000;  
8, 320000, 380000;
```



You can do coordinate transformation to rotate 90 clockwise or counter clockwise, flip vertical or horizontal for better drawing of the network. Undo is only for one last transformation. Do Undo every time to go back to the original data, before you do the next transformation

Link matrix

Each row in the input Link Matrix consists of the following data:

LinkID, startNodeID, endNodeID, linkCapacity, linkDistance (km), linkMaxSpeed (km/h);



```
1, 1, 2, 25900, 20064, 6, 60;  
2, 1, 3, 23403, 47319, 4, 60;  
3, 2, 1, 25900, 20064, 6, 60;  
4, 2, 6, 4958, 180928, 5, 60;  
5, 3, 1, 23403, 47319, 4, 60;  
6, 3, 4, 17110, 52372, 4, 60;  
7, 3, 12, 23403, 47319, 4, 60;  
8, 4, 3, 17110, 52372, 4, 60;
```



End each row by a semicolon. Separate each data in one row by comma or a space.

- Link ID is useful number for your own identification. Each link is one directional traffic stream.
- If the road is two ways, in macroscopic level, you need to create two links, one for each direction. In microscopic level, each turning direction is one link such that there is no ambiguity of the directional traffic stream (see examples of Microscopic T or - Intersections).
- Start Node ID is the beginning node identification number of the link
- End Node ID is the ending node identification number of the link
- Link capacity is either given based on standard (such as HCM) in *pcu/hour/link direction*, or approximated based on road width (in *meters/link direction*) or number of *lanes per link per direction* (See: Setting tab)
- link distance is the road length per link, in *km*.
- link max speed (to be precise: free flow speed) is in *km/hour*.

Make sure your link data produces a strongly connected network. You can test it using button above.

IFN requires the network to be strongly connected. If it happens that your network is weakly connected, can either clean your network by having only the largest strongly connected network , or you can create a cloud node and connect each of the source node (or source component) in the network into the cloud node through dummy links and connect the cloud node to each of the sink node (or sink component) in the network using dummy links.

In most practical purposes, you want to exclude the links related to the cloud nodes from the computation of network performances. For theoretical purposes, the inclusion of links related to the cloud node would guarantee that the ideal flow matrix is pragmatic.

Gambar Menu Network bagian Node Matrix dan Link Matrix.

- Buatlah Node Matrix (letak koordinat suatu titik) dengan format :


NodeID, X-Coordinate, Y-Coordinate;

(Jika jaringannya tidak Strongly Connected maka buat 1 titik tambahan sebagai Cloud Node agar menjadi jaringan jalan yang Strongly Connected)

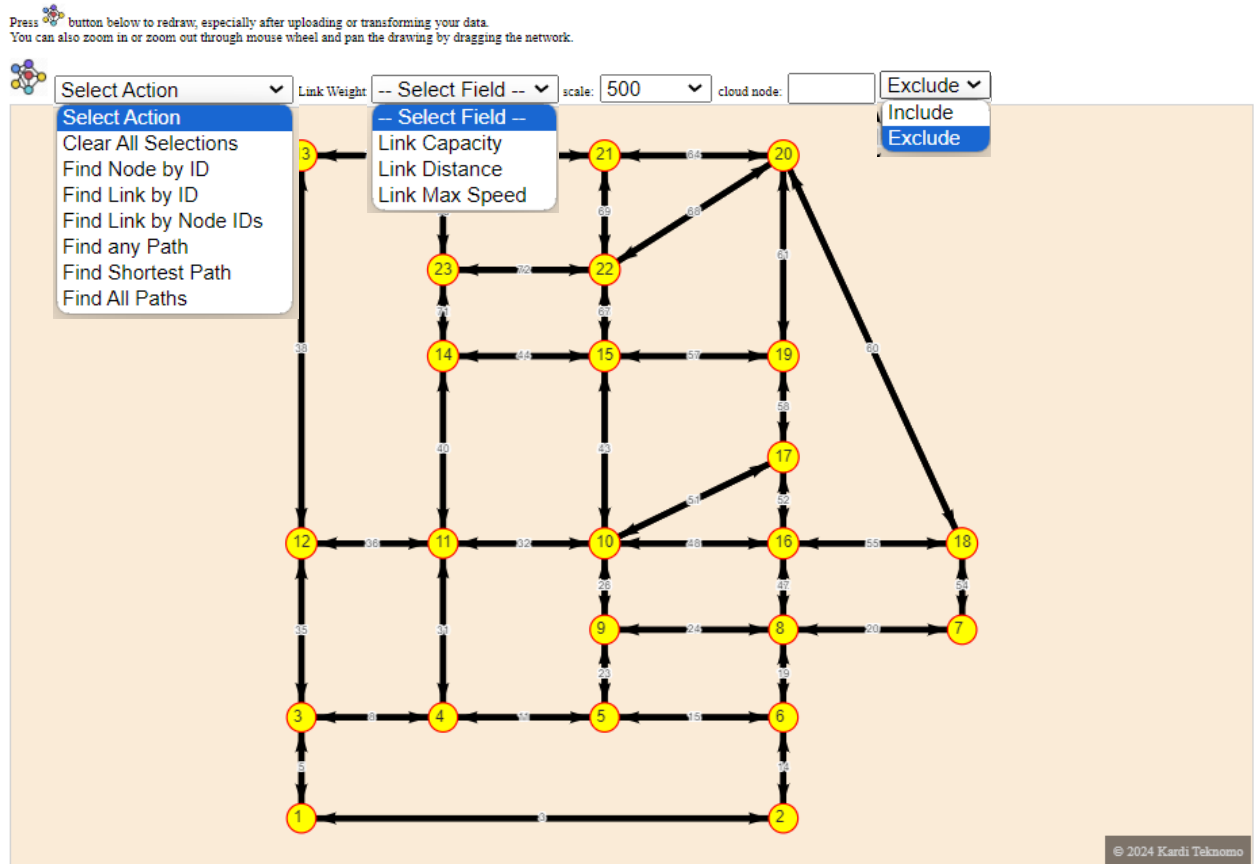
- Buatlah Link Matrix (alur jalan dari 1 titik ke titik lainnya) sesuai dengan format :

