“空间句法”理论及应用

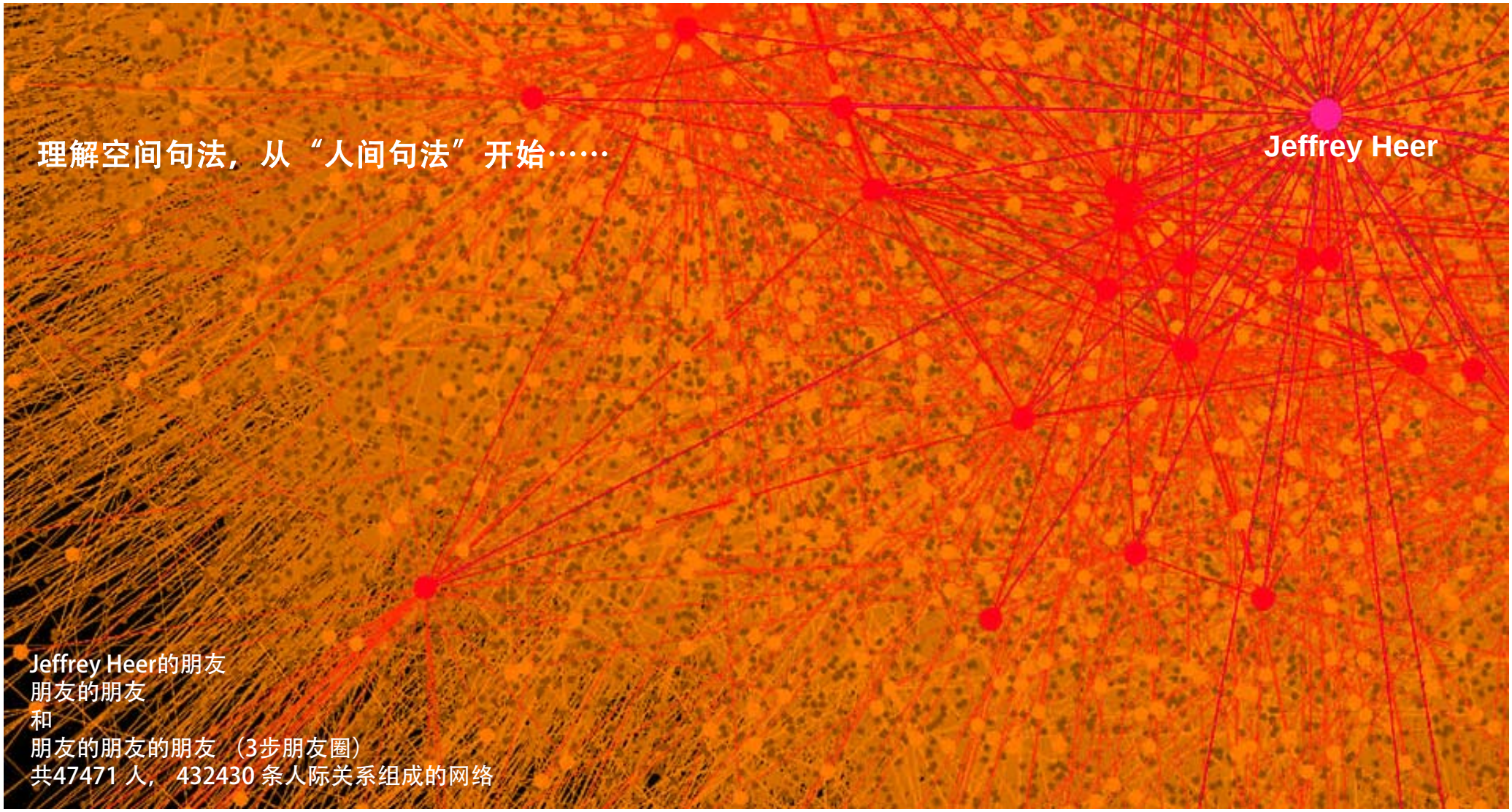
Space Syntax Theory and Applications

盛强

伦敦UCL空间句法公司北京办事处

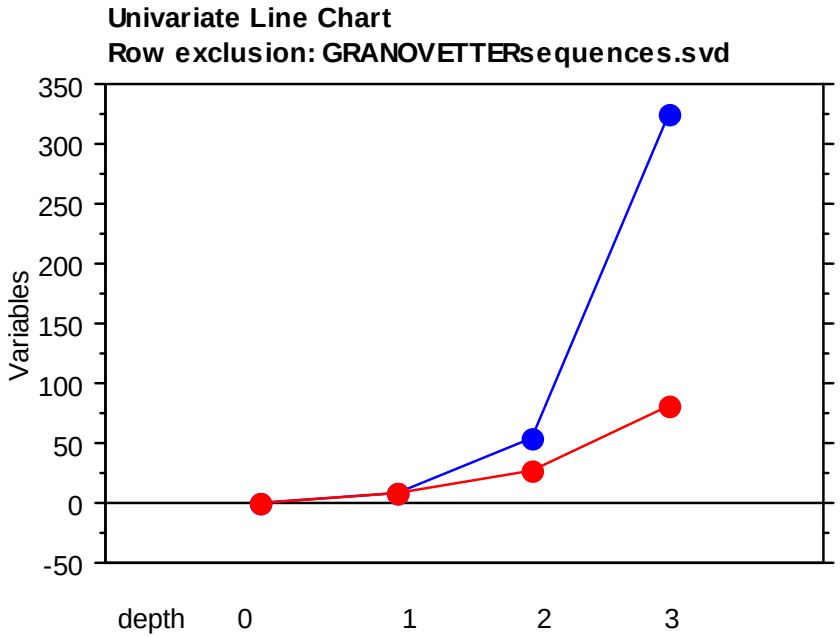
Qiang Sheng

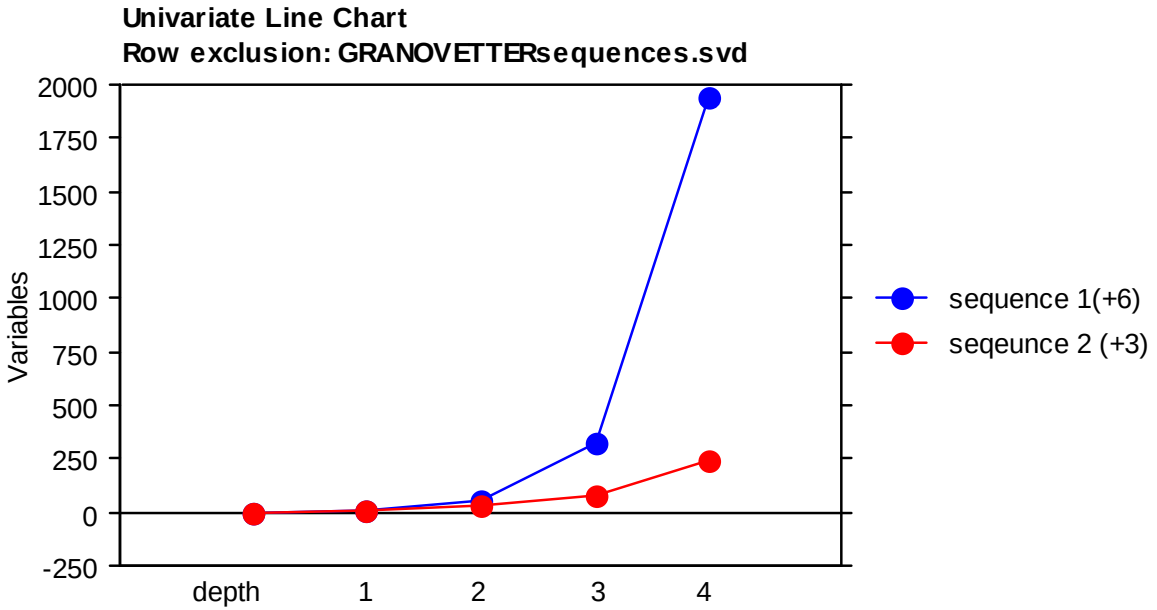
UCL Space Syntax Ltd. Beijing Office



从“关联性网络”的视角来重新审视我们生活的世界。

！ 本质上说，这种社会关系网络便是空间句法的一个社会学版本。

