Geospatial
Research
Innovation +
Development

Two New Pedestrian Navigation Path Options based on Semi-indoor Space

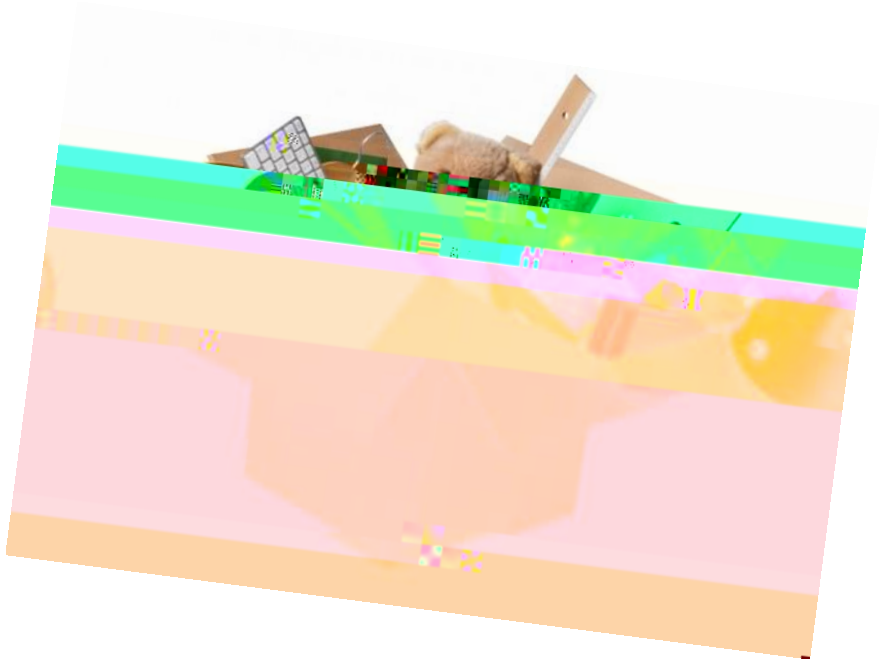
Jinjin Yan

Supervisors: Sisi Zlatanova, Abdoulaye Diakite

Faculty of Built Environment

jinjin.yan@unsw.edu.au

Contents



INTRODUCTION

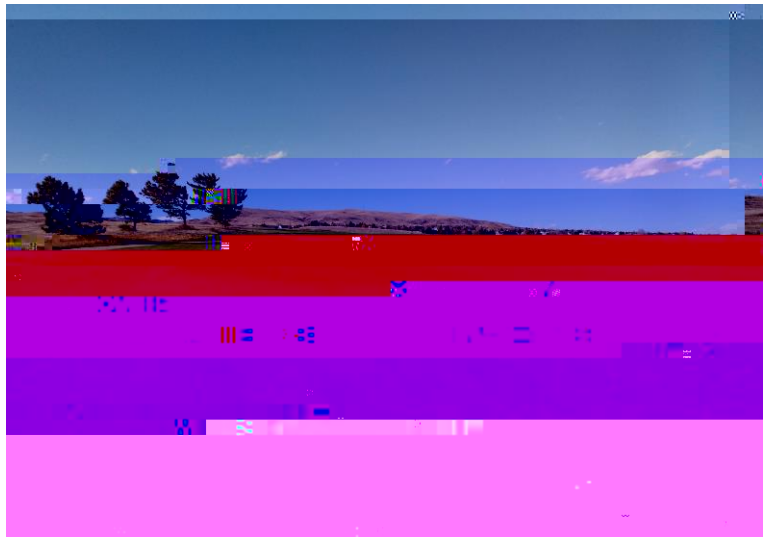
Vehicle navigation

Pedestrian navigation

Environments (spaces) where navigation happens

Indoor

Semi-indoor



Outdoor

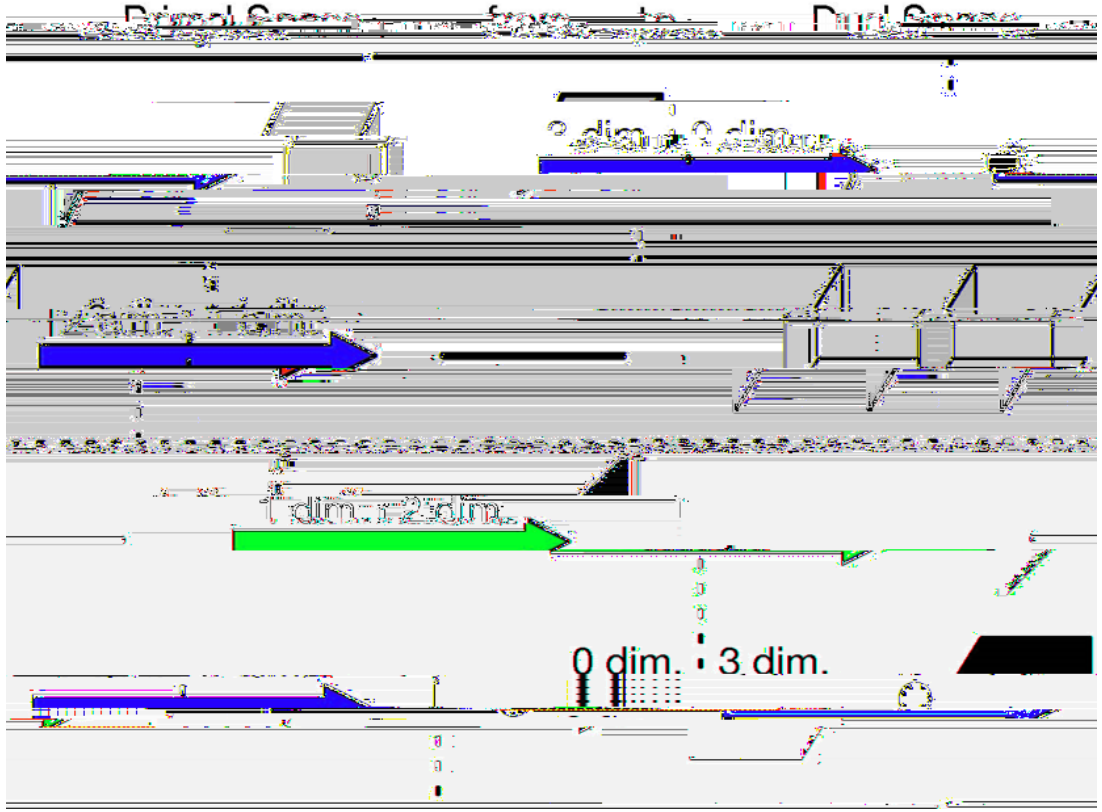
Semi-outdoor

Yan, J., Diakité, A. A., & Zlatanova, S. A generic space definition framework to support seamless indoor/outdoor navigation systems. Transactions in GIS. 2019; 23(6): 1273-1295.