LinkID, startNodeID, endNodeID, linkCapacity (pcu/h), linkDistance (km), linkMaxSpeed (km/h);

- Link ID : Nomor yang digunakan untuk identifikasi arah arus lalu lintas. (Jika jalannya dua arah, perlu membuat dua tautan, satu untuk setiap arah)
- Start Node ID : Nomor identifikasi node posisi awal dari link.
- End Node ID : Nomor identifikasi node posisi akhir dari link.
- Kapasitas jalur diberikan berdasarkan standar (seperti HCM) dalam *pcu/hour*, atau diperkirakan berdasarkan lebar jalan (dalam meter) atau jumlah jalur/jalur/arah
- Link Distance : Panjang jalan per link, dalam km.
- Link Max Speed (kecepatan aliran bebas) dalam km/jam.

3. Untuk memunculkan gambar jaringan jalan yang ingin dianalisa melalui **Display Network** dengan cara klik gambar  dengan skala yang dapat diatur antara (10-500.000). Dalam *Display Network* ini juga dapat mempermudah dalam mencari aksi, mencari bidang, dan menginput Cloud Node untuk jaringan jalan yang tidak *Strongly Connected*.

Display Network



Gambar Contoh Display Network.

4. Menu **Model** :

- *Traffic Assignment Model* : digunakan untuk memilih jenis Model Penugasan Lalu Lintas
- *IFN Constrain* : digunakan untuk menentukan batasan IFN
- *Travel Time Model* : bisa diatur menjadi **Greenshields; BPR; Modified Green Shield**
 - Greenshields, nilai Max Congestion < 1
 - BPR, nilai Max Congestion > 1

- **Capacity** : bisa diatur kapasitas lajunya ingin menggunakan **PCU/hour; Number of Lanes; Road Width in meter**
- **Capacity to Stochastic Model** : untuk mengubah Kapasitas menjadi Model Stokastik

Map Network **Model** Result



Traffic Assignment Model

Set the Traffic Assignment model: **Ideal Flow Network**

IFN Constraint

Set a constraint to the model:

real world flow

Input: real world flow using the following format:

Node1, Node2, ActualFlow:

```
1, 2, 4494.657646;
1, 3, 8119.079948;
2, 1, 4519.079948;
2, 6, 5967.336396;
3, 1, 8094.657646;
```

In any model, we need to have invariant, something that we assume to be constant. Using IFN, you could calibrate the results based on one of the following assumptions.

- **Total flow as constant** means you assume the total demand in the entire network does not change. This is useful for modeling short-term effect by comparing scenarios on the same invariant
- **Max flow as constant** means you assume the maximum demand on certain links would be used as the basis of comparison. This is useful for modeling medium-term effect by comparing scenarios on the same invariant
- **Max congestion level as constant** means you assume the maximum congestion level on certain links would be used as the basis of comparison. This is useful for modeling long-term effect by comparing scenarios on the same invariant
- **Real-World Flow as constant** means you assume the observed real world flow as the ground truth to be used as the basis of comparison. This is useful if you have one or several link flow data for the base scenario.
