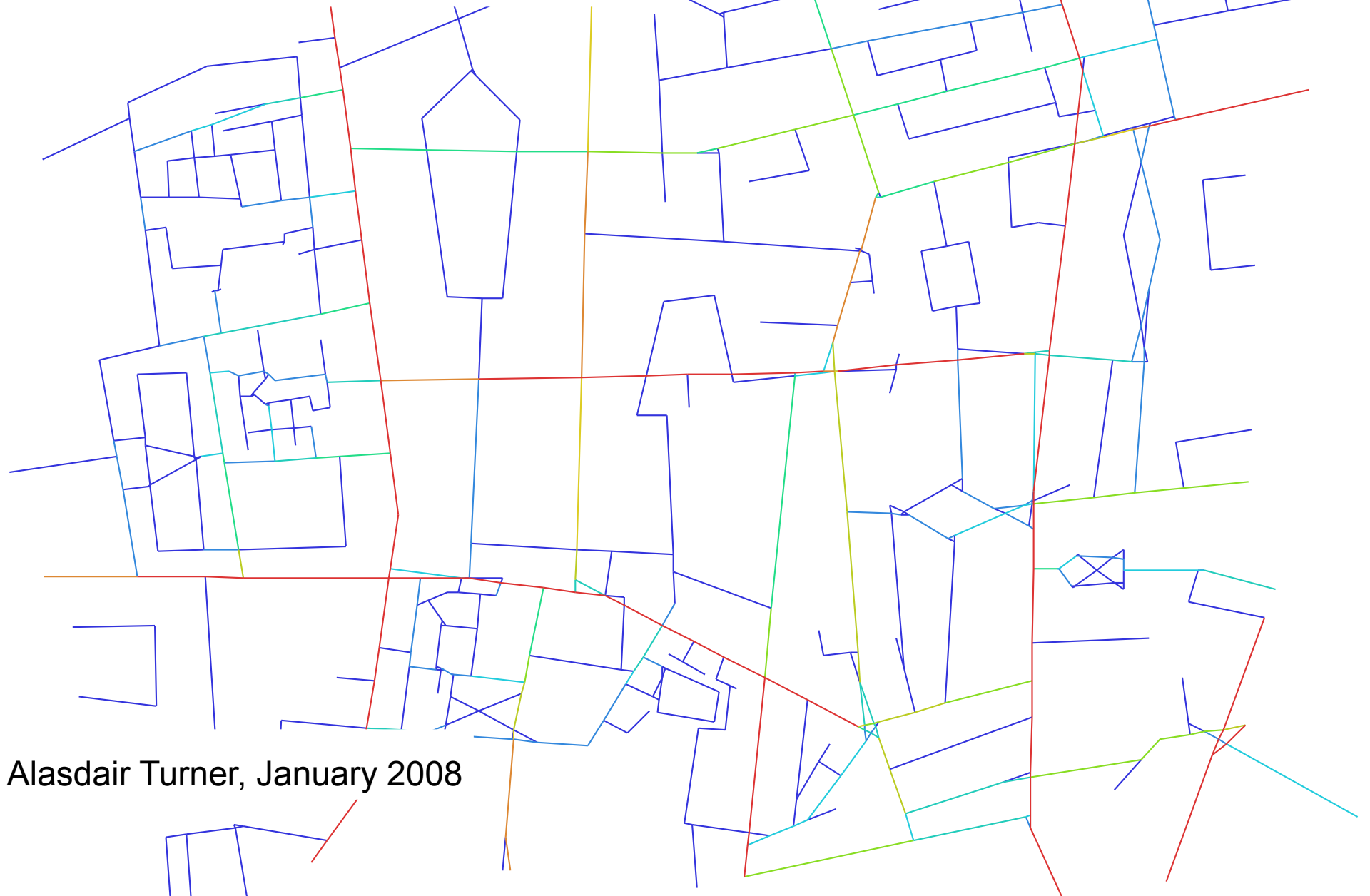


# Getting Serious with Depthmap

*Segment Analysis and Scripting*



Alasdair Turner, January 2008

# Outline

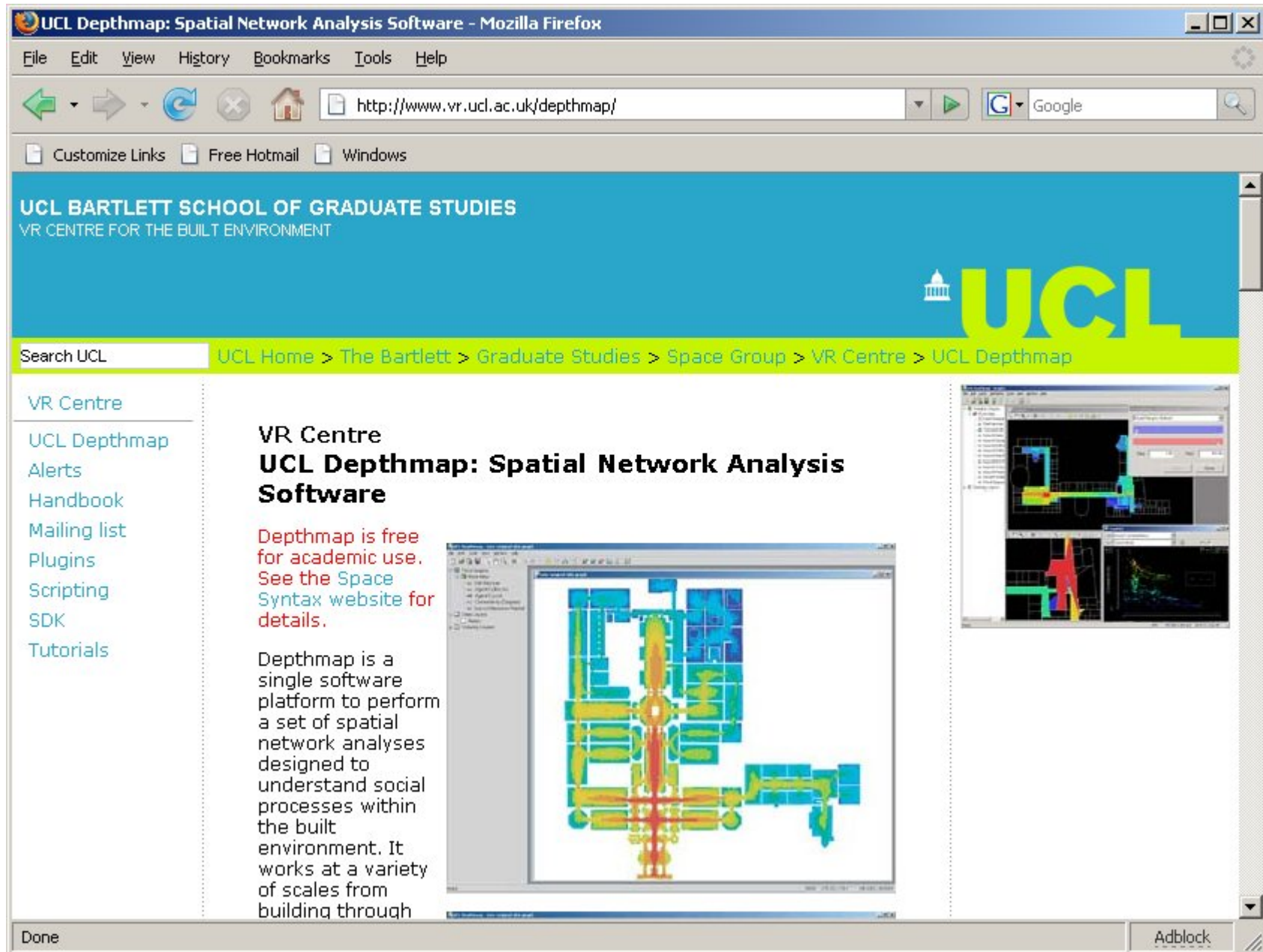
- Before we begin: some essential resources
- Segment analysis: analysis types and radii
- Angular segment analysis
  - Angular integration

Before we begin:

Download crucial Depthmap resources for the advanced user:

1. Topomet plug-in (usage described later in this presentation)
2. The Scripting manual
3. Join the Mailbase

# Crucial Depthmap resources for the advanced user



**UCL Depthmap: Spatial Network Analysis Software - Mozilla Firefox**

File Edit View History Bookmarks Tools Help

http://www.vr.ucl.ac.uk/depthmap/

Customize Links Free Hotmail Windows

**UCL BARTLETT SCHOOL OF GRADUATE STUDIES**  
VR CENTRE FOR THE BUILT ENVIRONMENT

**UCL**

Search UCL UCL Home > The Bartlett > Graduate Studies > Space Group > VR Centre > UCL Depthmap

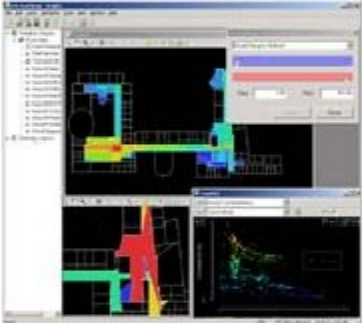
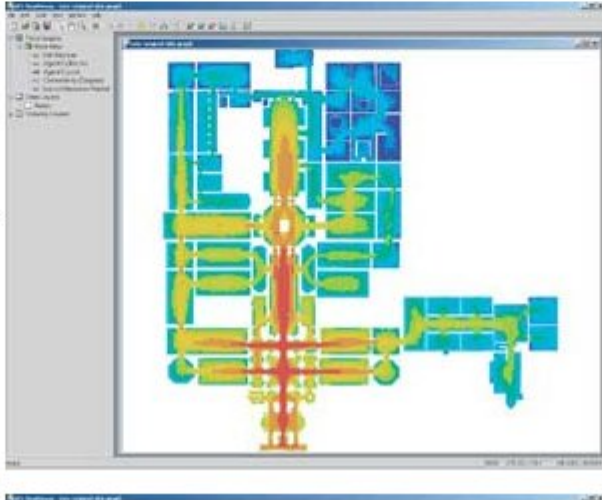
VR Centre

- UCL Depthmap
- Alerts
- Handbook
- Mailing list
- Plugins
- Scripting
- SDK
- Tutorials

**VR Centre**  
**UCL Depthmap: Spatial Network Analysis Software**

Depthmap is free for academic use. See the [Space Syntax website](#) for details.

Depthmap is a single software platform to perform a set of spatial network analyses designed to understand social processes within the built environment. It works at a variety of scales from building through



Done Adblock

# 1. Topomet plug-in (usage described later in this presentation)

UCL Depthmap: Plugins - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.vr.ucl.ac.uk/depthmap/plugin.html

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VR Centre

UCL Depthmap

Alerts

Handbook

Mailing list

**Plugins**

Scripting

SDK

Tutorials

## UCL Depthmap Downloadable Plugins

Find extra utilities and plugins written for UCL Depthmap here.

To install plugins:

1. Right click on the appropriate download below and save the ".dll" file into the same folder as your UCL Depthmap program.
2. Ensure the UCL Depthmap program is called "Depthmap.exe". Plug-in modules cannot be loaded if it has a version number, e.g., "Depthmap60818.exe"
3. Restart UCL Depthmap
4. A new menu item should appear under the "Tools" menu for each new module you install.

See the [Depthmap researcher's handbook](#) for more details.