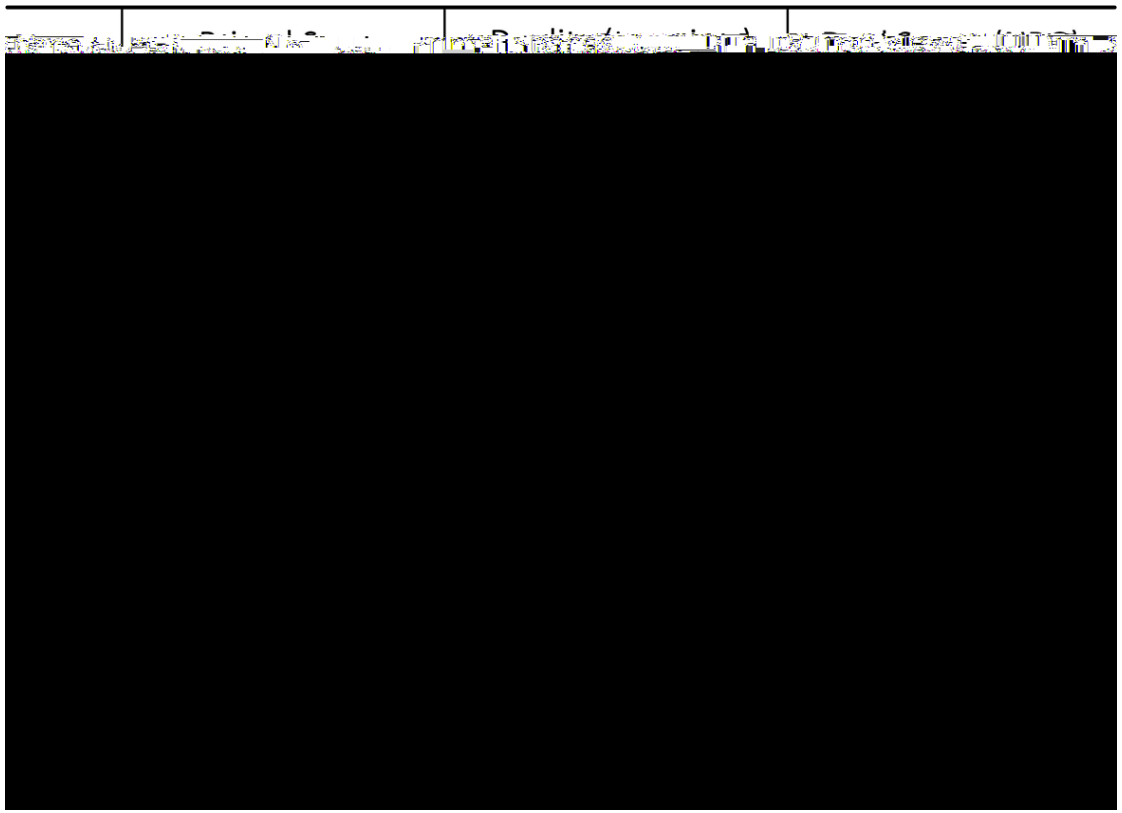
The sI-spaces are the **hollow parts** formed by living environments that are **semi-open** to the outdoors, physically enclosed by **upper boundaries** (e.g., roof, shelter), and may have a **surrounding boundaries** (e.g., wall, fence), but is **not physically enclose-3(o)-3(f,)]TJETQEMC /P 25 1041 333.8 Tm0 25 g0**

smof semi

Duality used for navigation network derivation



Poincaré duality



The duality used in this paper

Parameters for Navigation Path

- Path length ( )
- Covered/Uncovered length of a path (/)
- Top-coverage-ratio of a path ( )
-

