

CLC Network Modelling Project (Inter-agency)

NSCC x Geoworks Enablement Series 2021

5th March 2021

- How street network spatial modelling and analysis can value-add planning processes and policies within govt agencies
- How High Performance Computing (HPC) played a role

Content produced by the Complexity Science team at CLC

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Overall Project Goals Network Modelling Project

- Develop street network modelling analysis to uncover hidden urban structures, missing opportunities
- Designing a robust analytical methodology for scientific modelling and application to agencies' use cases
- Scientifically testing design options and masterplan proposals
- Providing objective advice, consultancy wherever needed

SPACE SYNTAX Street Network Model





1. Measures accessibility of existing and proposed masterplans

2. Uncovers potential in active mobility routes and identifies missed opportunities

Betweenness Centrality

Choice / Through-Movement



Segment Angular Analysis

Angular Change

The way angular connectivity is calculated refers also to the way Angular Analysis weights the route choice within the graph.

(A) A turn of less than 22.5 degrees has **0** weighting.

(B) A turn at 45 degrees is weighted by **0.5**

(C) A connection at 90 degrees is weighted by 1

(D) And so forth, the maximum is 180 degrees with a weighting of ${\bf 2}$















Typical workflow - Without HPC

depthmapX software



Running analysis using depthmapX software Processing time: 24-48 hours



Typical workflow - With HPC

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depthmapX software

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Running DepthmapX on NSCC's server

2.

Using DepthmapX CLI (Command Line Interface)



3.

Split the different radius analysis as different task to make use of HPC parallel computing

Typical workflow - With HPC

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Global

Choice Accessibility

- Betweenness Centrality
- Potential for Human Movement
- Multi-scale





Radius 5000m

Choice Accessibility

- Betweenness Centrality
- Potential for Human Movement
- Multi-scale





Radius 3000m

Choice Accessibility

- Betweenness Centrality
- Potential for Human Movement
- Multi-scale





Radius 2000m

Choice Accessibility

- Betweenness Centrality
- Potential for Human Movement
- Multi-scale



Medium



Radius 1200m

Choice Accessibility

- Betweenness Centrality
- Potential for Human Movement
- Multi-scale





Radius 800m

Choice Accessibility

- Betweenness Centrality
- Potential for Human Movement
- Multi-scale



Medium

demo 01a

accessibility studies

residential homes to east coast park

- residential catchment from ecp entrances
- 401 bus stop catchment
- spatial accessibility
- cycling routes



network catchment

0m - 2000m

Origin:



network catchment

0m - 2000m

Origin:





bus stops with 401

0m - 800m

Origin: Entrances to East Coast Park



bus stops with 401

0m - 800m

Origin:





bus stops with 401

0m - 800m

Bedok Pare Division C residential catchment

0m - 2000m

cycling paths

ura scdp cycling path 2019







demo 01b

accessibility studies

residential homes to commercial activity

- catchment from commercial activity 20 min walk
- space syntax choice
- How can the cycling routes fill the gap?



Origin: Entrances to East Coast Park



Origin: Entrances to East Coast Park



Origin:





Origin:



Origin:



Origin:



Origin:



Choice 800m

Origin:

demo 02

accessibility studies

homes to various amenities

baseline data sources for POI:



schools tertiary

0-1600m (20 min walk)

baseline data sources for POI:



schools primary

0-1600m (20 min walk)

baseline data sources for POI:



schools secondary

0-1600m (20 min walk)



retail shops

0-1600m (20 min walk)

baseline data sources for POI:



0-1600m (20 min walk)

baseline data sources for POI:



polyclinics

0-1600m (20 min walk)

baseline data sources for POI:



parks

0-1600m (20 min walk)

baseline data sources for POI:



residential plots

east coast grc

Street network **catchment** from <u>all residential plots</u> to the <u>**nearest** amenity</u> (by type)

baseline data sources for POI:

minimum distance from home to amenity



Distance to Amenity (coloured)

minimum distance from home to amenity

Non-landed Landed [Non-Landed] Distance to Amenity [Landed] Distance to Amenity 5000 -5000 -4000-6 4000 -3000 -8 3000 o t Park 000 000 Distance Distance 8 8 8 O ED CODE 9 2000 -2000 -2 8 0 COLOR COMPONIE 1000 -1000 -00000000 0-0polydinicschool pri school_ber parks school_pri polyclinic ahopa Ishop9 sphool_pec parks school_see achool In (arcentri Amenity Amenity

[note] landed v non-landed could be an indicator for socioeconomic background, as well as reliances on car as a main form of commute

developing effective cycling routes

For each residential plot that is <u>not</u> a cycling route yet





0-1600m (20 min walk)

baseline data sources for POI:



0-1600m (20 min walk)

baseline data sources for POI:



0-1600m (20 min walk)

space syntax recommended cycling routes

(High Choice Accessibility values for 1200, 2000, 3000m radius)

baseline data sources for POI:







Topological

Step Depth



Topological Step Depth



TOPOLOGICAL STEP DEPTH

Area Size: 3km² Sample Size: 644 Outlets



SPACE SYNTAX

Benefits of a street network model as a baseline analysis

- Conducting preliminary studies before making a case to stakeholders
- Simple analysis can help in engaging stakeholders and develop deeper ideas
- Avoid guesswork between various stakeholders and govt agencies
- These ideas can be tested through the model, to examine its effectiveness



Demo 01

Measures accessibility of existing and proposed masterplans

What it can do for SID:

- A. Analysing connections *between* the various plots of land
- B. Analysing connections within the various plots of land

- 1. Process and evaluate existing street network model, calculate global, local & multi-scale accessibility
- 2. Geo-reference masterplans. Digitise proposed network to stitch it into the street network model.
- 3. Run analysis on the proposed network. Evaluate the differences in accessibility between existing and proposed.
- 4. Identify missed opportunities in connections, or better placement of connects. Run tests.



Demo 01

Measures accessibility of existing and proposed masterplans

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Uncovers potential in active mobility routes and identifies missed opportunities

What it can do:

- A. Evaluates how well the proposed active mobility routes compliments the MRT catchment of a 10-mins walk
- B. Identifies which streets are suitable for active mobility and any new connections are necessary

- 1. Process and evaluate street network model, calculate local accessibility
- 2. Perform network catchments for all MRT stations (800m radius or 10 min walk) Actual AM routes and Space Syntax pedestrian-recommended
- Calculate what percentage of those MRT catchments are active mobility / pedestrian-recommended
- 4. Evaluate the connection of the proposed active mobility paths outside the catchments do they connect well to the catchments?
- 5. In areas NOT within the catchments, is there a need for more active mobility routes? Analyse Telco data to determine density and movement of people



Effectiveness: Sum of length of streets within the MRT Catchment



% of LTA proposed cycling routes (sum of length) / Total street length within MRT catchment

% of pedestrian recommended routes (based on network model) / Total street length within MRT catchment

Outreach: MRT Catchment + Proposed Cycling Paths



Street catchment from any MRT station origin (10-mins walk)

LTA Proposed Cycling Masterplan



CLC Network Modelling Project (Inter-agency)

NSCC x Geoworks Enablement Series 2021

Special Thanks

Bernard Tommy Shin Yee Thong Yan Michael Sim