### topomet

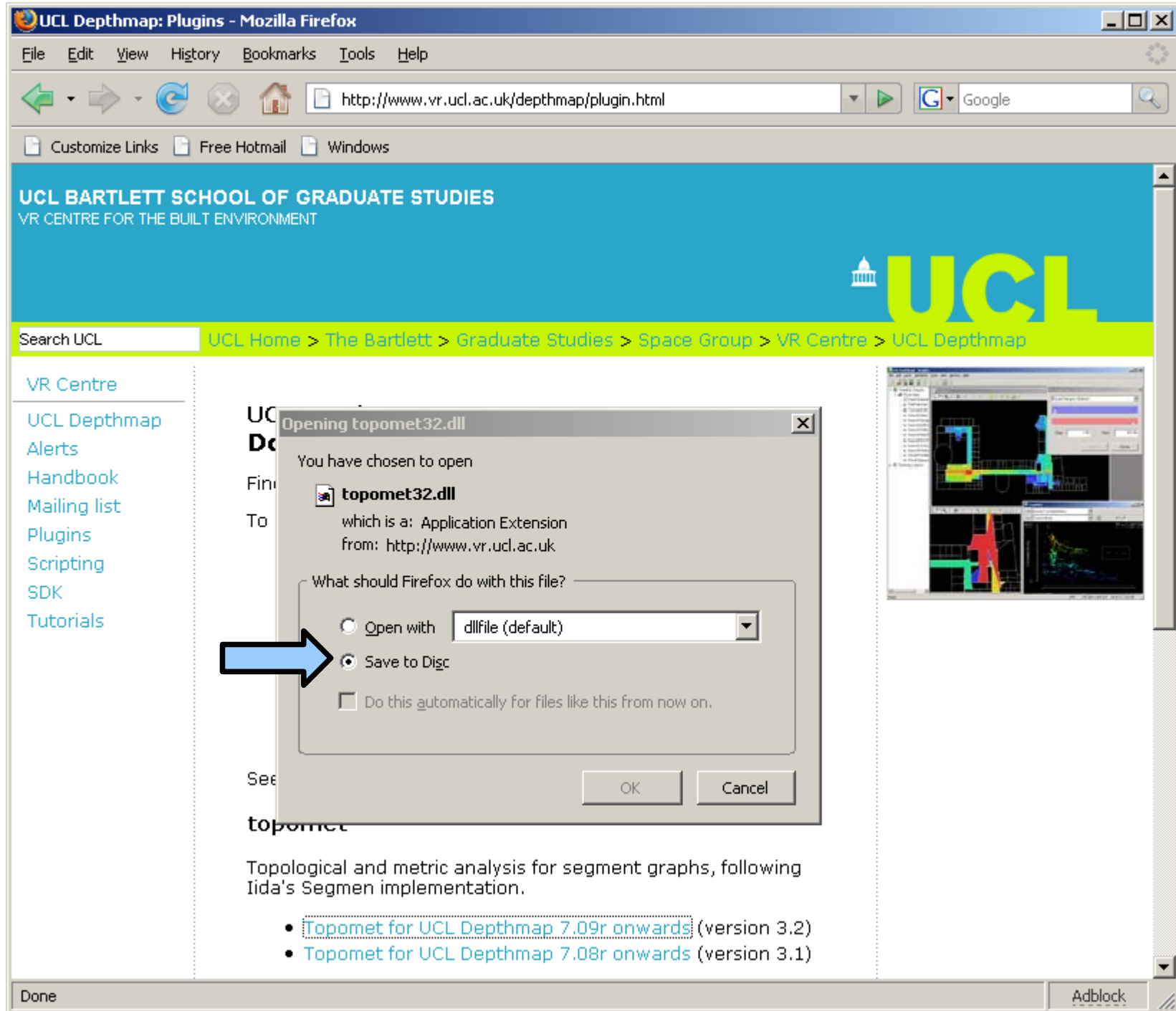
Topological and metric analysis for segment graphs, following Iida's Segmen implementation.

- [Topomet for UCL Depthmap 7.09r onwards \(version 3.2\)](#)
- [Topomet for UCL Depthmap 7.08r onwards \(version 3.1\)](#)

http://www.vr.ucl.ac.uk/depthmap/plugin.html

Adblock

# 1. Topomet plug-in (usage described later in this presentation)



The screenshot shows a Mozilla Firefox browser window titled "UCL Depthmap: Plugins - Mozilla Firefox". The address bar contains the URL "http://www.vr.ucl.ac.uk/depthmap/plugin.html". The page content includes the UCL logo and navigation links. A dialog box titled "Opening topomet32.dll" is overlaid on the page, asking "What should Firefox do with this file?". The dialog shows the file "topomet32.dll" from "http://www.vr.ucl.ac.uk". The "Save to Disc" option is selected, and a blue arrow points to it. The "Open with" dropdown is set to "dfile (default)".

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UCL

Search UCL UCL Home > The Bartlett > Graduate Studies > Space Group > VR Centre > UCL Depthmap

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Tutorials

Opening topomet32.dll

You have chosen to open

**topomet32.dll**  
which is a: Application Extension  
from: http://www.vr.ucl.ac.uk

What should Firefox do with this file?

Open with dfile (default)

Save to Disc

Do this automatically for files like this from now on.

OK Cancel

topomet

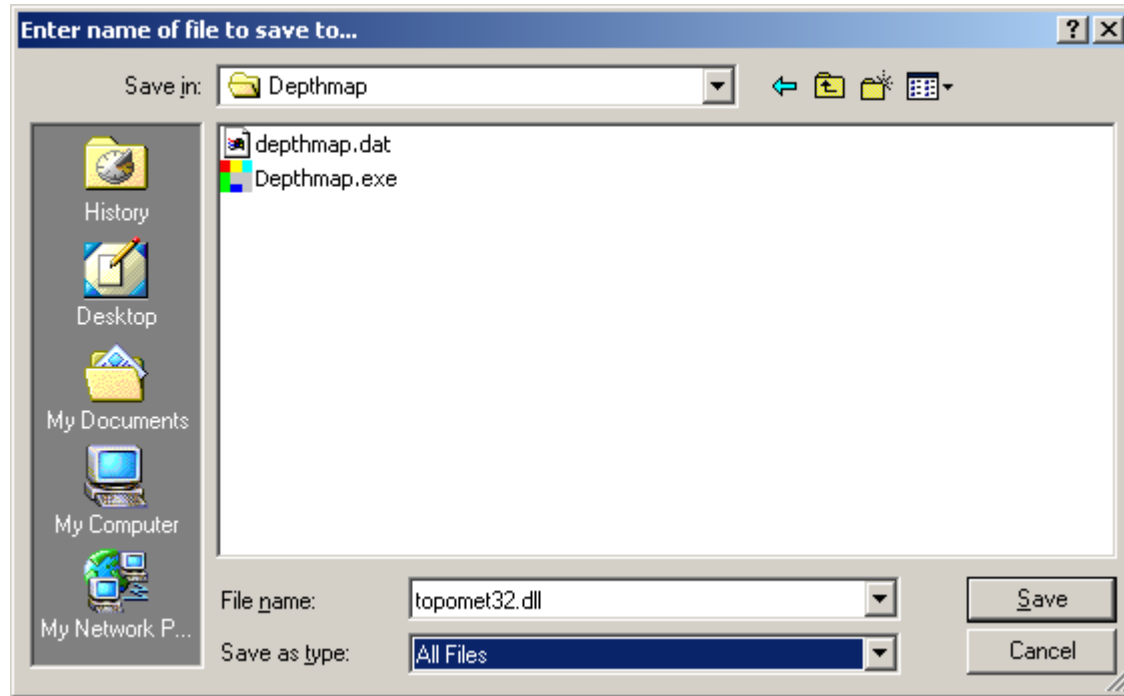
Topological and metric analysis for segment graphs, following Iida's Segmen implementation.

- [Topomet for UCL Depthmap 7.09r onwards](#) (version 3.2)
- [Topomet for UCL Depthmap 7.08r onwards](#) (version 3.1)

Done Adblock

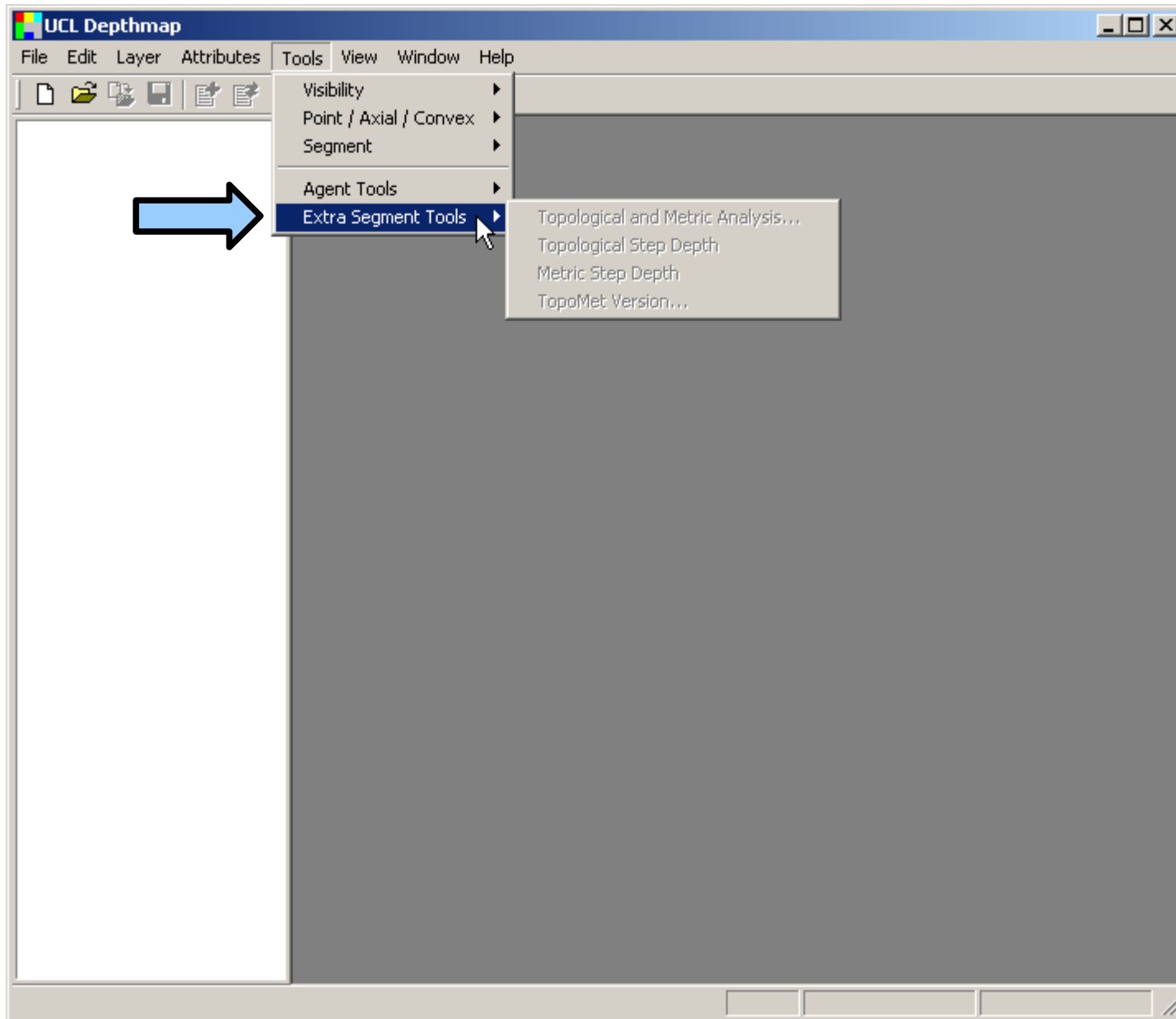
# 1. Topomet plug-in (usage described later in this presentation)

Save in the same folder as the Depthmap application



In order for DLLs to work, you must not change the name of the Depthmap program

To check installation, restart Depthmap and look at the tools menu



There should be an extra menu item called "Extra Segment Tools"



## 2. The Scripting manual

UCL Depthmap: Spatial Network Analysis Software - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.vr.ucl.ac.uk/depthmap/ Google

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VR Centre

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- Plugins
- Scripting**
- SDK
- Tutorials