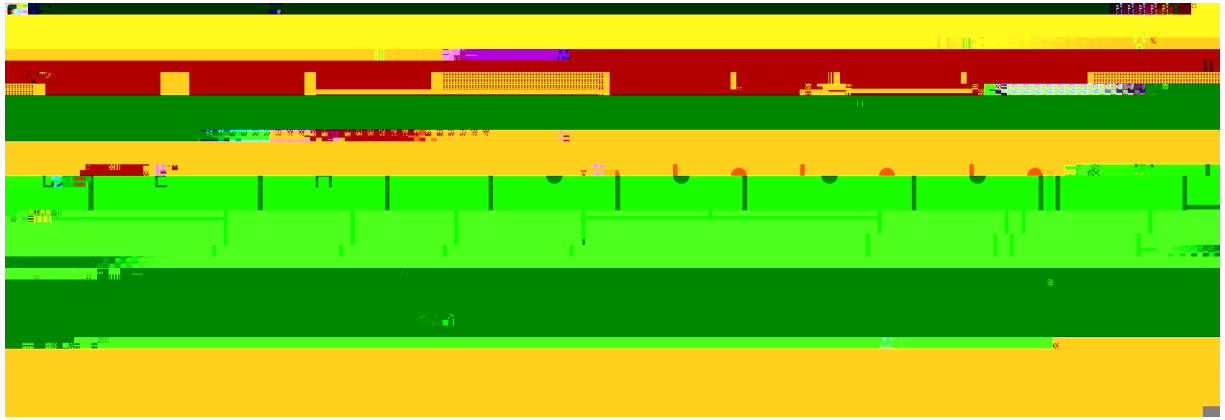
A Path Selection Strategy

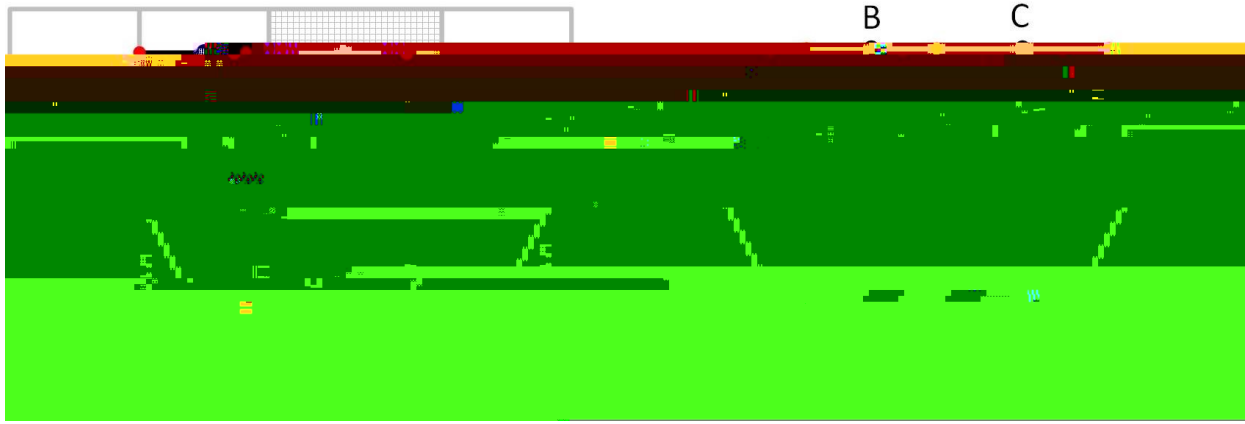
MTC-path

Condition 1: Uncovered length of a MTC-path ( ) is **shorter** than that of the Shortest path ( )

Condition 2: Top-coverage-ratio of a

ILLUSTRATION OF THE TWO PATH OPTIONS





A navigation example, in which C, F and G are three sI-spaces.

(a) All spaces.

(b) Nodes extracted from spaces;

(c) Navigation graph derived from spaces based on duality theory;

(d) Navigation graph with distance.

Planned paths

The three navigation paths from S_A (departure) to S_H (destination). S_A S_D S_E S_H is path 1 (green), S_A S_F S_G S_H is path 2 (black), and S_A S_F is path 3 (blue).