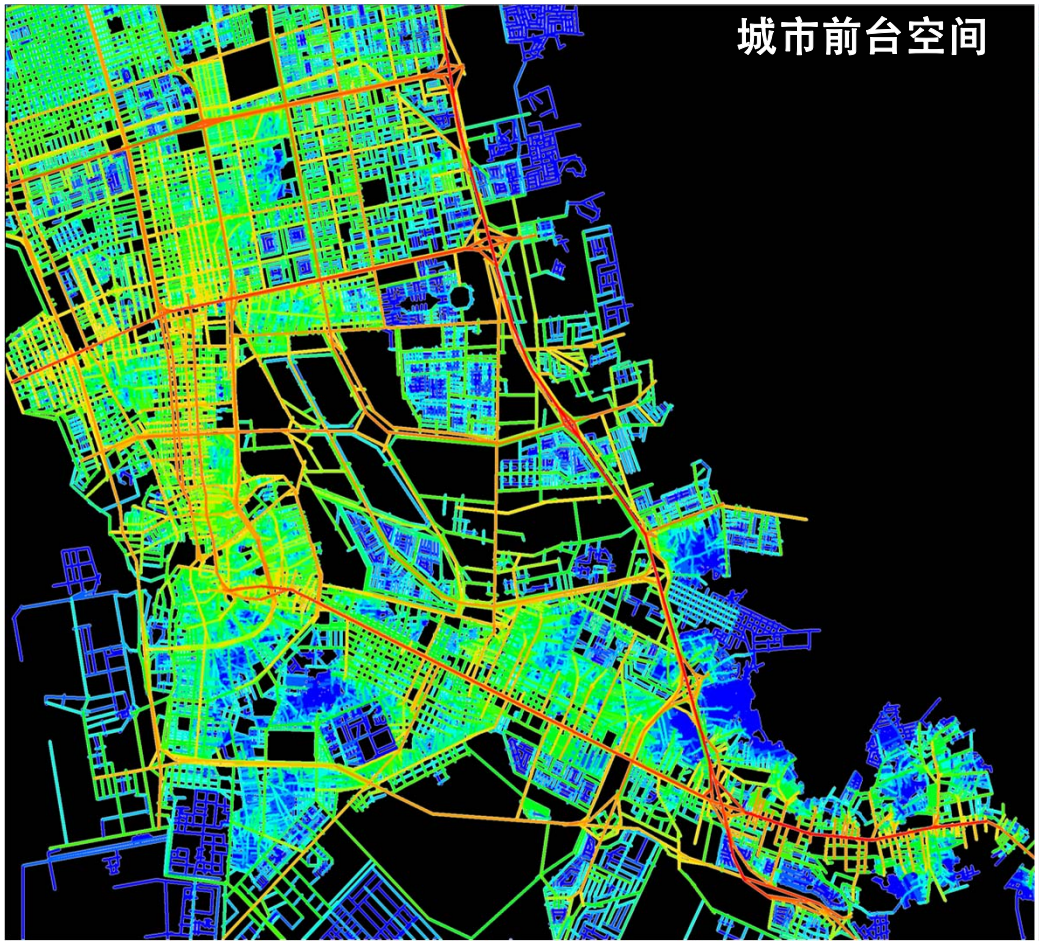


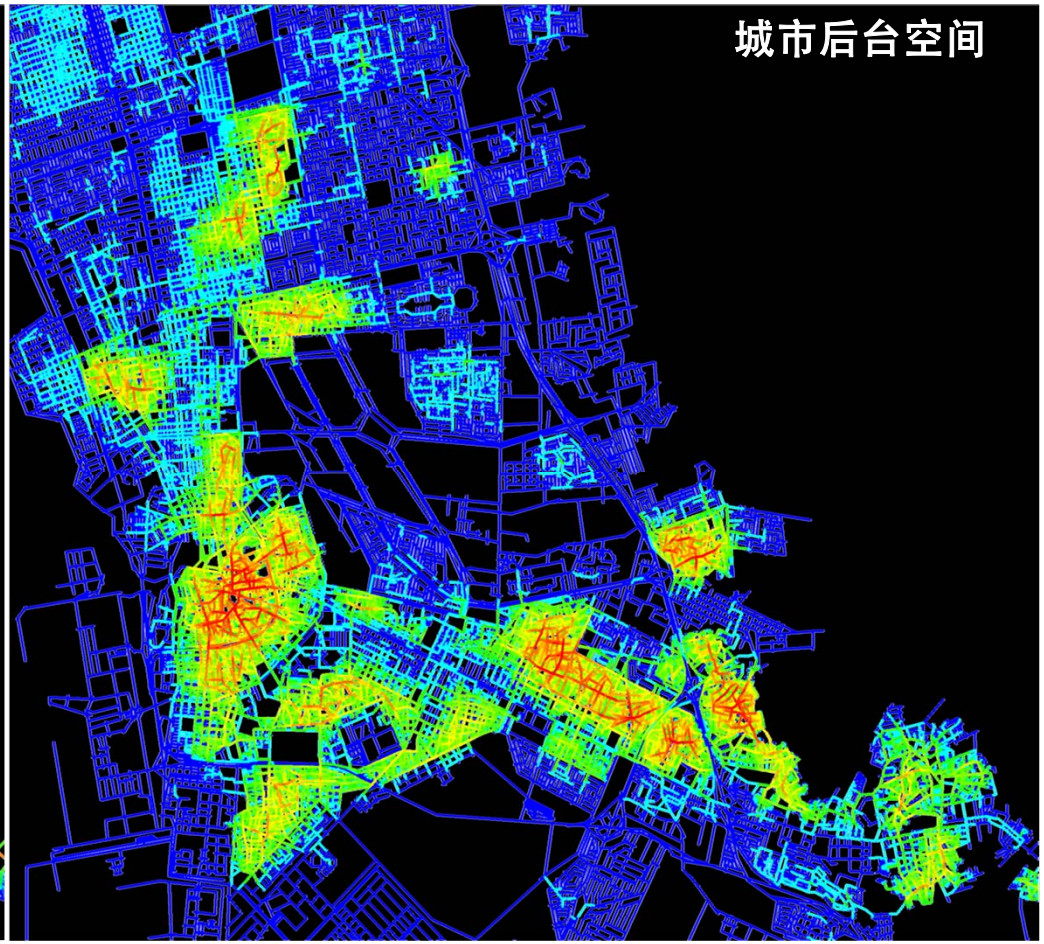


从“关联性网络”的视角来重新审视我们生活的世界。

！ 本质上说，这种社会关系网络便是空间句法的一个社会学版本。

吉达市Jeddah的层级空间结构（角度整合度）





简单化的理解：中产阶级占据了城市中更为可见可达的[前台空间]，而弱势群体则在空间上更为隔离和不可见，成为城市生活中的[后台空间]。
城市中不同的功能和用地同样呈现着前台和后台空间的属性。

最低纲领

[理论]
空间句法理论及方法缘起的背景

空间句法对城市研究及设计的意义