**VR Centre**  
**UCL Depthmap: Spatial Network Analysis Software**

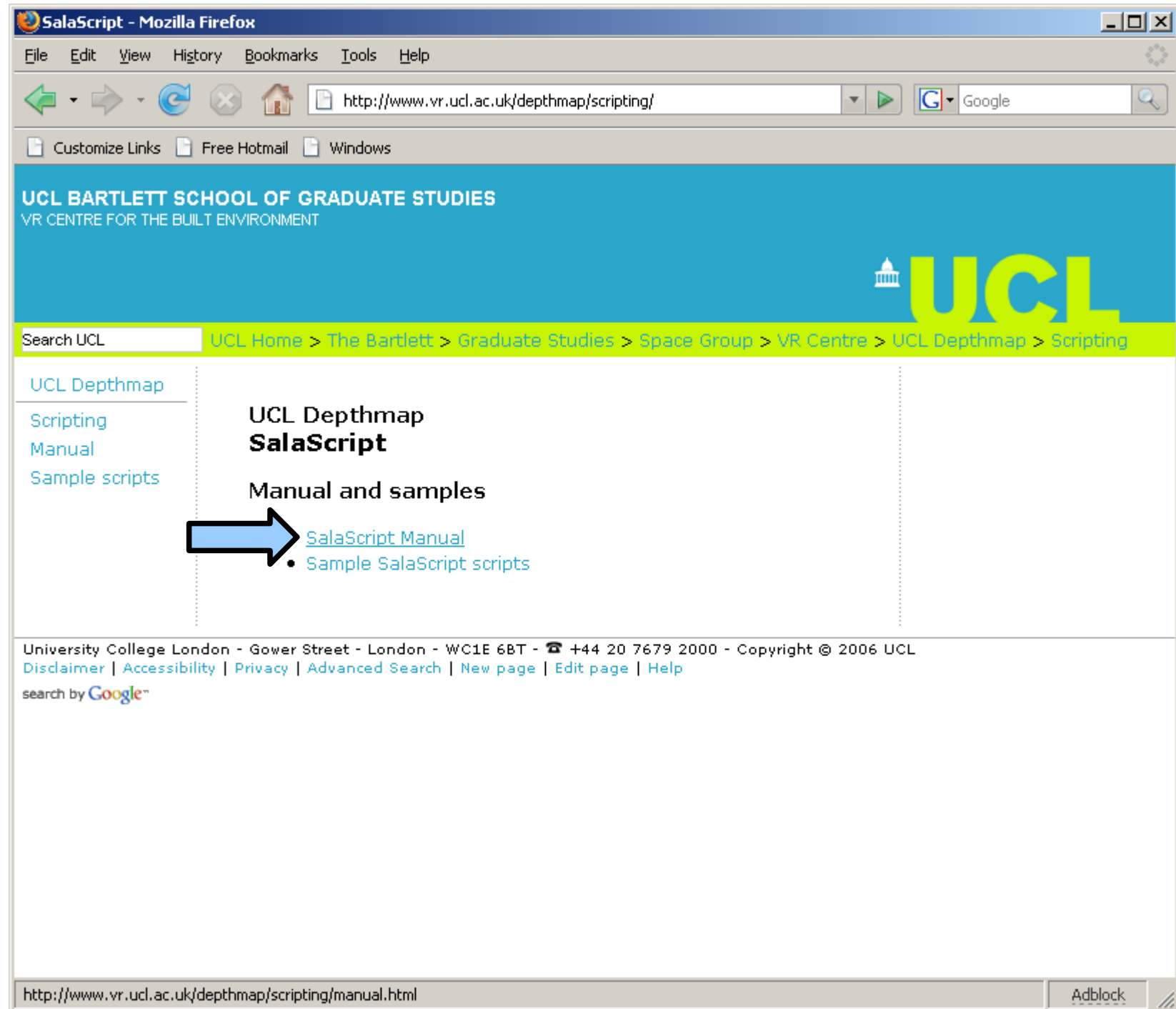
Depthmap is free for academic use. See the Space Syntax website for details.

Depthmap is a single software platform to perform a set of spatial network analyses designed to understand social processes within the built environment. It works at a variety of scales from building through small urban to whole cities or states.



http://www.vr.ucl.ac.uk/depthmap/scripting/ Adblock

## 2. The Scripting manual



The screenshot shows a Mozilla Firefox browser window with the address bar displaying `http://www.vr.ucl.ac.uk/depthmap/scripting/`. The page header includes the UCL logo and the text "UCL BARTLETT SCHOOL OF GRADUATE STUDIES VR CENTRE FOR THE BUILT ENVIRONMENT". A navigation breadcrumb trail reads: "UCL Home > The Bartlett > Graduate Studies > Space Group > VR Centre > UCL Depthmap > Scripting".

On the left side, there is a sidebar menu with the following items:

- UCL Depthmap
- Scripting
- Manual
- Sample scripts

The main content area is titled "UCL Depthmap SalaScript" and "Manual and samples". A blue arrow points to the link "SalaScript Manual", which is followed by a sub-link "• Sample SalaScript scripts".

At the bottom of the page, there is a footer with contact information: "University College London - Gower Street - London - WC1E 6BT - +44 20 7679 2000 - Copyright © 2006 UCL". It also includes links for "Disclaimer", "Accessibility", "Privacy", "Advanced Search", "New page", "Edit page", and "Help". A search bar with the Google logo is also present.

The browser's status bar at the bottom shows the URL `http://www.vr.ucl.ac.uk/depthmap/scripting/manual.html` and an "Adblock" extension icon.

## 2. The Scripting manual

Scripting: Manual - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.vr.ucl.ac.uk/depthmap/scripting/manual.html

UCL BARTLETT SCHOOL OF GRADUATE STUDIES  
VR CENTRE FOR THE BUILT ENVIRONMENT

UCL

Search UCL UCL Home > The Bartlett > Graduate Studies > Space Group > VR Centre > UCL Depthmap > Scripting

UCL Depthmap

Scripting  
Manual  
Sample scripts

**Scripting  
SalaScript Manual**

[Manual version 1.0 \(pdf\)](#)

The examples used in this manual can be found with the [Sample SalaScript scripts](#).

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search by ™

http://www.vr.ucl.ac.uk/depthmap/scripting/salascript.pdf

Adblock

## 2. The Scripting manual

salascript.pdf (application/pdf Object) - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.vr.ucl.ac.uk/depthmap/scripting/salascript.pdf

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75%

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# Chapter 1

## Introduction

SalaScript is part of the UCL Depthmap software package to perform spatial network analysis. UCL Depthmap primarily creates and analyses networks according to space syntax techniques, but it is able to analyse any network which has spatial representation of nodes. SalaScript further allows the user to modify measures calculated by UCL Depthmap, and to perform their own analysis of graphs within UCL Depthmap.

At its most basic, SalaScript allows manipulation of measures calculated by UCL Depthmap, or the selection of nodes according to values assigned by UCL Depthmap. For example, rather than *connectivity*<sup>1</sup>, you may want to look at *connectivity* squared, or you may want to select all the nodes where the *connectivity* is greater than 3. For column replacement, SalaScript is invoked when you edit an attribute in UCL Depthmap, for example, right-clicking on the attribute in the sidebar and choosing 'Edit...' from the popup menu, or choosing 'Edit...' from the 'Attributes' menu. For querying, SalaScript is invoked from the 'Edit' menu, and choosing 'Select by Query'. You are presented with a box to enter your formula and a list of existing attribute columns for the map.

If replacement of attribute values or selection by query is the sort of usage you have in mind, then you can dive straight into Chapter 2 now. For the vast majority of users this will be their only mode of encounter with SalaScript. However, more advanced users may wish to calculate their own measures of the graph. In SalaScript version 1.0, these measures are restricted to 'per node' calculations. So you are given a clean sheet for each node, and your script is run for it. If this is your sort of usage, then you will probably be able to guess

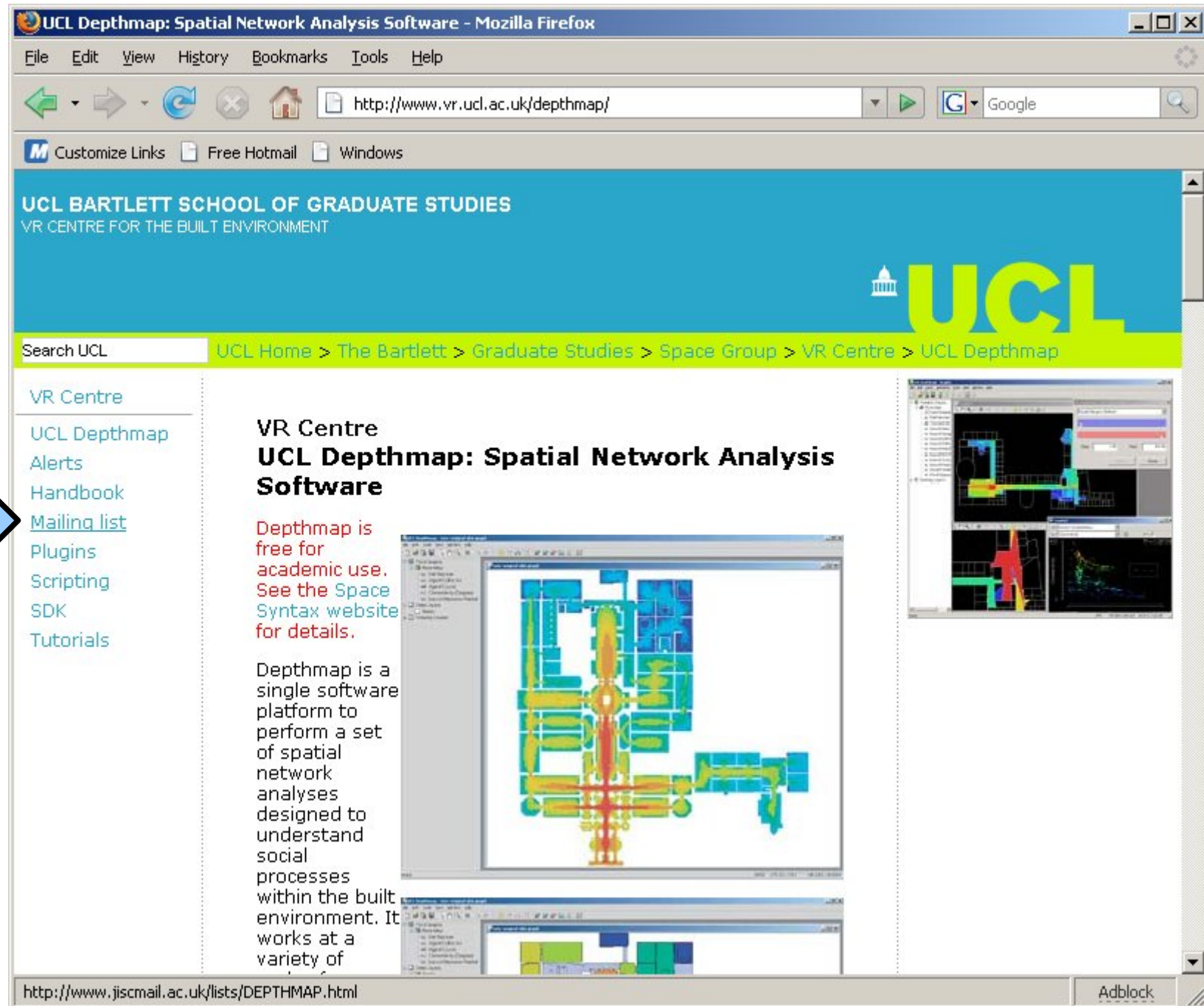
<sup>1</sup>In space syntax terms, the *connectivity* of a node is the number of adjacent nodes.

Select by Connectivity

Done

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### 3. Join the Mailbase



The screenshot shows a Mozilla Firefox browser window with the address bar displaying <http://www.vr.ucl.ac.uk/depthmap/>. The page header includes the UCL logo and the text "UCL BARTLETT SCHOOL OF GRADUATE STUDIES VR CENTRE FOR THE BUILT ENVIRONMENT". A navigation breadcrumb trail reads: "UCL Home > The Bartlett > Graduate Studies > Space Group > VR Centre > UCL Depthmap".

In the left sidebar, a list of links is visible: "VR Centre", "UCL Depthmap", "Alerts", "Handbook", "Mailing list", "Plugins", "Scripting", "SDK", and "Tutorials". A blue arrow points to the "Mailing list" link.

The main content area features the heading "VR Centre UCL Depthmap: Spatial Network Analysis Software". Below this, a text block states: "Depthmap is free for academic use. See the Space Syntax website for details." To the right of this text is a screenshot of the software interface showing a 3D architectural model with a spatial network analysis overlay in various colors (red, yellow, green, blue). Below the main screenshot is another smaller screenshot of the software interface.

At the bottom of the browser window, the status bar shows the URL <http://www.jiscmail.ac.uk/lists/DEPTHMAP.html> and an "Adblock" button.