= 0.6

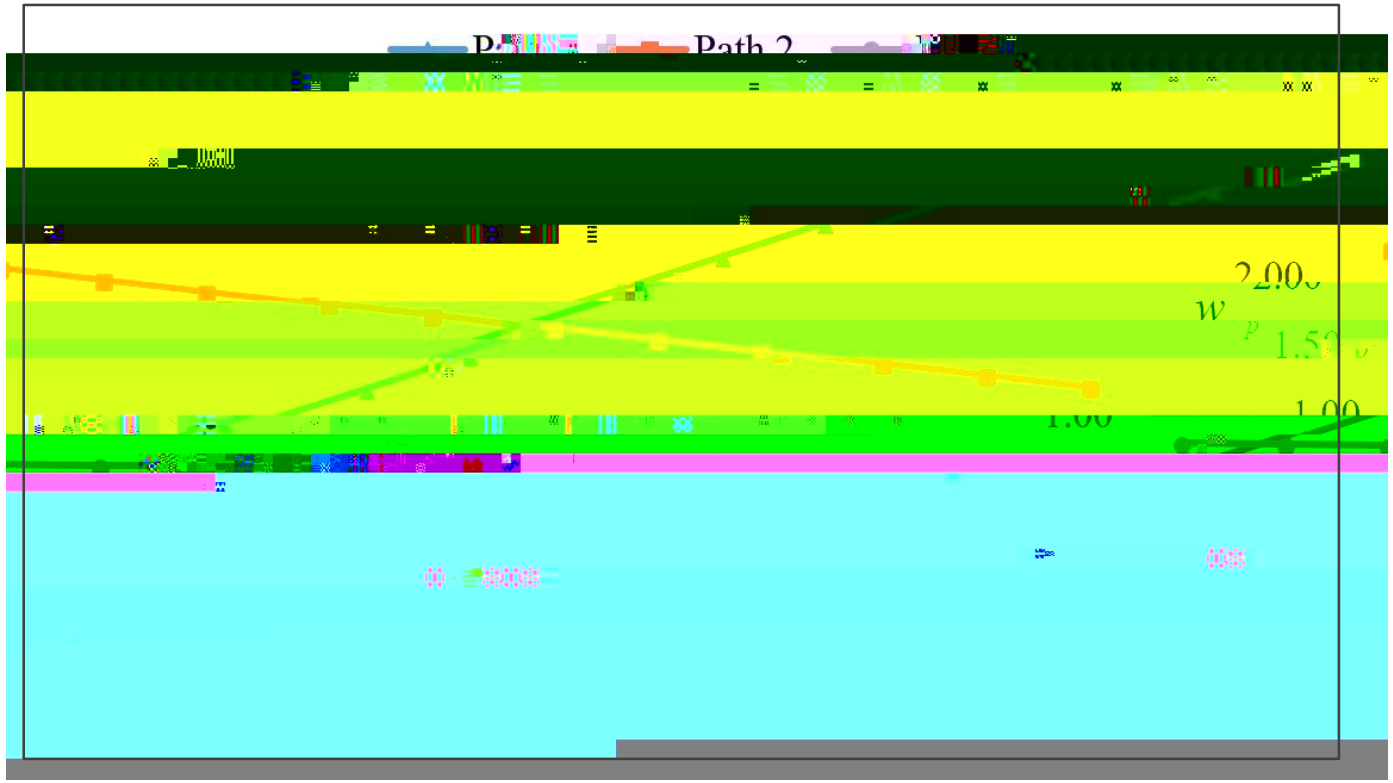
=

= ″ + ″ + ″

= 0.77 + 0.24 + 0.85

= 1.86

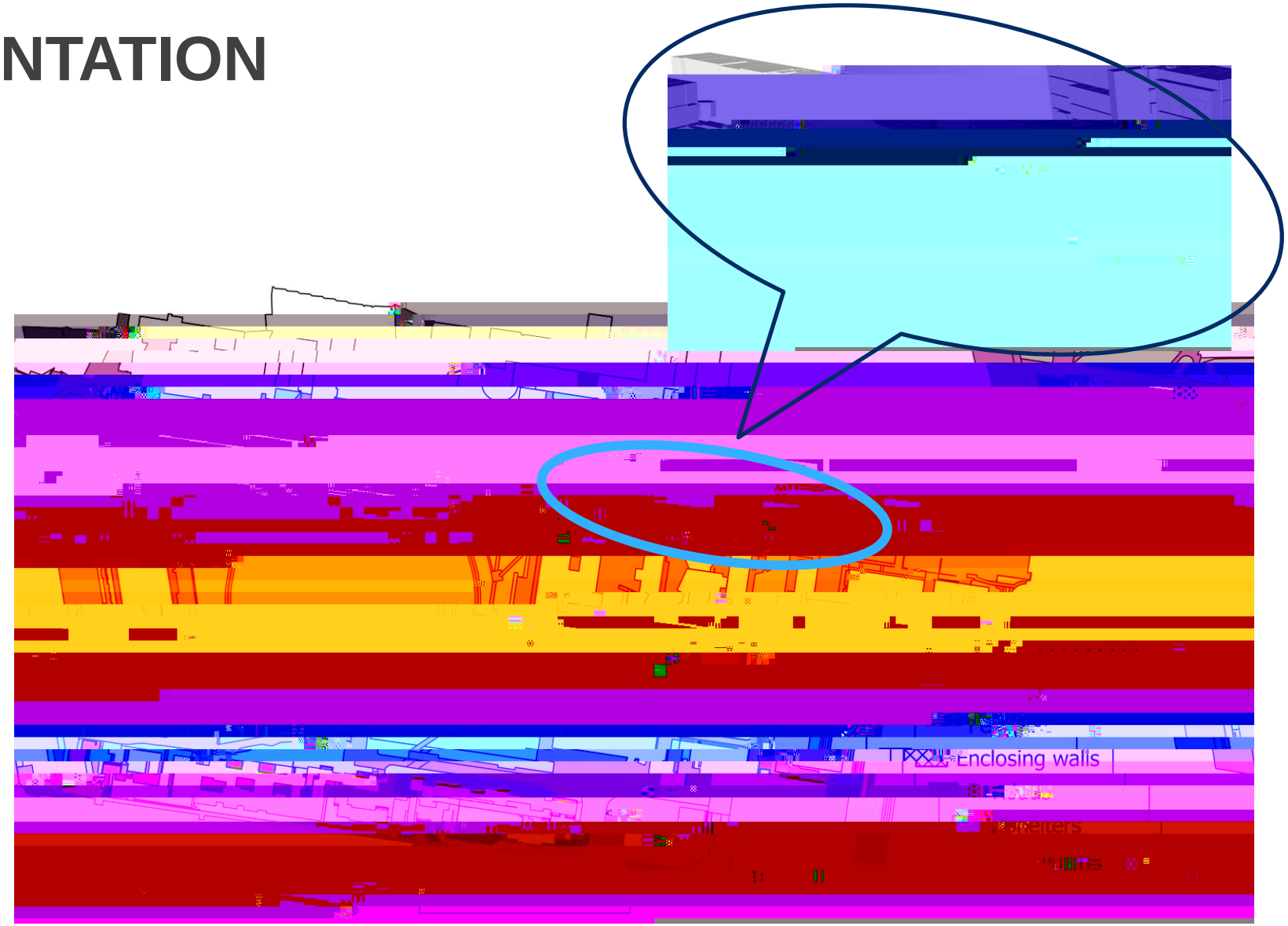
Path selection



The changes of Wp with the changing of the coefficient .