空间句法未来的发展方向

[实践]
掌握空间句法软件Depthmap的主要功能和各空间参数的含义

通过实际案例掌握以空间形态为基础的分析方式

最高纲领

1, 重新认识空间，进而学会从“空间”的角度思考！

2, 了解用数字来描述空间，进而分析空间和行为关系的方法！

3, 走向 “数据化”的城市设计！

空间句法是搞好社会主义城市建设的关键！

第一讲 重新认识空间

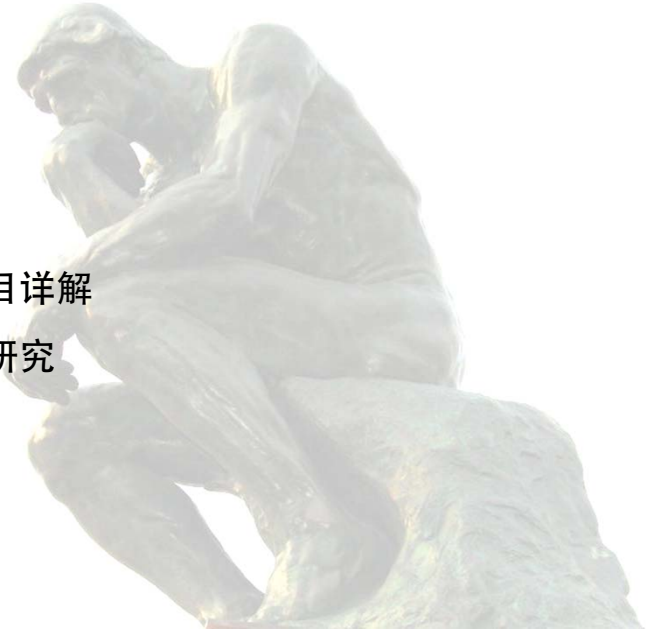
1. 空间句法概况
2. 空间句法的科学发现
3. 拓扑空间概念
4. 凸空间分析
5. 轴线分析
6. 视域分析
7. 常见问题解答