### 3. Join the Mailbase

Archives of DEPTHMAP@JISCMail.AC.UK - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.jiscmail.ac.uk/lists/DEPTHMAP.html

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**JISCmail**

## Archives of DEPTHMAP@JISCMail.AC.UK

*UCL Depthmap*

**List Archives**

- [Subscriber's Corner](#)
- [Server Archives](#)
- [List Archives](#)
- [List Management](#)
- [List Moderation](#)
- [Server Management](#)
- [Help](#)
- [Log off](#)
- [Archive Search](#)

**CONTACTS:**

- [List Owner\(s\)](#)
- [JISCmail Helpline](#)

- [Search the archives](#)
- [Post to the list](#)
- [Join or leave the list \(or change settings\)](#)
- [Manage the list \(list owners only\)](#)
- [UCL Depthmap](#)
- [January 2008](#)
- [December 2007](#)
- [September 2007](#)
- [July 2007](#)
- [June 2007](#)
- [February 2007](#)

**JISCmail Tools**

- [Files Area](#)
- [Surveys](#)
- [Discussion Room \(Help\)](#)

**List Information**

Subscribers:	<a href="#">46</a>
Last Post:	<a href="#">15/01/2008 07:51</a>
Files:	0
Active Surveys:	0
Discussions:	0 in room

http://www.jiscmail.ac.uk/cgi-bin/webadmin?SUBED1=depthmap&A=1

Adblock

### 3. Join the Mailbase

The screenshot shows a Mozilla Firefox browser window with the address bar containing the URL `http://www.jiscmail.ac.uk/cgi-bin/webadmin?SUBED1=depthmap&A=1`. The page title is "Join or Leave the DEPTHMAP List".

**Subscription Settings**

**Subscriber's Corner**  
[Server Archives](#)  
[DEPTHMAP Home](#)

**Help**  
[Log in](#)

### Join or Leave the DEPTHMAP List

This screen allows you to join or leave the DEPTHMAP list. To confirm your identity and prevent third parties from subscribing you to a list against your will, an e-mail message with a confirmation code will be sent to the address you specify in the form. Simply wait for this message to arrive, then follow the instructions to confirm the operation.

Alternatively, you can [login with your LISTSERV password](#) (if you have one) and update your subscription interactively, without e-mail confirmation.

**Your E-Mail Address:**

**Your Name:**

**Subscription Type:**

- Regular [NODIGEST]
- Digest (traditional) [NOMIME DIGEST]
- Digest (MIME format) [NOHTML MIME DIGEST]
- Digest (HTML format) [HTML DIGEST]
- Index (traditional) [NOHTML INDEX]
- Index (HTML format) [HTML INDEX]

**Mail Header Style:**

- Normal LISTSERV-style header [FULLHDR]
- LISTSERV-style with list name in [SUBJECTHDR]

Done Adblock

# Segment Analysis



## Segment analysis varieties: **Analysis Type**

*Analysis in Depthmap examines the shortest path between one node and a series of other nodes in the system*

'Shortest path' can be defined in a number of ways:

**Angular** = the shortest path is the one that minimises the angle between you and your destination

**Segment** = the shortest path is the one that uses the least number of streets (actually the least number of “interjunction” stretches of street) to get to your destination

**Topological** = the shortest path is the one that uses the fewest number of turns (note that topological is the analysis as axial, but with a finer resolution)

**Metric** = the shortest path is the one that is physically shortest

## Segment analysis varieties: **Radius**

*Analysis in Depthmap examines the shortest path between one node and a series of other nodes in the system*

In addition to the analysis type, the selection of “other nodes” in the system can be governed by radius, which we might think of as a “cookie cut” of a set of nodes.




The radius might be “all nodes within 100m from the current node”, or “all nodes within 5 turns of the current location”.

Note that the radius, like the analysis type, can be angular, segmental, topological or metric.

For example, we might want to look at the shortest angular path to all nodes within 100m of the node being analysed.






# Segment Analysis Varieties



In fact, a matrix can be drawn of analysis types and radius types.

		Analysis type			
		Angular	Segment	Topological	Metric
Radius type	Angular				
	Segment				
	Topological				
	Metric				

 Depthmap analyses these combinations

# Segment Analysis Varieties

		Analysis type			
		Angular	Segment	Topological	Metric
Radius type	Angular				
	Segment				
	Topological				
	Metric				

 Depthmap       The TopoMet tool analyses these combinations

## Segment Analysis Varieties: *Radius in more detail*

Radius might be thought of as a “cookie cutter” for the system to be analysed around a particular node.

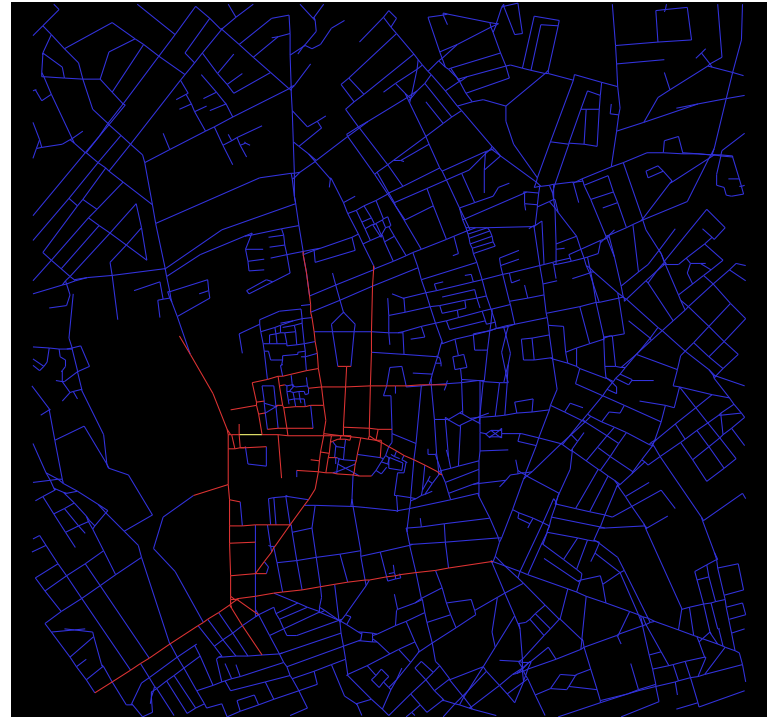
Angular radius examples:

Note the “cookie cut” section (in red) to be analysed depends on the node under consideration.



# Segment Analysis Varieties: *Radius in more detail*

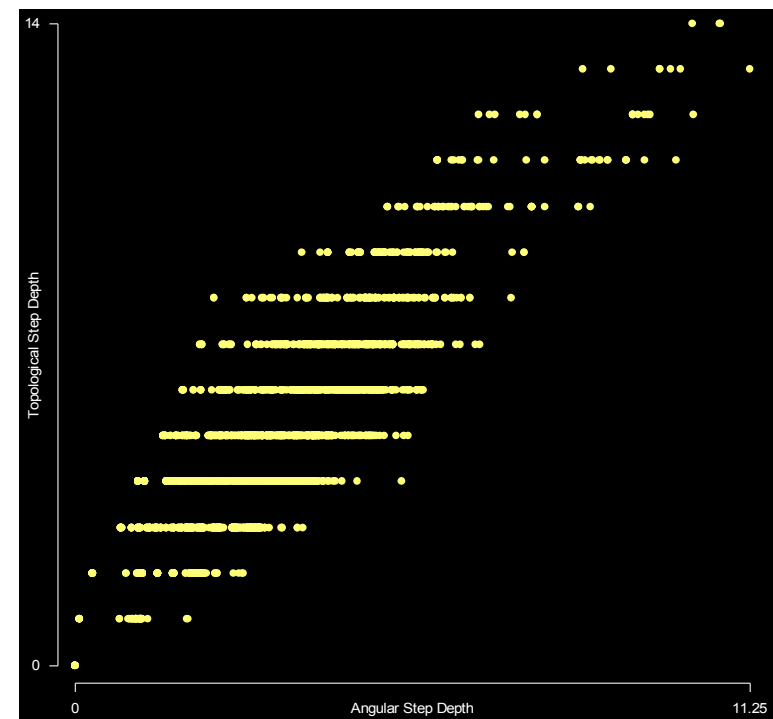
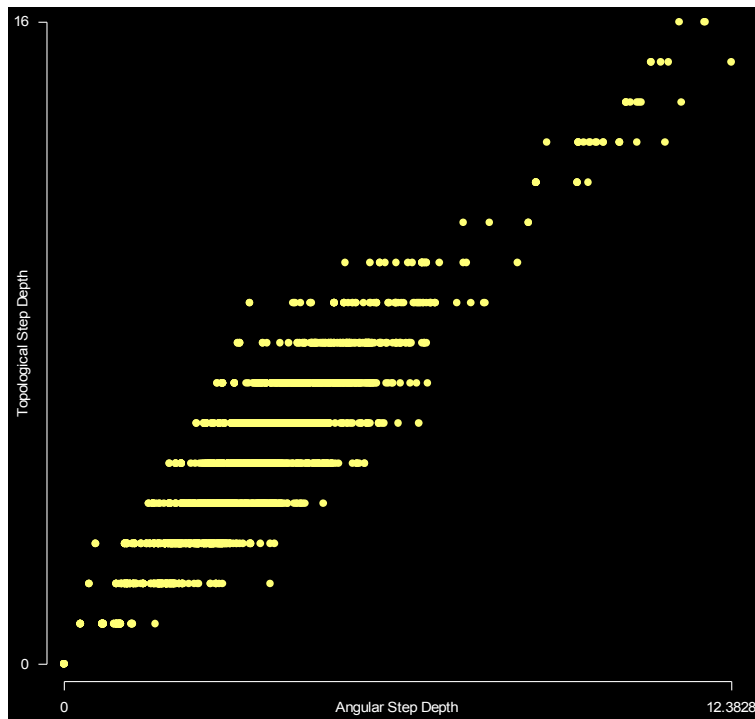
Topological radius



## Segment Analysis Varieties: *Radius in more detail*

Note that although it does not initially look like it, angular and topological radius are (roughly) proportional to each other

We can demonstrate this with scatter plots of angular step depth versus topological step depth



(Two scatter plots are shown: one for each of the nodes shown in the previous example)

## Segment Analysis Varieties: *Radius in more detail*

Metric radius is quite different, and corresponds to an approximately circular cookie cut around the node under consideration





## Segment Analysis Varieties: *Radius in more detail*

Just as angular and topological depths are proportional to each other, metric and segment depths are proportional to each other

(Unfortunately, there is no segmental analysis in Depthmap, so we cannot demonstrate this directly)

*There are therefore some important things we can say:*

- Using angular or topological radius will give similar results
- Angular and topological analysis approximate each other (especially at high radius)
  
- Using metric or segment radius will give similar results
- Metric and segment analysis approximate each other (especially at high radius)

## Segment Analysis over Axial Analysis






If the previous slide is correct, then surely segmental angular analysis, because it approximates topological analysis, should have no advantage over axial analysis?



In fact this is not true, as the segmental analysis is more distinguishing than axial analysis.

In addition, the relationship between topological and angular analysis may only hold for more grid like systems.

## Segment Analysis Varieties: *Reminder*






In terms of the possible analysis combinations, Depthmap is quite restricted. Segmen, by Shinichi Iida covers all combinations

		Analysis type			
		Angular	Segment	Topological	Metric
Radius type	Angular				
	Segment				
	Topological				
	Metric				

 Depthmap       The TopoMet tool analyses these combinations

## Segment Analysis Varieties: *Reminder*

Most research to date has been into just two types:  
Angular with metric radius, and metric with metric radius

		Analysis type			
		Angular	Segment	Topological	Metric
Radius type	Angular				
	Segment				
	Topological				
	Metric				

The rest of this presentation will cover these in more detail

# Angular Segment Analysis

Angular Integration

# Angular segment analysis

There are two main types of analysis:

- Integration, which is thought to be related to “to movement”
- Choice, which is thought to be related to “through movement”

## Angular segment analysis: *Integration*

Unlike axial integration, there is no “approved” normalisation, and therefore no integration measure in segment analysis

Some debate exists over what it should be:

It is known, however, that MD is an inappropriate measure, as pointed out by N S C Dalton