It reveals that with paying more attention to the top-coverage-ratio of the path, the traditional shortest path becomes less attractive.

IMPLEMENTATION

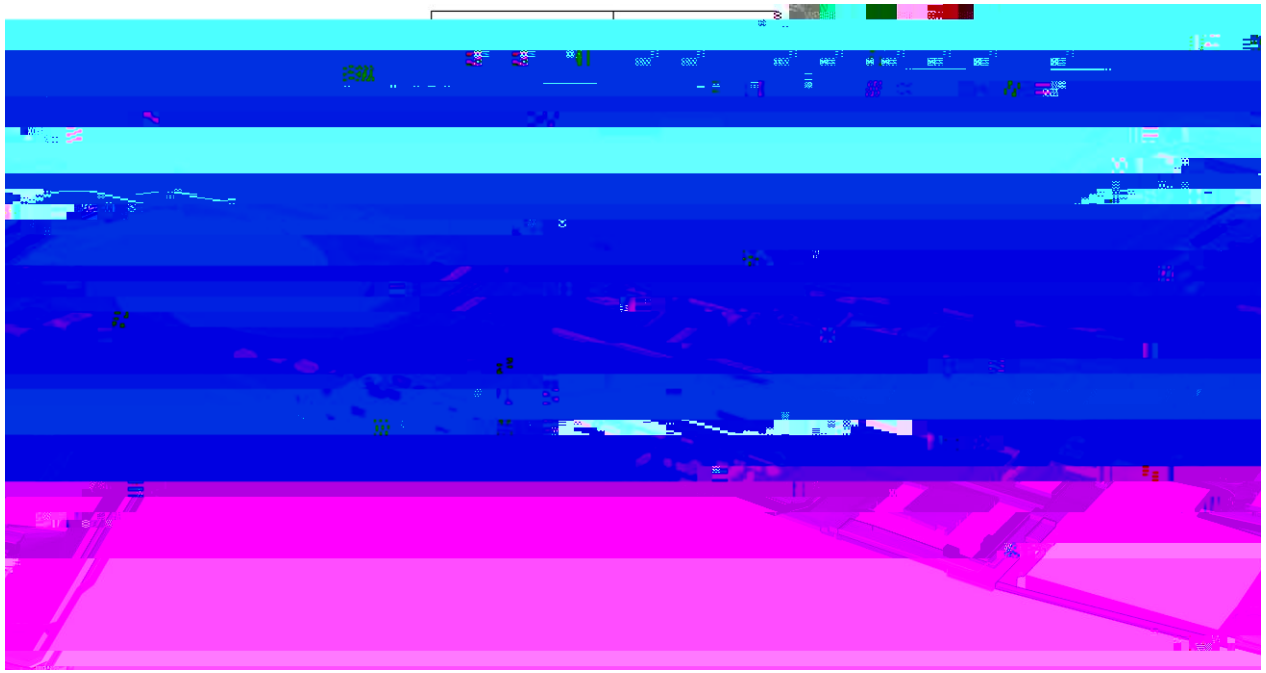


Selected area of university campus for testing.