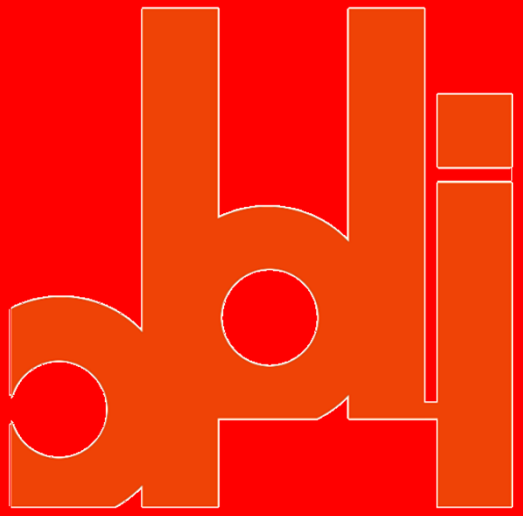
第二讲 质疑与发展

1. 线段分析
2. 回归分布图
3. 研究分析实例
4. 一些理论背景

第三讲 现状与未来

1. 空间句法实际项目详解
2. 信息时代的空间研究
3. 数据化设计初步





空间句法概况

什么是空间句法？它能用来做什么？

什么是空间句法？

一种以**空间拓扑形态**为基础的空间分析**方法**及计算机软件。

一种从空间形态出发理解人类社会、经济和文化行为的城市和建筑**理论**。

空间句法软件的特点：

-空间句法软件不是为了完成特定的任务，而是提供一系列量化描述城市和建筑空间拓扑形态的参数。

-空间句法软件在操作和使用上相对简单，但难在分析思考的过程，不是功能指向性明确的工具型软件，而是一种**研究型软件**。

-软件发展的动力和过程源自对空间形态与人类社会、经济、文化行为的科学研究。

什么是空间句法？

一种以**空间拓扑形态**为基础的空间分析**方法**及计算机软件。

一种从空间形态出发理解人类社会、经济和文化行为的城市和建筑**理论**。

空间句法理论及方法的创始人

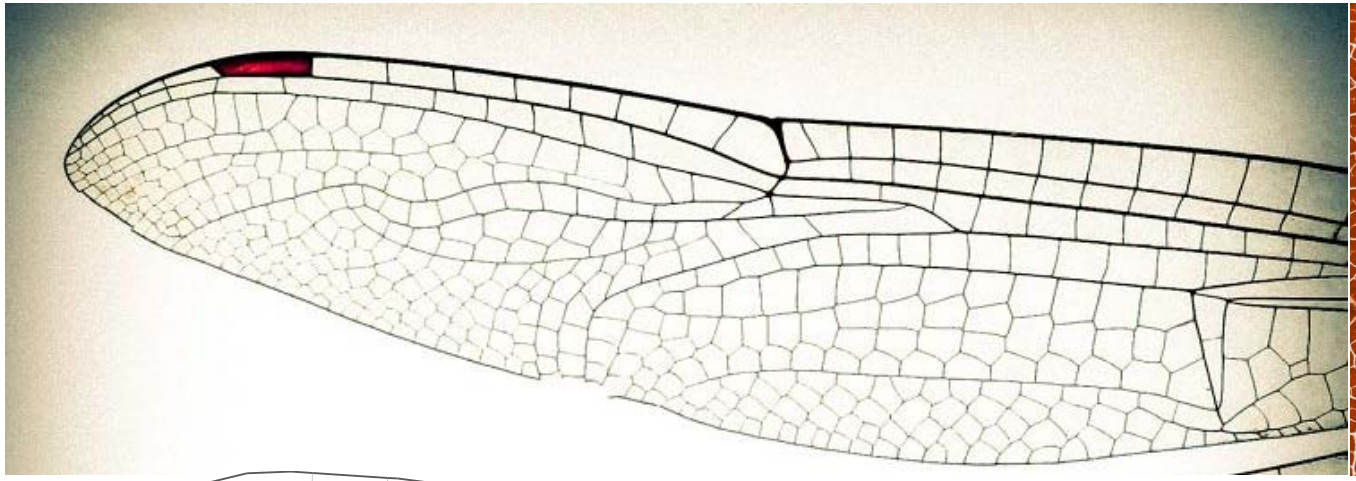
Prof. Bill Hillier

英国伦敦学院大学（UCL）建筑与环境学院教授

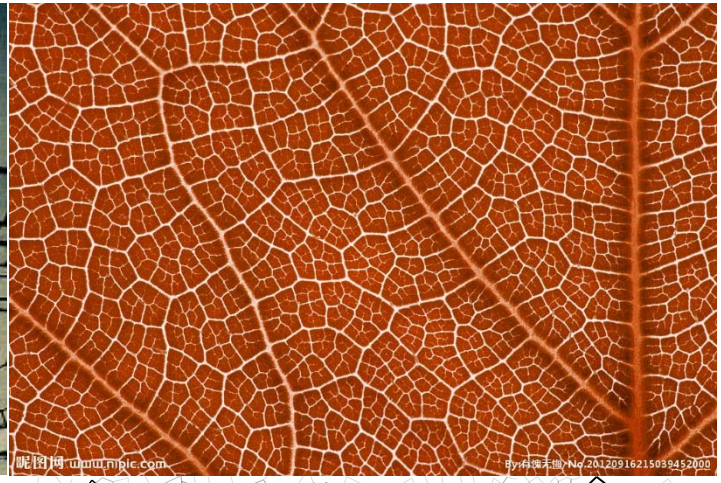
空间句法的世界影响

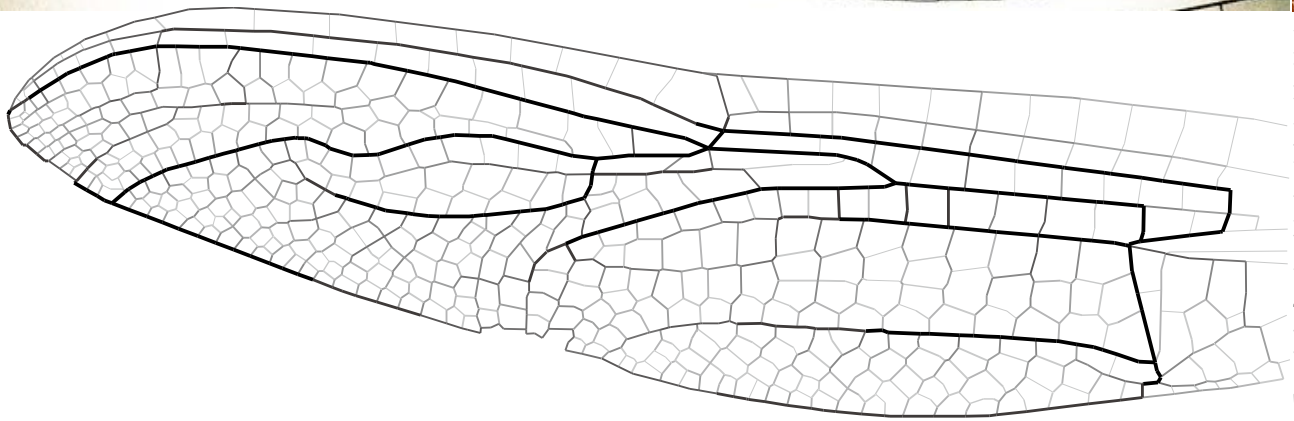
空间句法能用来做什么？

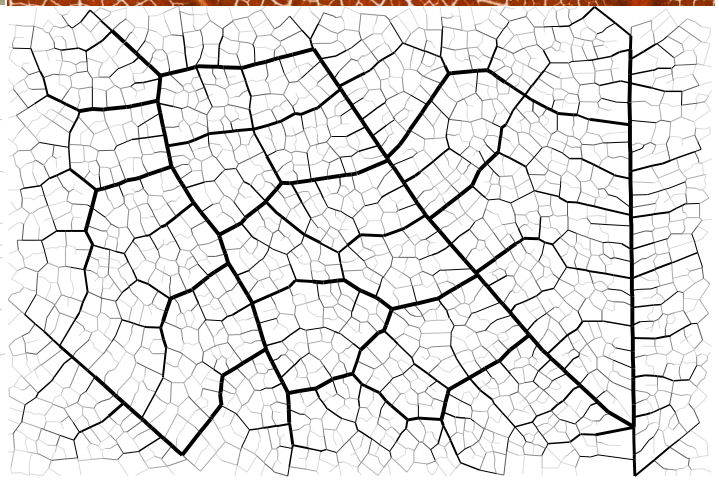
对蜻蜓翅膀的标准化穿行度分析



对叶脉的标准化穿行度分析



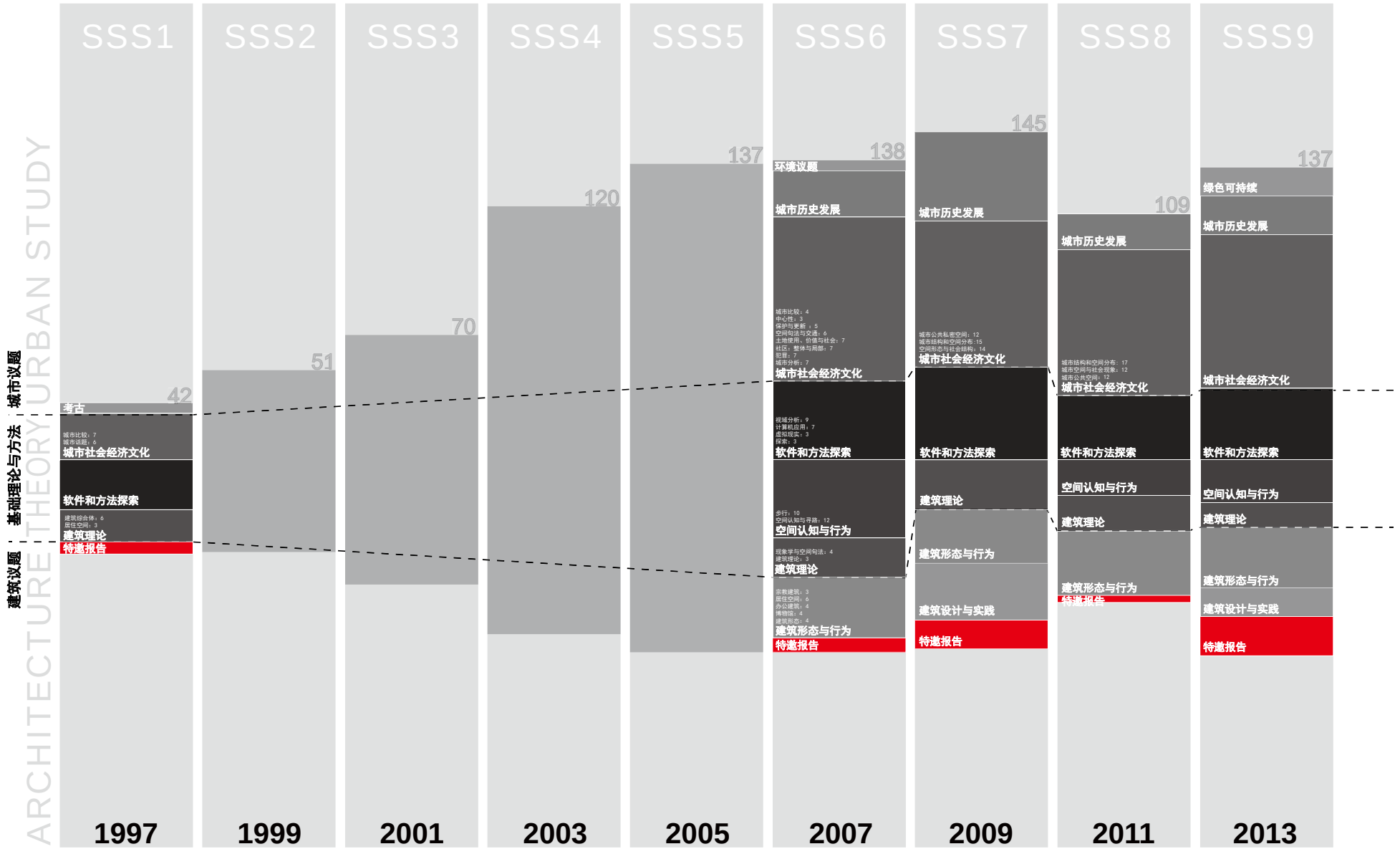