Hillier has suggested

$$\text{Integ} = \text{NC} / \text{MD}$$

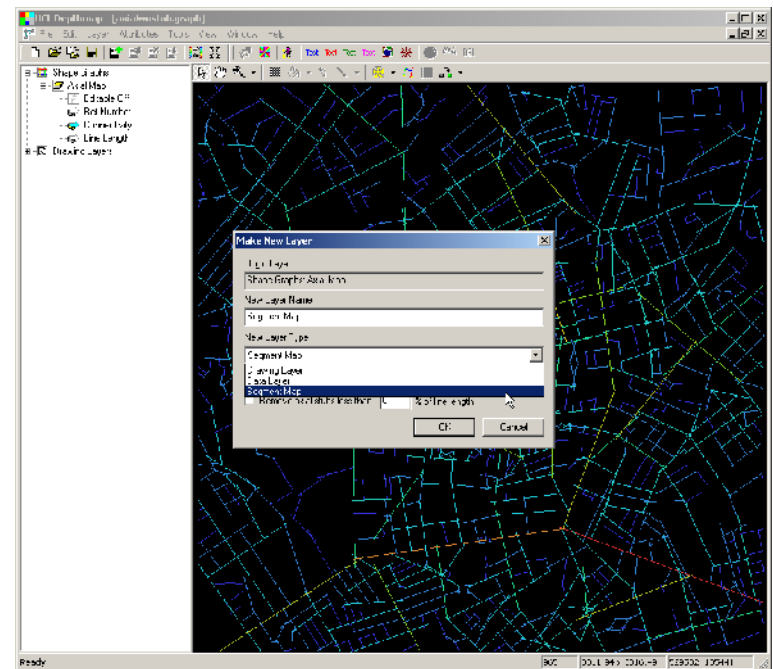
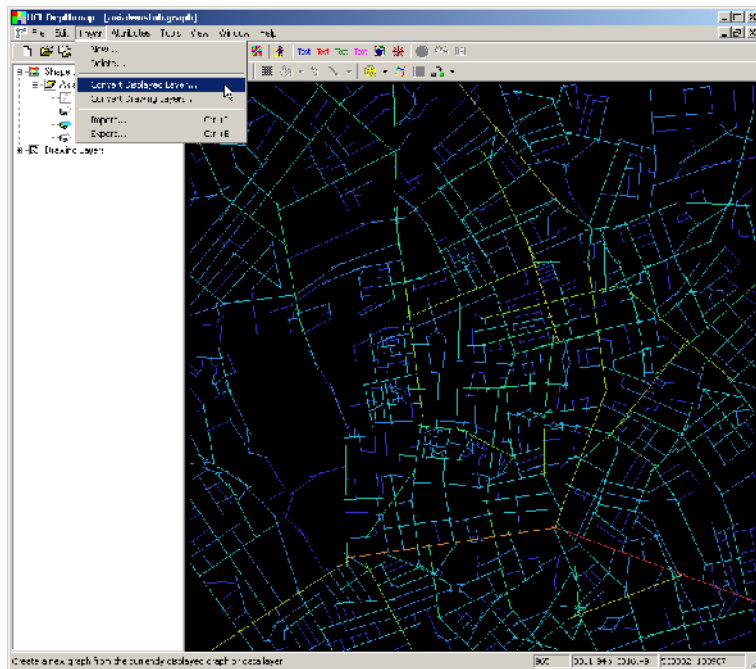
Where NC is node count (i.e., the number of nodes within a “cookie cut” radius), and MD is mean depth of the nodes with respect to the root node.

## Angular segment analysis: *The problem with MD*

Firstly let us show the problem with MD. Let us prepare the measures we need...

Starting with an axial map, convert to a segment map:

- 1) Choose “Convert displayed” layer from the “Layer” menu
- 2) Change the default type to convert to from “Drawing layer” to “Segment map”

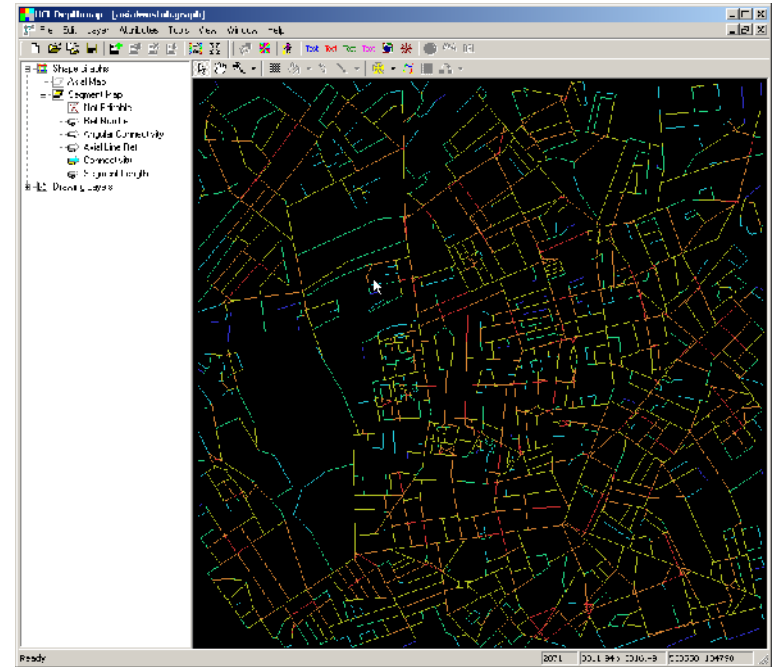
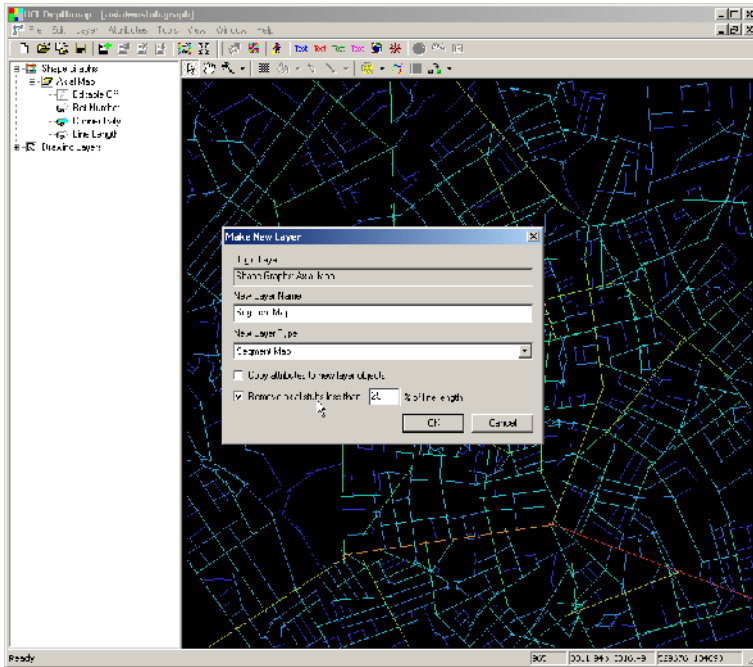




## Angular segment analysis: *The problem with MD*

3) Not necessary, but it will improve processing times and produce a tidier map:  
select remove “axial stubs”, which chops off the end of lines which are not part of the network.  
At first, leave the default setting: any overhang of less than 25% of the length of the line will be removed

4) Click “OK”



## Angular segment analysis: *The problem with MD*

5) Select “Segment Analysis...” from the main segment tools menu  
(Note my version has the TopoMet DLL installed from earlier)

6) Now I have selected a set of standard settings from the Segment Analysis Options dialog:

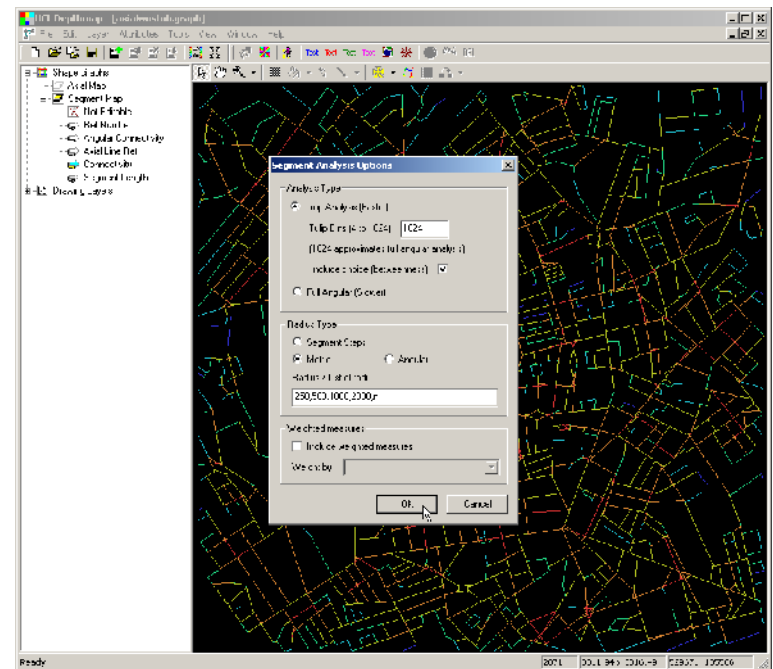
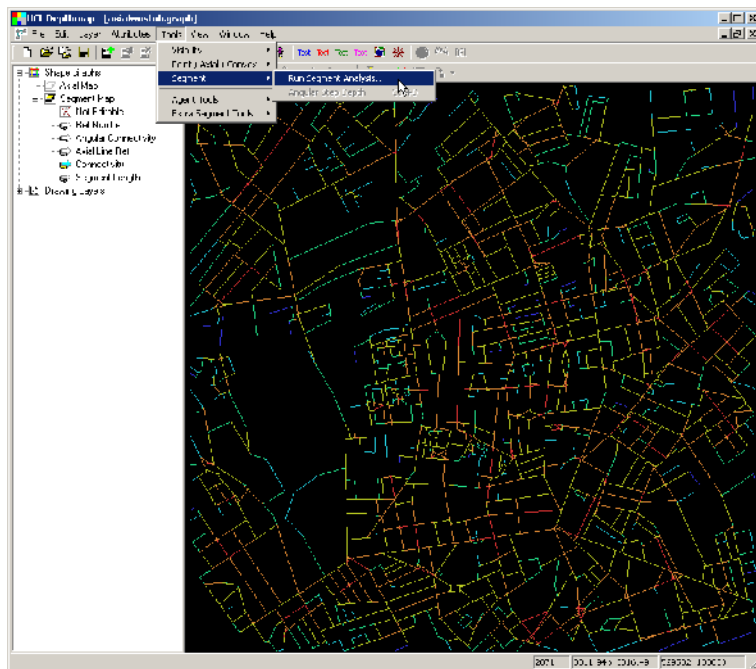
a) Leave the analysis type as “Tulip”, and the number of bins as “1024”