- **Origin-Destination (OD) Flow as constant** means you assume the observed origin-destination flow as the ground truth to be used as the basis of comparison. This is useful for comparison with traditional traffic assignment methods. You need to convert the OD Flow matrix into the Real-World Flow matrix. Then you can optionally add or modify the computed Real World flow. The IFN computation would be based on the Real-World Flow matrix, not the OD Flow matrix.

Travel Time Model

Set Travel Time Model:

BPR γ : 0.15 η : 4

Using Greenfield's traffic model, we assume the speed-density relationship is linear and the congestion level g (which is equal to the flow/capacity) is set to be between zero and one. Since the congestion level is normalized to be between zero and one, it is easier to interpret the meaning of congestion level. Congestion is just flow/capacity and capacity is the maximum flow. The Greenfield tends to have higher speed than BPR (for the same congestion level) and only operates when the traffic is not so congested (i.e., uncongested region of the fundamental diagram of traffic flow model).

EPR model $t = t_0 (1 + \gamma g^\eta)$ has two parameters, γ and η , while the internal parameter t_0 depends on link maximum speed and link distance, which is already inside the network link matrix data. Greenfield model $t = \frac{d}{u_f(1+\sqrt{1-g})}$ and Modified Greenfield model $t = \frac{d}{u_f(1+\sqrt{1-g})}$ has no external parameter because the internal parameters are link

maximum speed and link distance, which is already inside the network link matrix data. The \pm in Modified Greenfield model depends on $sign(1-g)$. EPR model and Modified Greenfield produces better variation of speed and travel time even when the traffic is congested. However, the congestion level (which is equal to the flow/capacity) can go beyond 1, which make the definition of capacity somewhat confusing because "practical capacity" is no longer the maximum flow. For Modified Greenfield, the max congestion must be less than 2.0. There is no limit of congestion value if you use EPR model. Transportation engineers is often using EPR model in conjunction with the practical capacity derived from Highway Capacity Manual (HCM).

Capacity

Set the values in link capacity to represent: **pcu/hour**

Optional input: set capacity multiplier: **1** vehicle/hour

You can set the link capacity is either given based on standard in passenger car unit per hour (pcu/hour). Alternatively, it is sometimes easier to approximate the link capacity based on road width (in meter) or number of lanes per link per direction.

Capacity multiplier is used when the link capacity unit is not in pcu/hour. The capacity multiplier would change as you change the meaning of link capacity. You can change the default value of capacity multiplier.

Capacity to Stochastic Model

The flow in IFN is proportional to the capacity ratio.

You can select to use either simple proportional model without any parameter $s_{ij} = \frac{c_{ij}}{\sum_{k=1}^n c_{ik}}$ or use power-exponential model with two parameters $s_{ij} = \frac{c_{ij}^\alpha \beta c_{ij}}{\sum_{k=1}^n c_{ik}^\alpha \beta c_{ik}}$.

Model: **Simple Proportion**

Gambar Menu Model.

5. Menu **Result**: Pada bagian *Run the Scenario* tekan calculate untuk menemukan output/ hasil jaringan yang diteliti. Akan ada *Report Table* untuk setiap link jalan yang dianalisa. Dari situ akan terlihat bagian jalan mana yang memiliki tingkat kemacetan tertinggi. Hasil dari analisa ini juga bisa di download dalam bentuk Excel melalui *Export Result to Excel*.

Map Network Model **Result**

Run the Scenario

If you upload or change your data or your model, you need to press Calculate button to recalculate.

Calculate

Output:

Network Performances

Total Flow = 1116066.00

Network Entropy = 4.1206

Network Entropy Ratio = 0.9515

Network Max Entropy = 4.3307

Number of Links on computation =76

Number of Links on the data =76

Number of Nodes on computation =24

Number of Nodes on data =24

Gambar Contoh Menu Result untuk skenario Sioux Falls.

Catatan Tambahan :

1. Di Indonesia menggunakan Lajur Kiri.
2. Dalam membuat Dummy Link perhatikan alur keluar masuk.
3. Perhatikan yang diminta skalanya secara microscopic/ macroscopic.
4. Untuk memudahkan pembuatan Node dan Link sebaiknya digambar dahulu di kertas.