空间句法无极限……

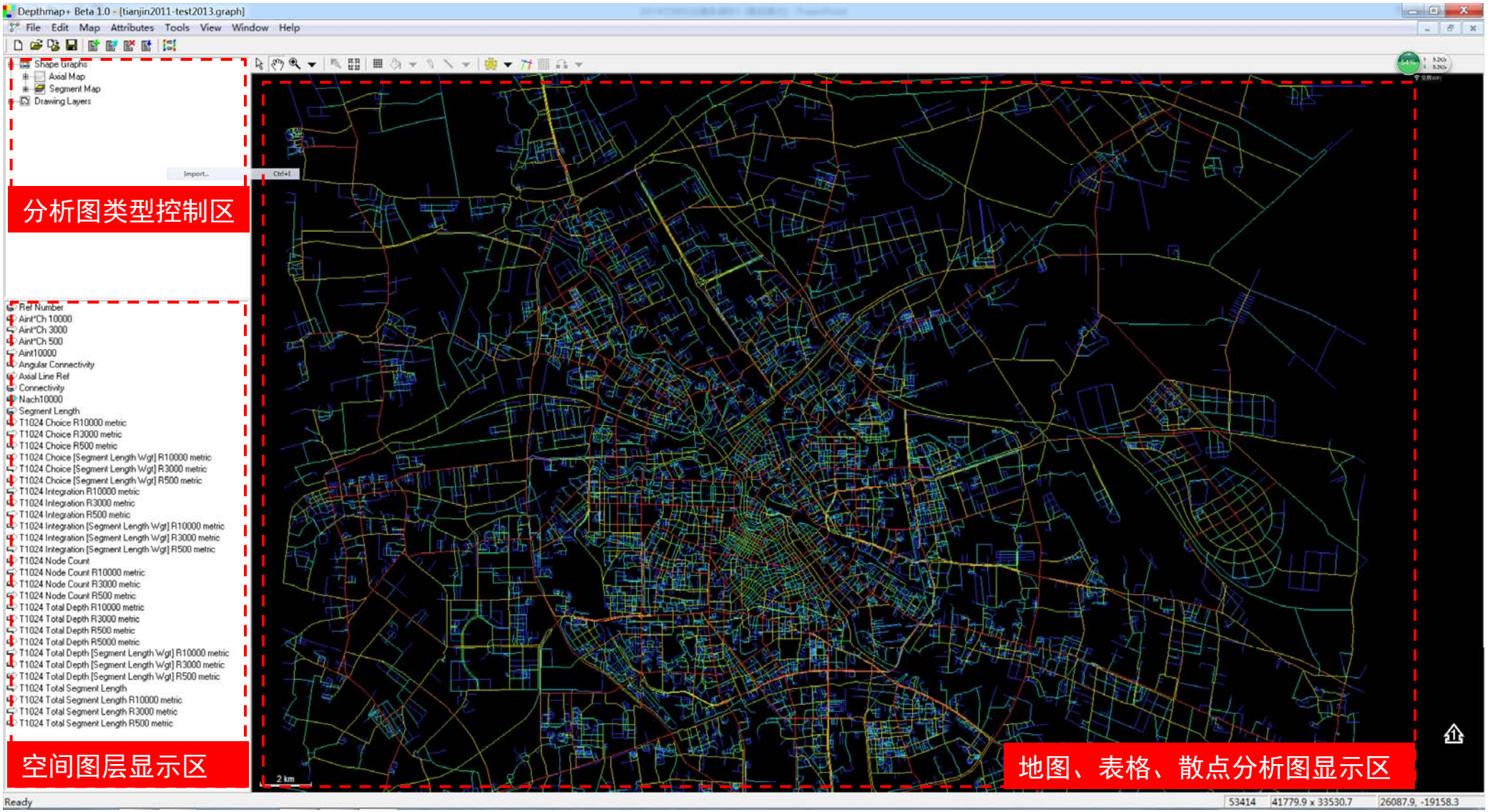
空间句法应用的广泛性来自于其本质是一种量化分析拓扑网络联系的工具。网络联系与网络内的物质能量流是互生的关系，这点其得以应用于上述两个例子的本质。

空间句法能用来做什么？——从会议的议题来看



空间句法软件的特点

- 简单：一切不必须的功能都被弱化，充分利用电脑的计算能力。
- 研究型软件：作为计算结果的各个图层并不明确指向建筑或城市学中特定的功能，而是纯粹的形态特征指标。



简体中文 Português English Search...

Space Syntax 25

Our approach Projects, clients & partners Downloads Contact

Trusted expertise in urban planning, building design & spatial economics

Follow @Space_Syntax

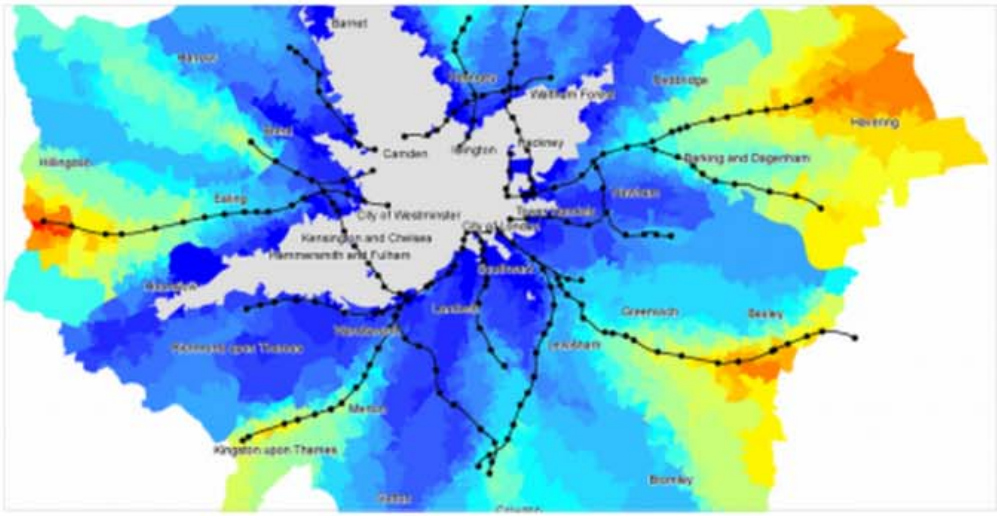
Space Syntax provides strategic, evidence-based consulting services in economics, planning, design, transport and property development.

Combining extensive global experience with robust and sophisticated technologies, we forecast the effects of planning and design decisions on the movement and interaction of people in buildings and urban areas.

Space Syntax's unique contribution to the field of urban planning and design is in the identification of fundamental links between spatial layout and the social, economic and environmental performance of places. Space Syntax research has made five key discoveries that demonstrate how spatial layout directly affects:

- **movement**, such that Space Syntax models can be used as strategic traffic modelling tools for vehicle, pedestrian and cycling movement

- **land use**, showing how land use

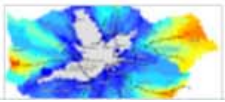
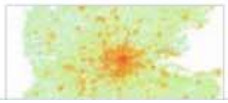
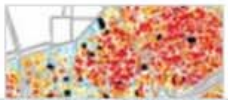


SkyCycle
A revolutionary cycling infrastructure to transform London's transport network
The Mayor's aim is for London to...