b) Include betweenness

c) Choose metric radius

d) Included a list of radii: 250,500,2000,n

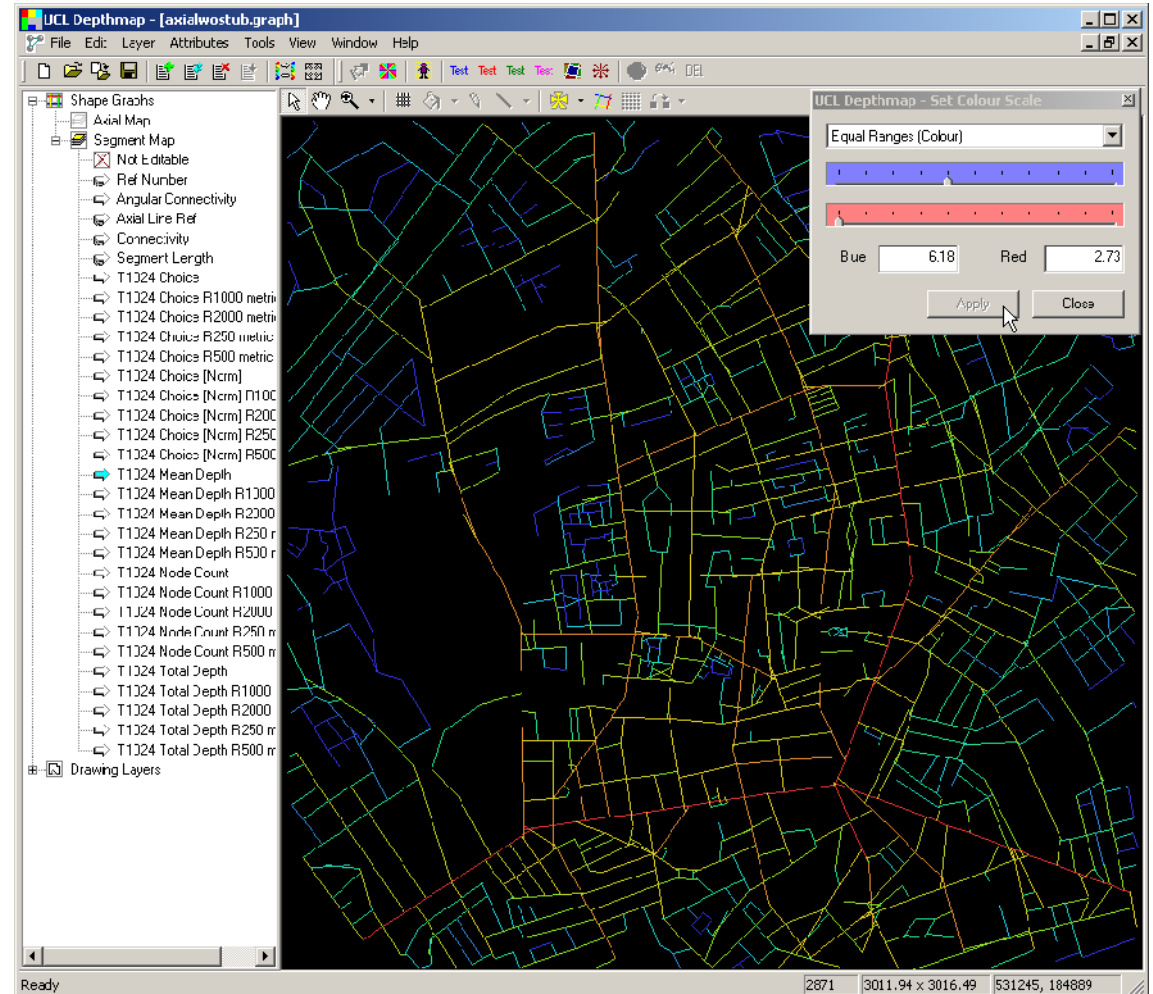
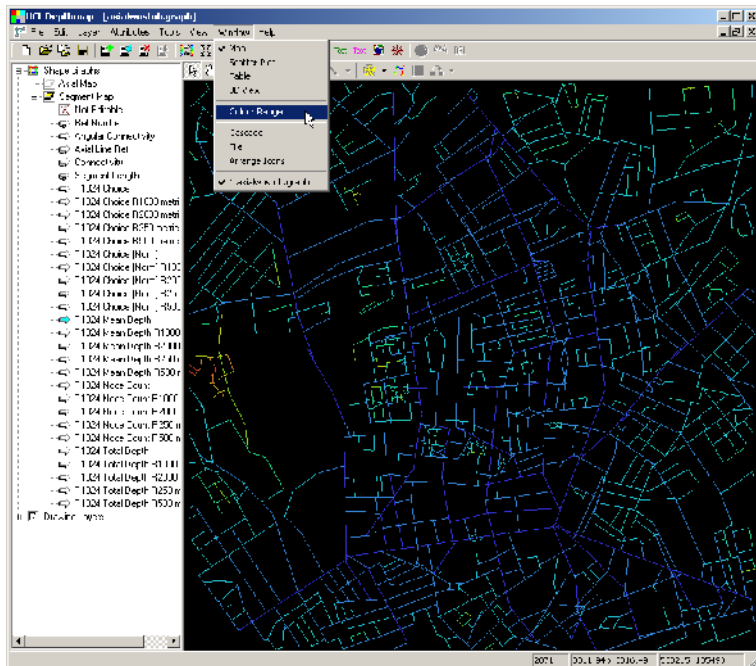
(This map is in metres, so these represent 250m, 500m, 2000m, and the whole map)



## Angular segment analysis: *The problem with MD*

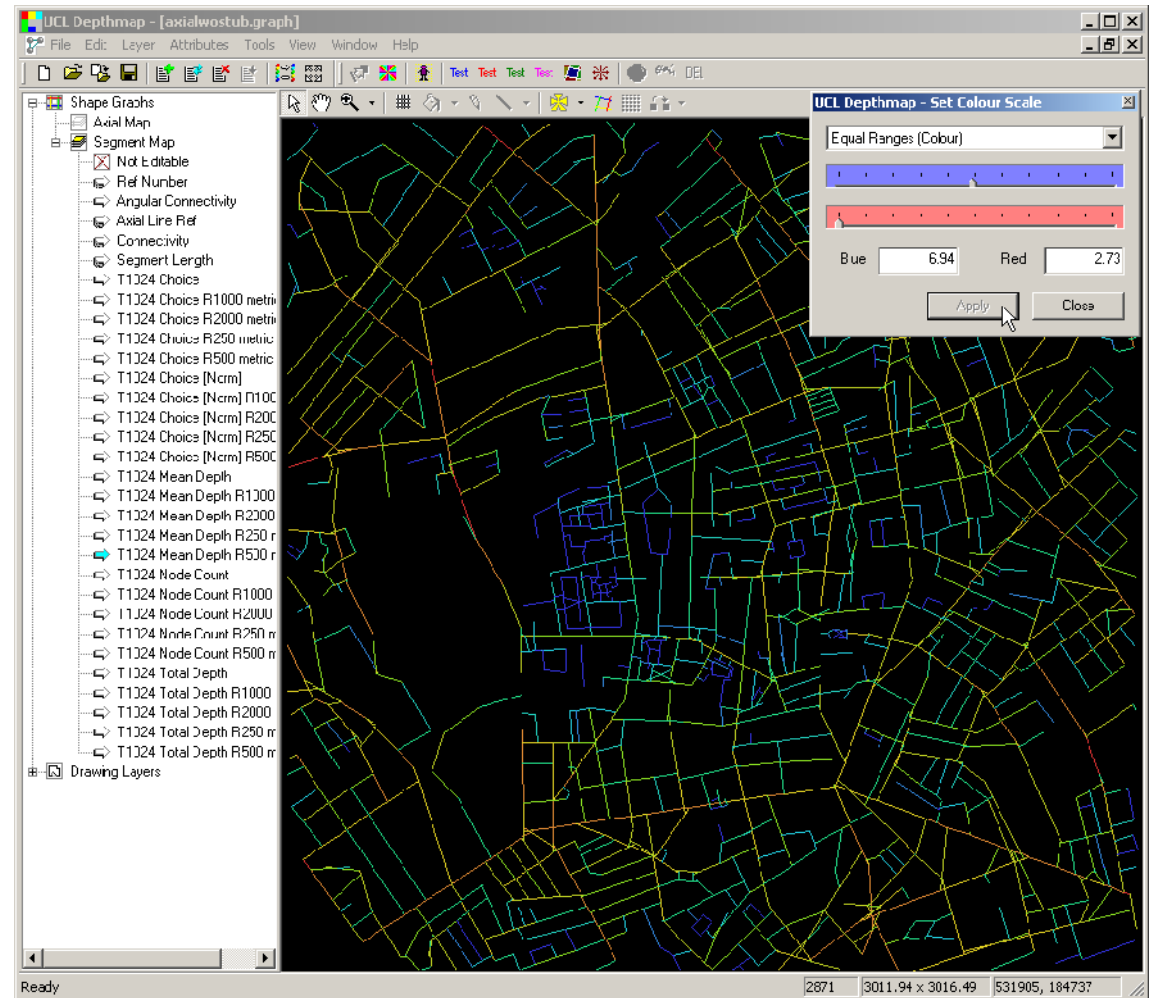
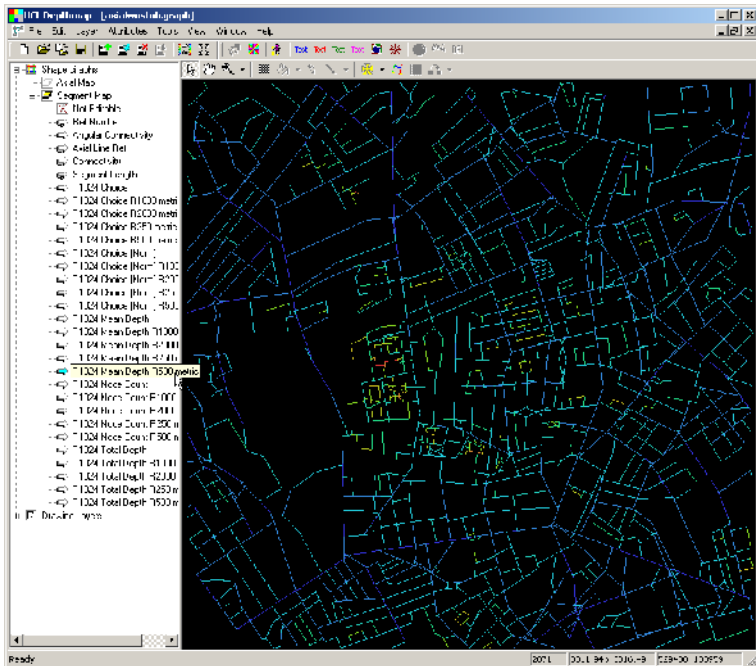
At first there seems little wrong: the default is mean depth at radius  $n$ , and, playing with the colour scheme somewhat we can get an “integration-like” measure.

Choose “Colour Range” from the “Window” menu, reverse the sliders, and tweak:



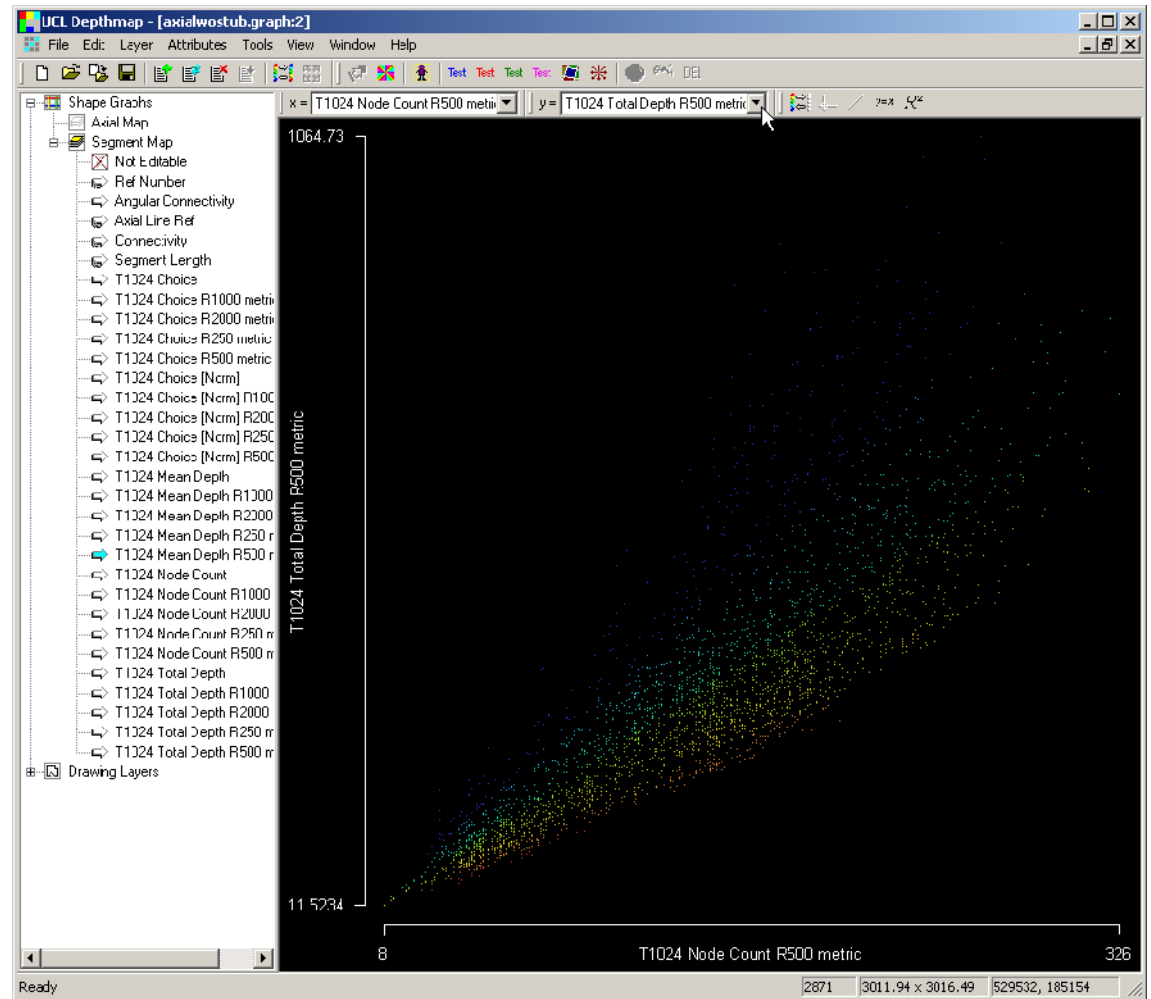
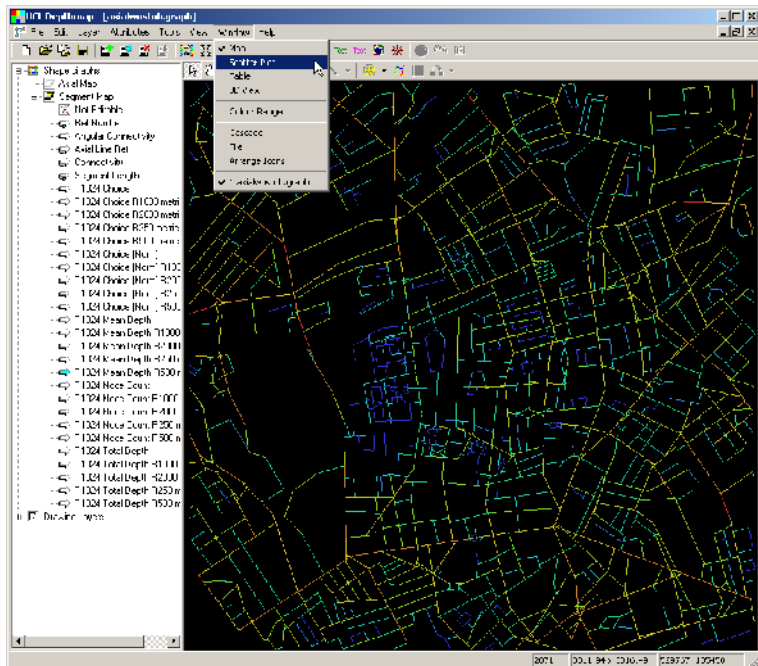
## Angular segment analysis: *The problem with MD*

However, if you switch to “T1024 Mean Depth r500 metric” (that is, angular mean depth with a metric radius), no amount of tweaking gives a proper feeling of “integrated” roads. True, a housing estate comes out blue, but the rest is pretty meaningless.