Yan, J.*, Diakité, A.A., Zlatanova, S. Finding Boundaries of Outdoor for 3D Space-based Navigation. Transactions in GIS. 2020, 24(2): 371 389.

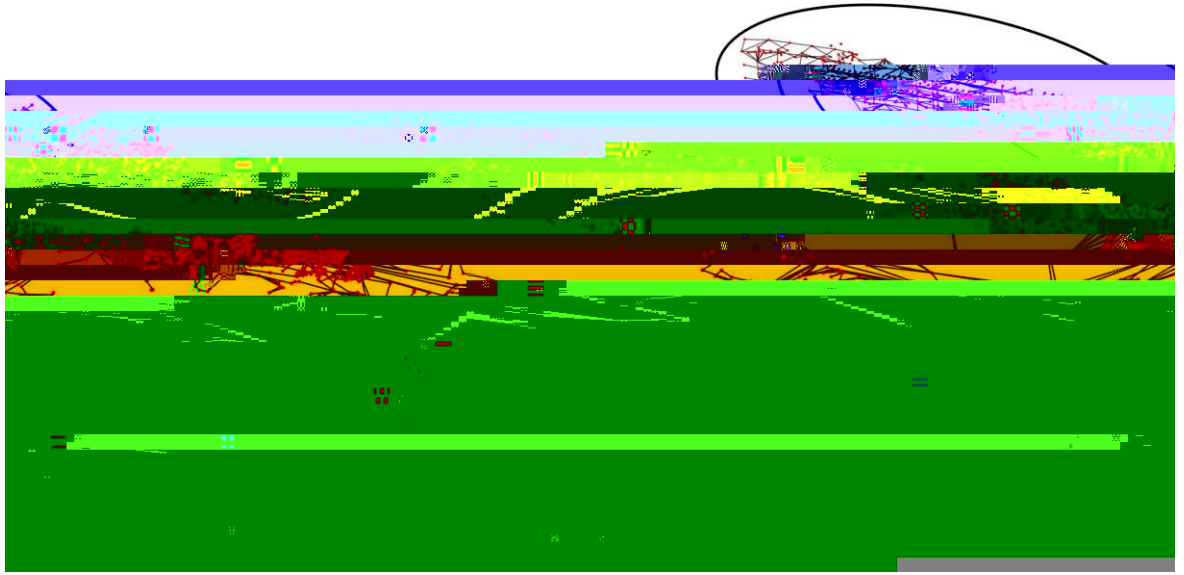
Space & Navigation Network

Space reconstruction



BIM spaces and 3D spaces in the test area.

Navigation network derivation based on duality

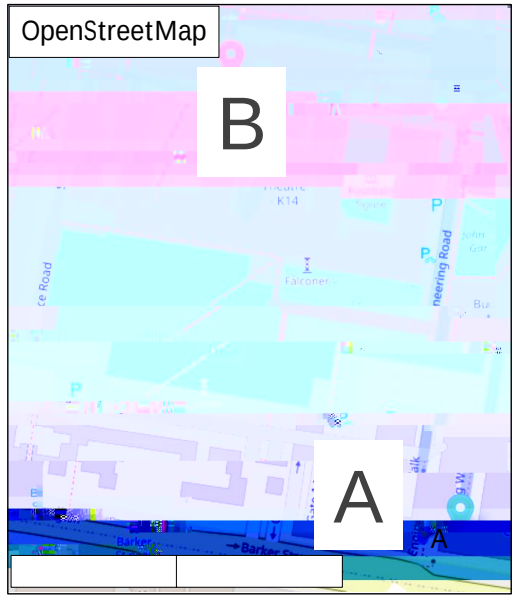


The navigation network automatically derived from 3D spaces based on duality.

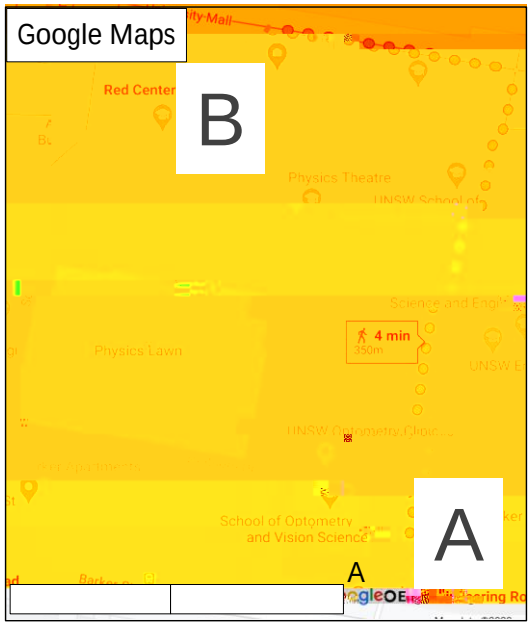
Yan, J.*, Diakité, A.A., Zlatanova, S. Finding Boundaries of Outdoor for 3D Space-based Navigation. Transactions in GIS. 2020, 24(2): 371 389.