Read more...

Partners
Exterior Architecture, Foster + Partners

Projects

空间句法网络资源

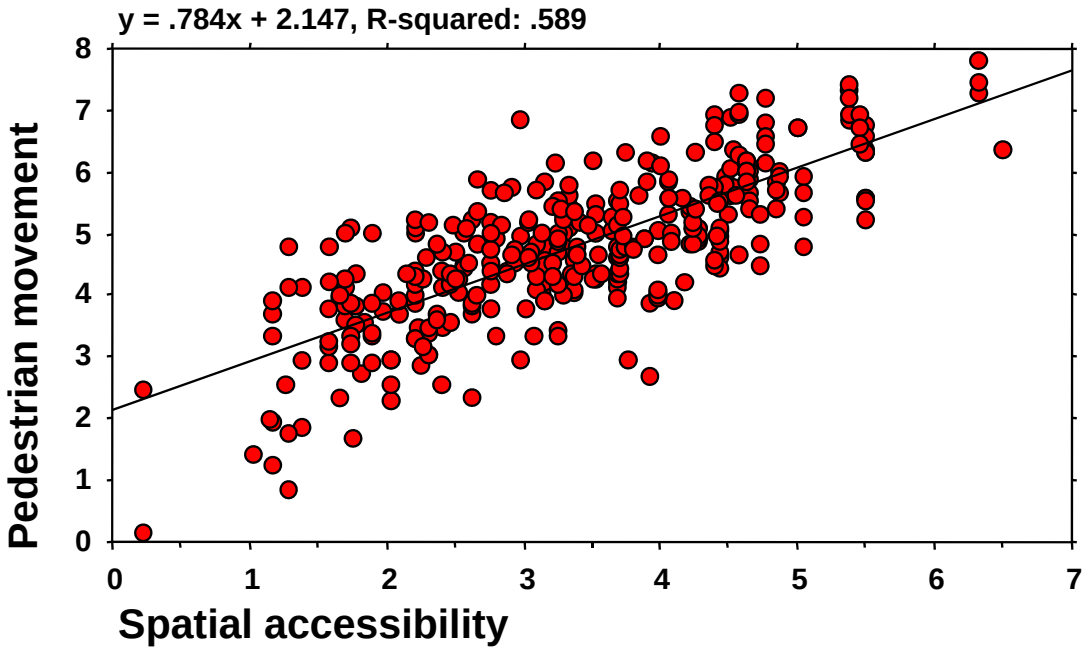
www.spacesyntax.com

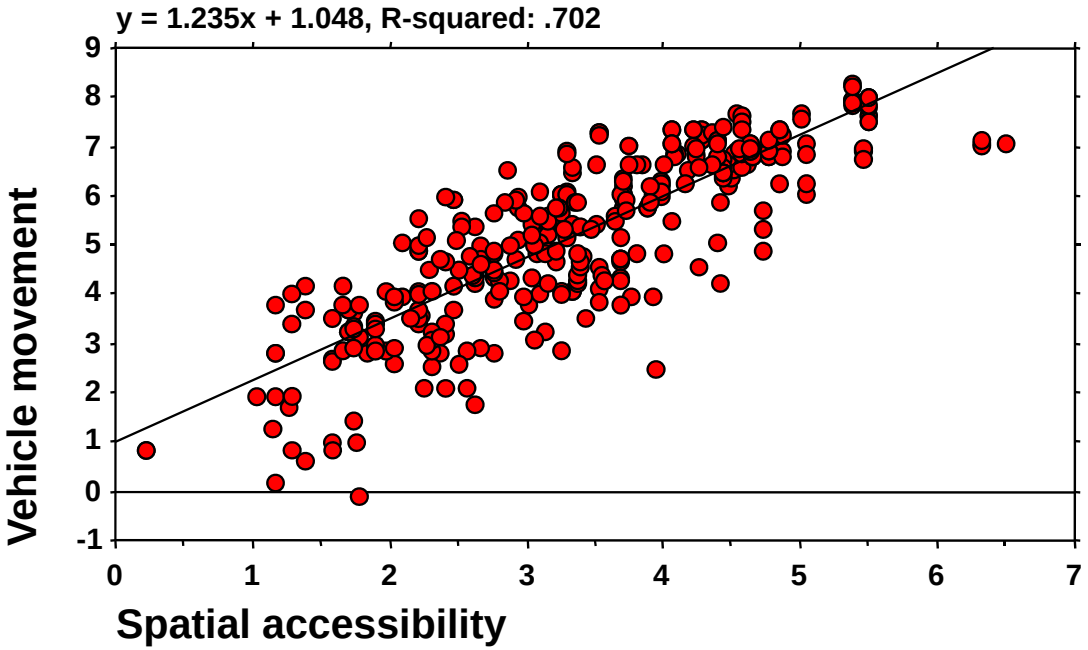
www.spacesyntax.net

www.spacesyntax.org

空间句法的科学发现

30年来国际空间句法研究的5个主要科研方向及其在城市和建筑设计中的应用。





关键发现1 空间格局影响人类行为（流量）

Research shows that 60-80% of movement flows are due to the structure of the network, measured by spatial accessibility.

研究表明60-80%的交通受到网络结构影响，可采用空间可达性来度量。

More accessible places get more movement.