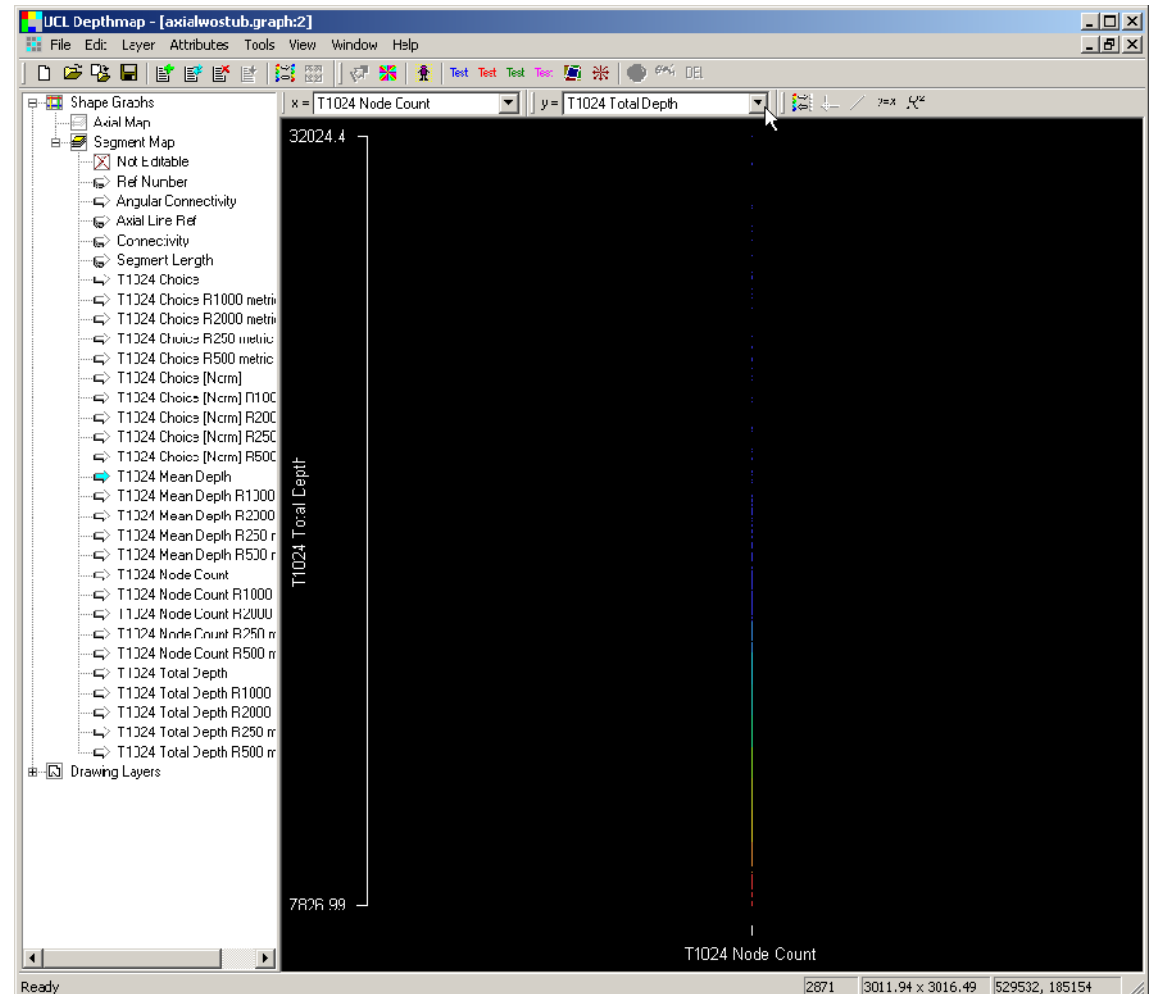
## Angular segment analysis: *The problem with MD*

The reason for this effect, pointed out by N S C Dalton, is that we are hoping MD tells us something about “centrality”: how “deep” or “shallow” the node is with respect to the rest of the graph. The problem is, at *low* radius, both TD and NC show this, and MD, which is simply TD / NC, therefore cancels itself out. It may show something interesting: that housing estate is not just an artefact, but perhaps not what we initially thought.



## Angular segment analysis: *The problem with MD*

At radius  $n$  there is no problem: as NC is constant (every node can see the whole system), MD is simply proportional to TD, a measure of centrality.



Angular segment analysis: *The integration solution*

Hillier's integration measure gives a solution that works both at low radius and radius n

$$\text{Integ} = (\text{NC} * \text{NC}) / \text{TD}$$

At radius n, NC is constant, so Integ for each node could as well be written  $1 / \text{TD}$

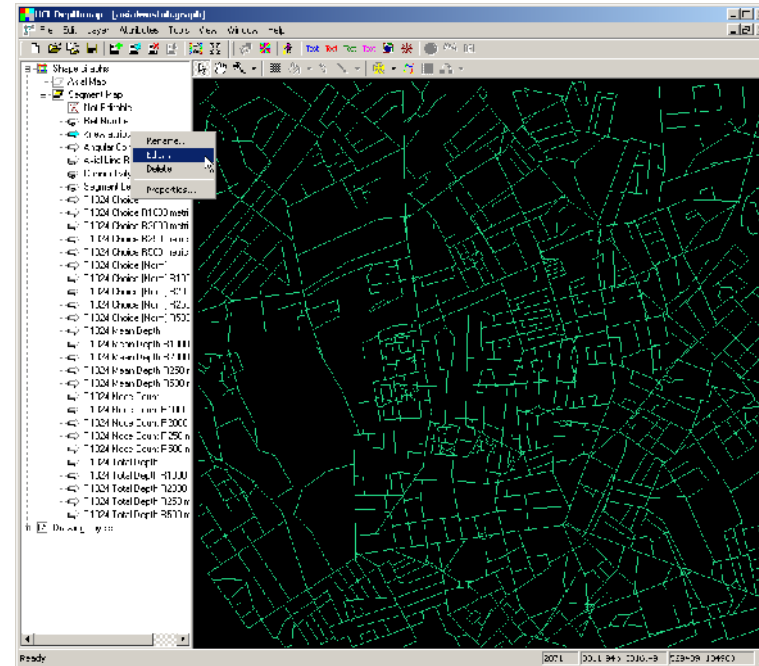
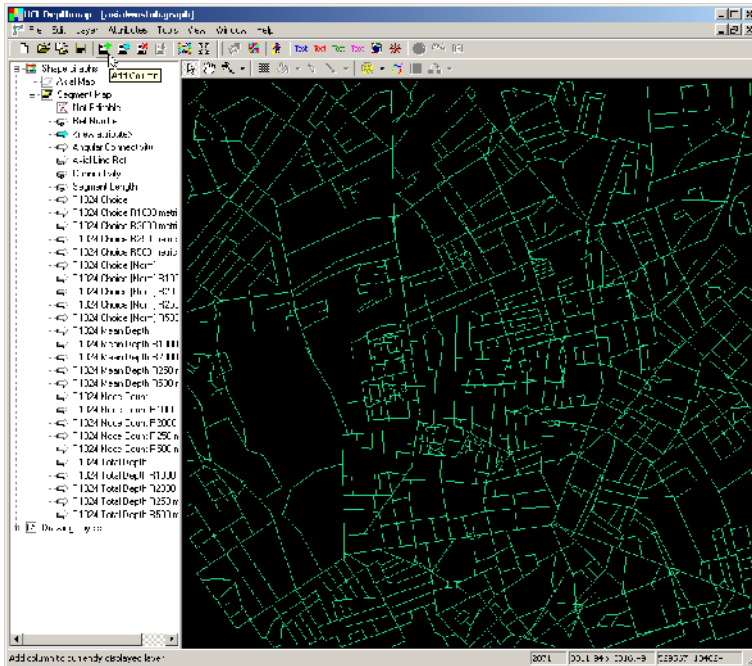
At low radius,  $\text{NC} / \text{TD}$  is (roughly) constant, so the second NC takes effect: Integ could as well be written NC

## Angular segment analysis: *The integration solution*

Let us demonstrate how integration works graphically, by creating new integration columns for radius 500m and radius n

Remember the formula is  $NC / MD$ :

- 1) Create a new column (the “Add column” button)
- 2) Edit the new column (right click on it or press the “Update column” button)





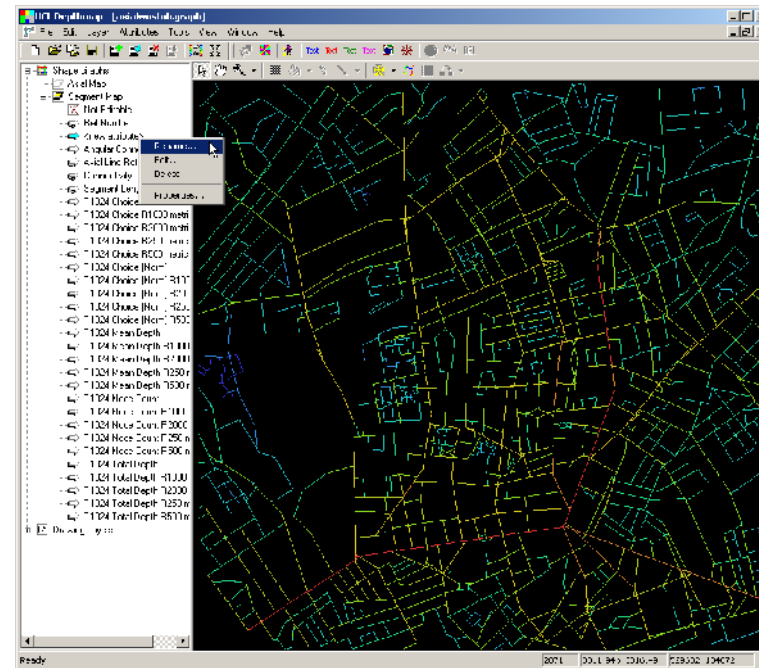
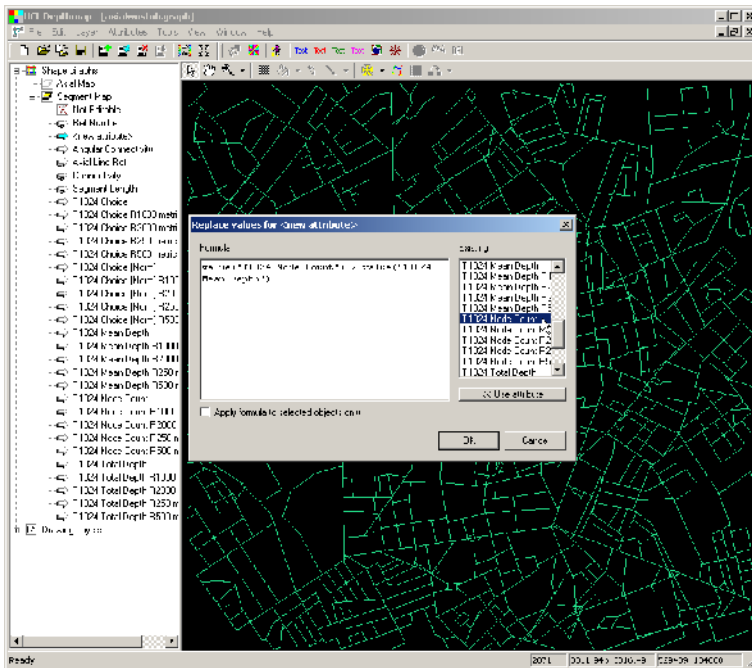
## Angular segment analysis: *The integration solution*