Navigation Path A to B

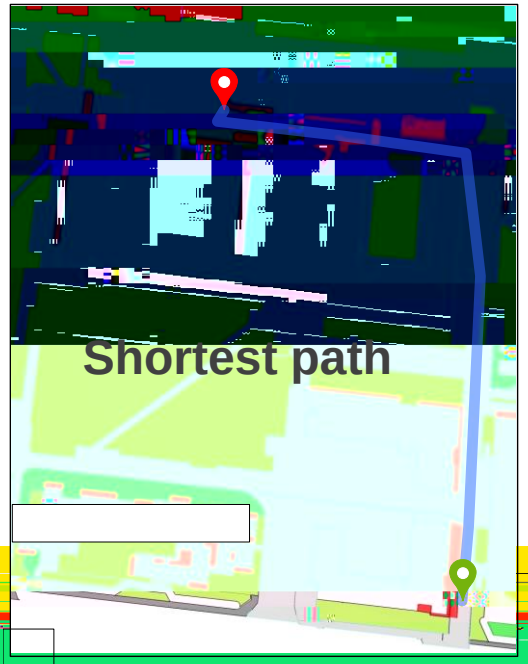
OpenStreetMap

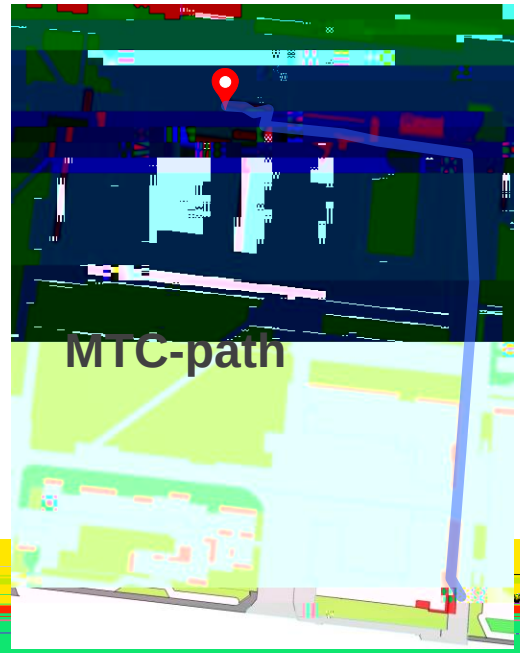


Google Maps

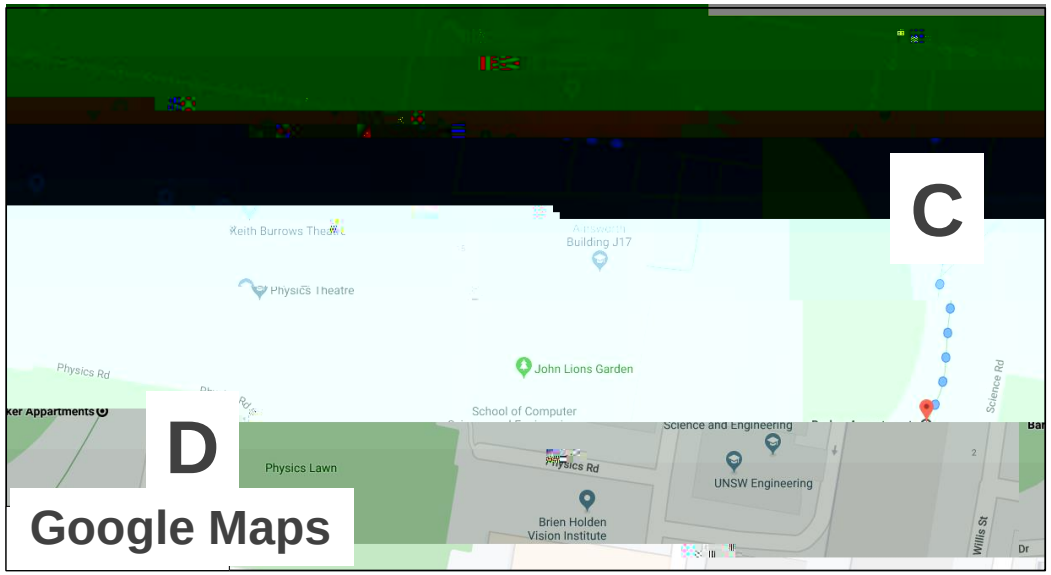


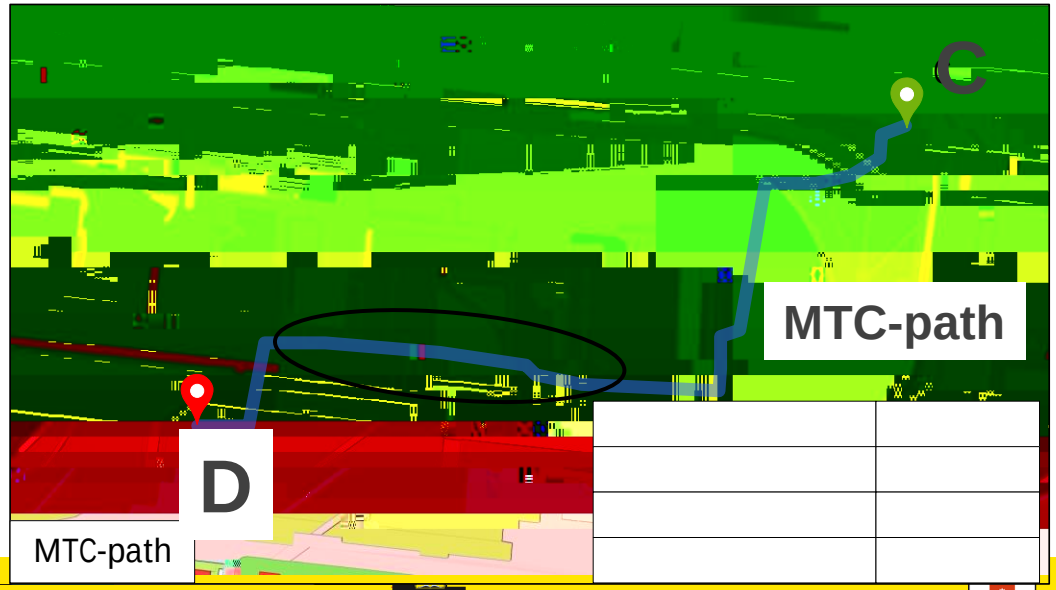
Our approach





Navigation Path C to D





Our Approach

Our Approach

UNSW SYDNEY

Results

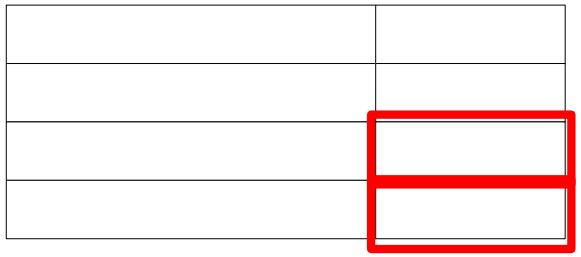
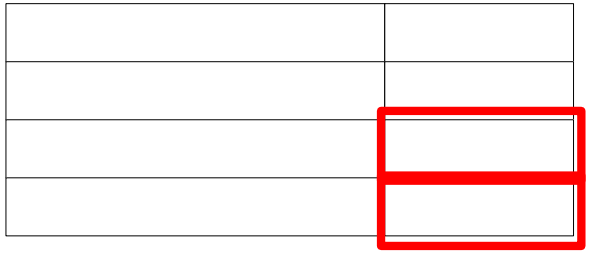
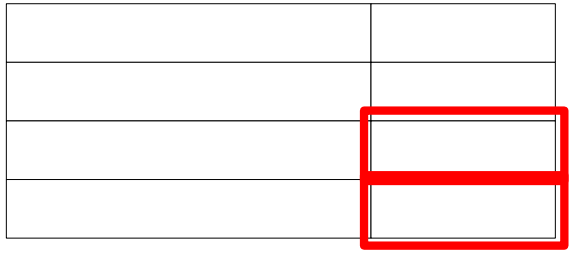
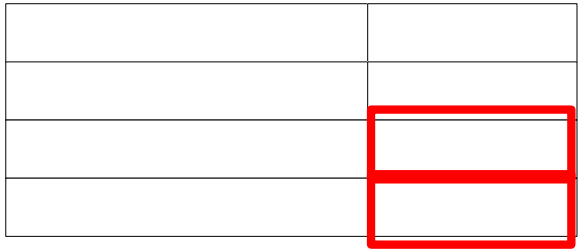
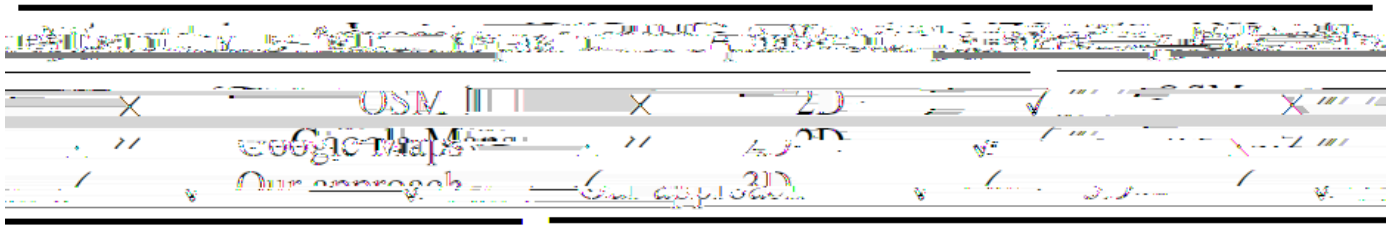
	Shortest path	MTC-path	Recommended path
A B			MTC-path
C D			MTC-path

Table 4. Comparisons of three navigation systems.



CONCLUSION

This research has two contributions to navigation path planning:

sI-spaces are included in navigation paths as destination or departure;

MTC-path and NSI-path are computed for users who need the shortest path with as many covers from the top as possible;

FUTURE WORK

Extend this research to new path options with sI-spaces to I-spaces, even sO-spaces or O-spaces;

Investigate more aspects that are related to sI-spaces;

Investigate the preferences of users.

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