3) Type the formula:

```
value("T1024 Node Count") / value("T1024 Mean Depth")
```

(This can be speeded up by double clicking on the column names in the chooser to the right of the formula box)

4) Rename the column by right click on the column name and selecting "rename". I will call the column "Angular Integration"



# Angular segment analysis: *The integration solution*

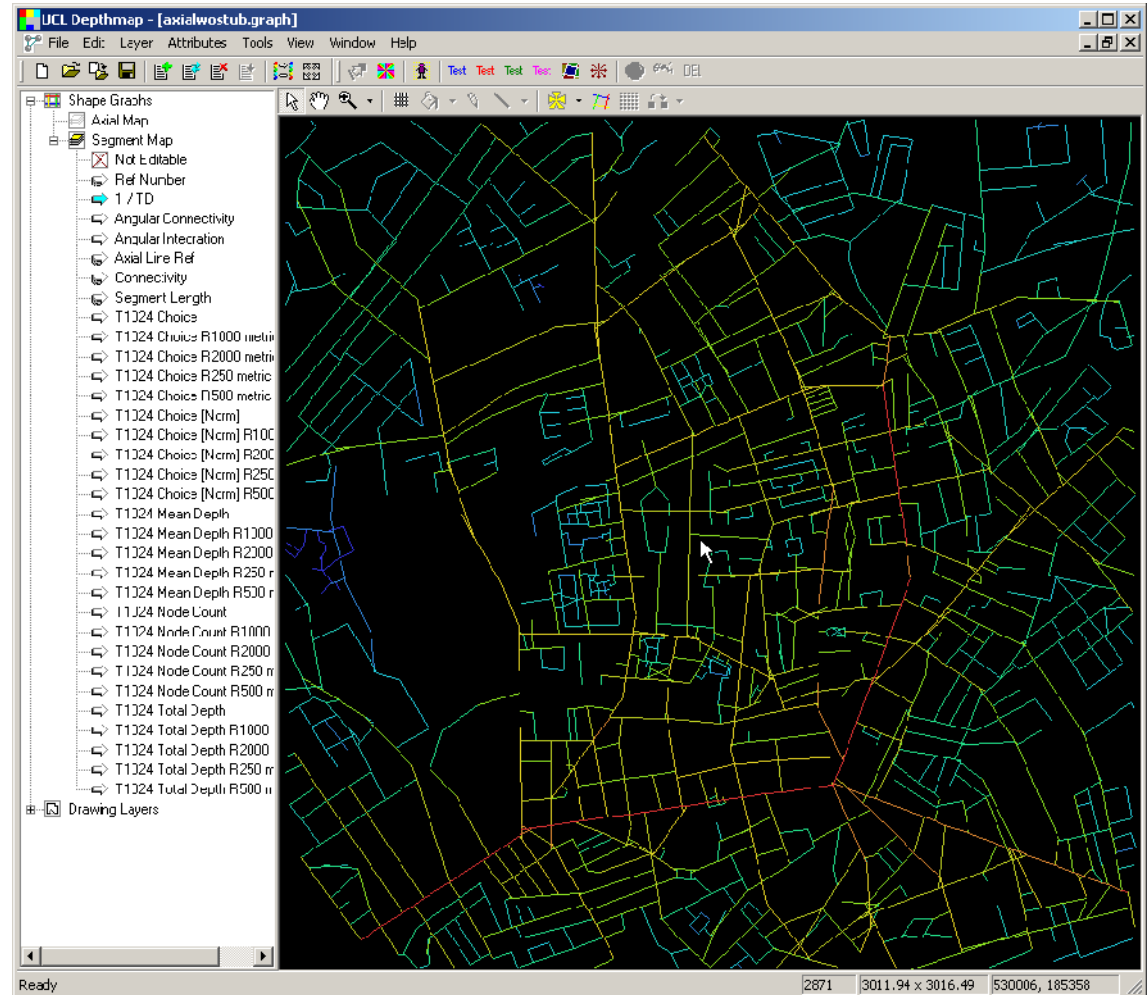
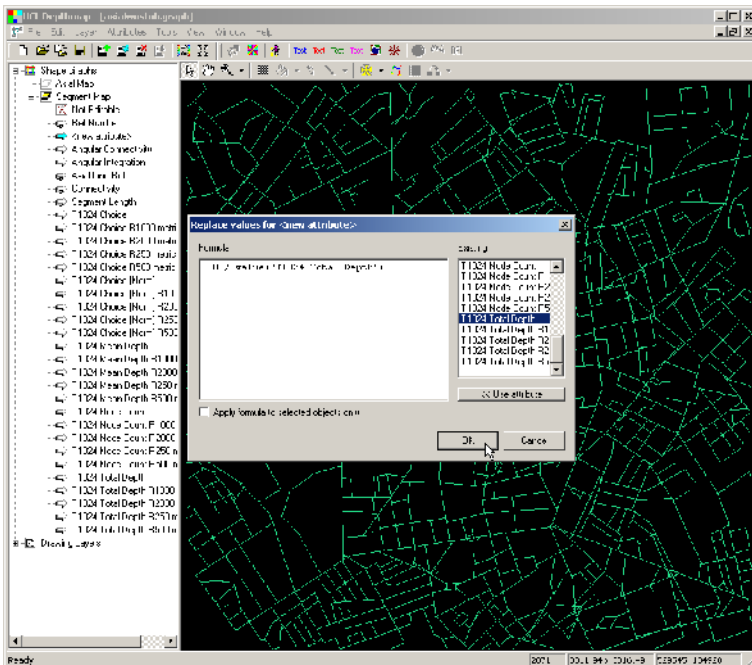
Angular integration, radius  $n$



# Angular segment analysis: *The integration solution*

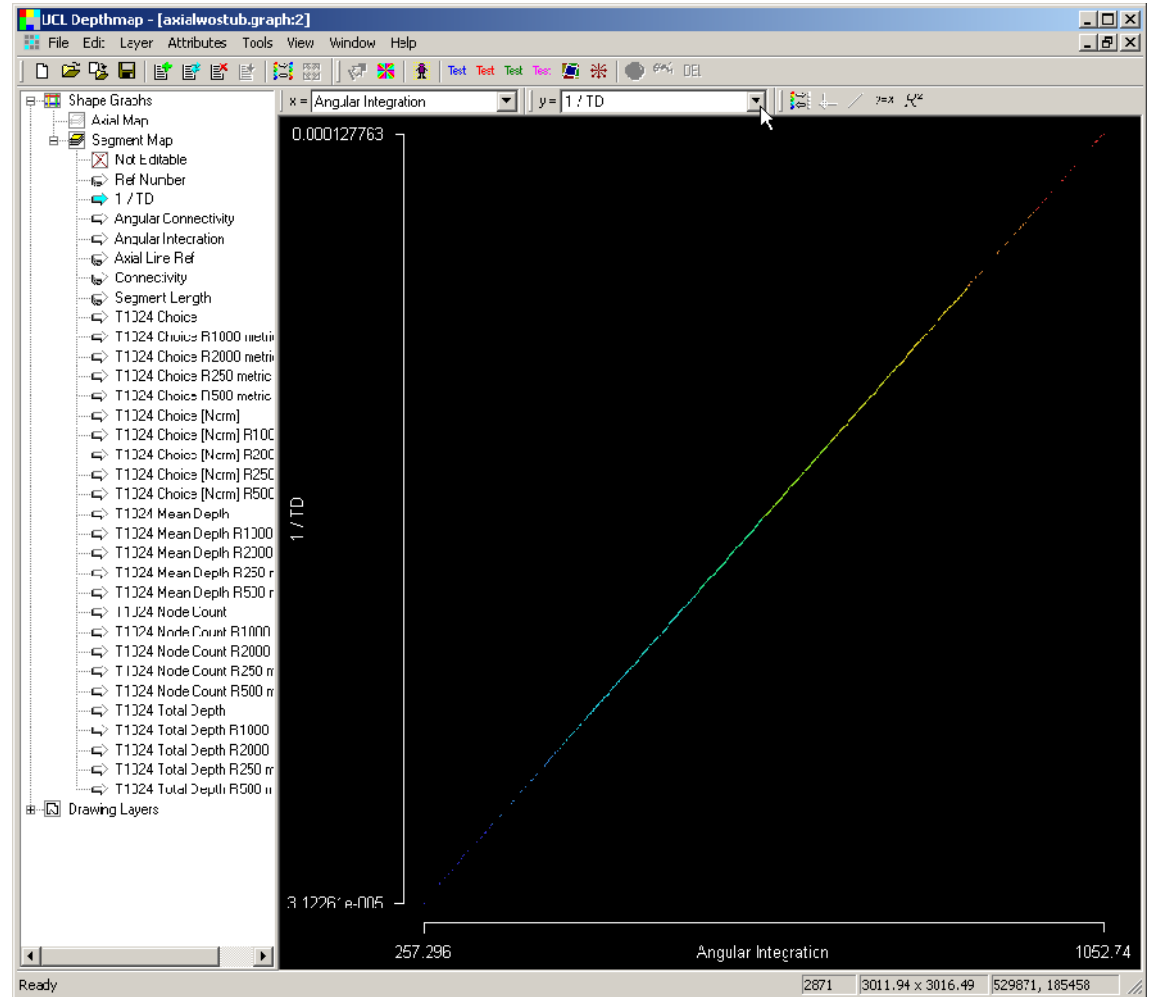
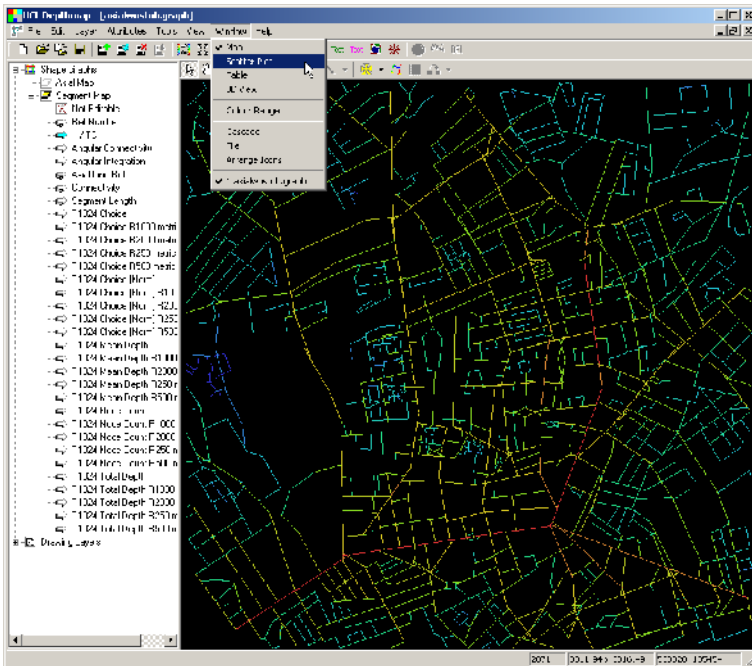
We can verify that this is equivalent to 1/TD by creating a 1/TD column.

Follow the steps once again (add column, edit, rename) this time with the formula `1.0 / value("T1024 Total Depth")`



# Angular segment analysis: *The integration solution*

Now plot a scatter of “1 / TD” versus “Integration”



# Angular segment analysis: *The integration solution*

To verify that at low radius integration is proportional simply to NC, also create a local integration column. The formula for this is:

```
value("T1024 Node Count R500 metric") /  
value("T1024 Mean Depth R500 metric")
```

Compare this column simply to the existing  
"T1024 Node Count R500 metric"  
in the scatter plot