更可达的场所吸引更多交通流量。

观测地点：天津滨江道沿线106个街道截面。

观测内容：街道上各个观测点在2分钟之内的双向过观测线步行人流量，不记录1.5m以下儿童，自行车量和机动车量。

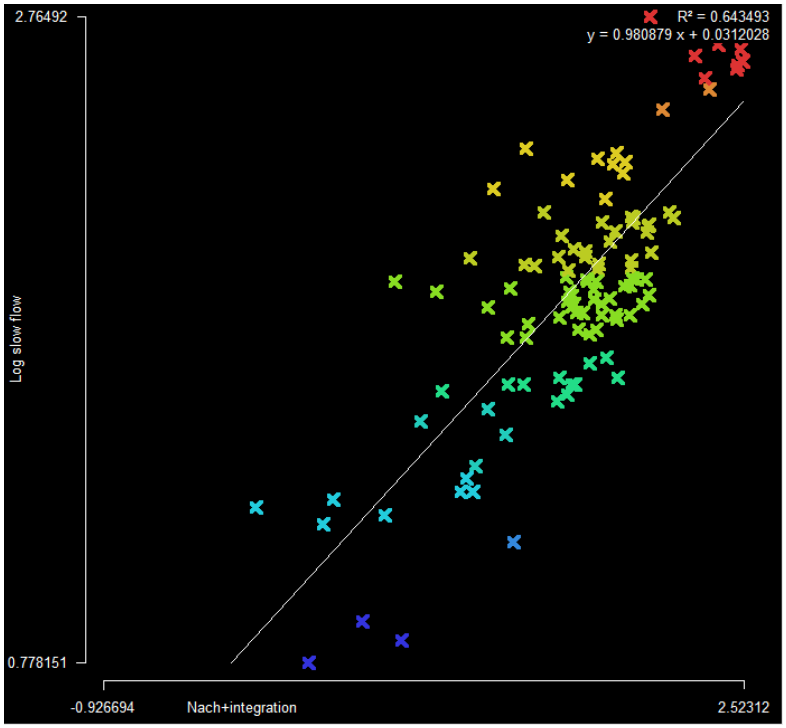
实测慢速交通流量 Flow intensity　Pedestrian+Bike

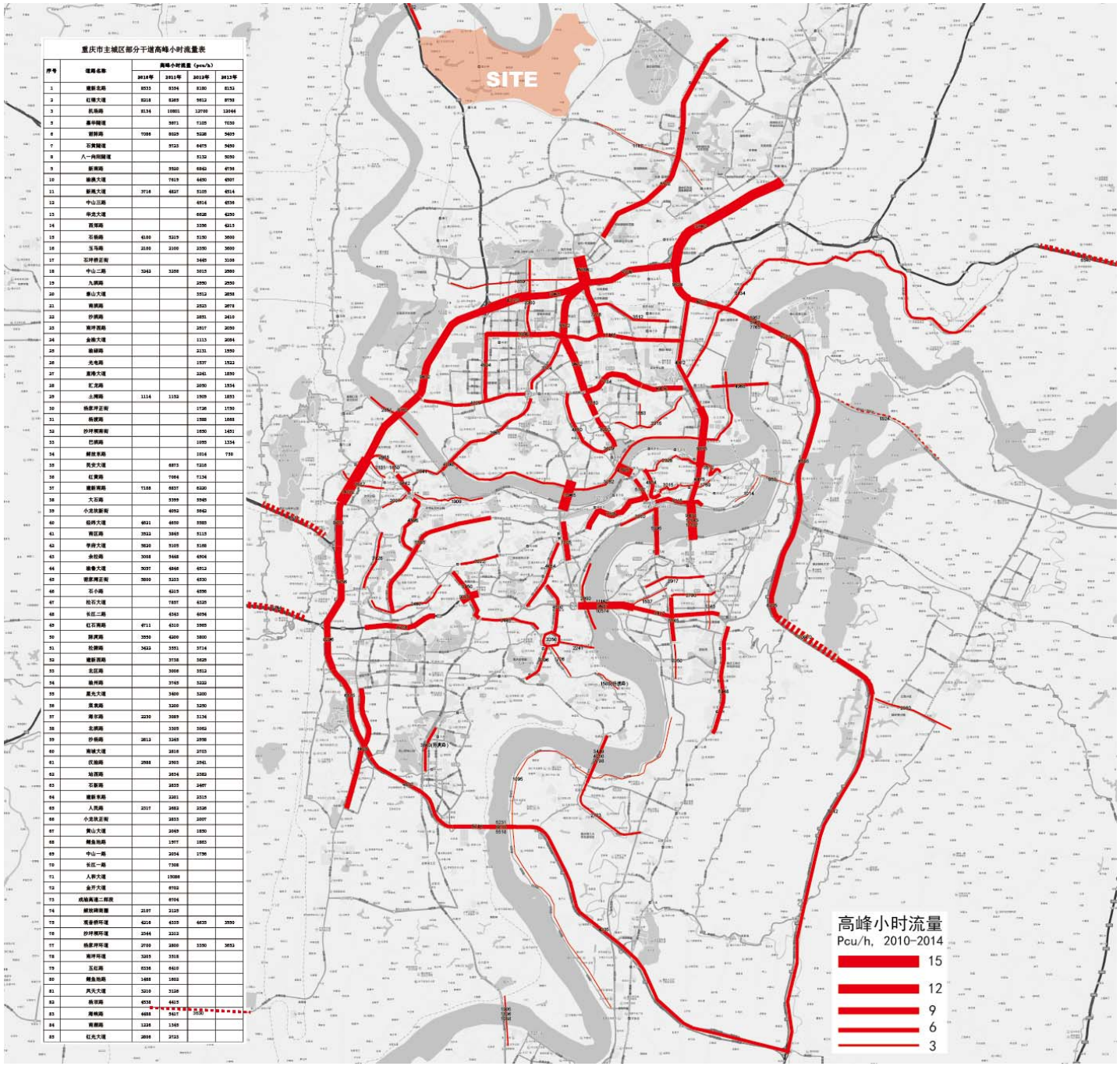
空间句法分析 Space Syntax Anlysis　Nach1500+ AINT1500

应用excel多元一次回归分析工具，最终锁定分析半径为1.5公里的整合度与穿行度作为该地区的流量预测模型。

滨江道空间DNA= 0.00163237*value("T1024 Integration R1500 metric")
+1.263178146*value("Nach 1500")-0.925061803

回归统计						
Multiple	0.80218					
R Square	0.643493					
Adjusted	0.588236					
标准误差	0.255571					
观测值	111					
方差分析						
	df	SS	MS	F	gnificance F	
回归分析	2	10.39469	5.197346	79.57158	5.76E-22	
残差	108	7.054194	0.065317			
总计	110	17.44889				
	Coefficien	标准误差	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-0.92506	0.203317	-2.67115	0.008729	-0.9461	-0.14008
X Variabl	1.263178	0.26103	3.429977	0.000856	0.377919	1.412731
X Variabl	0.001632	0.000474	3.496013	0.000686	0.000718	0.002598





重庆市主城区部分干道高峰小时流量表

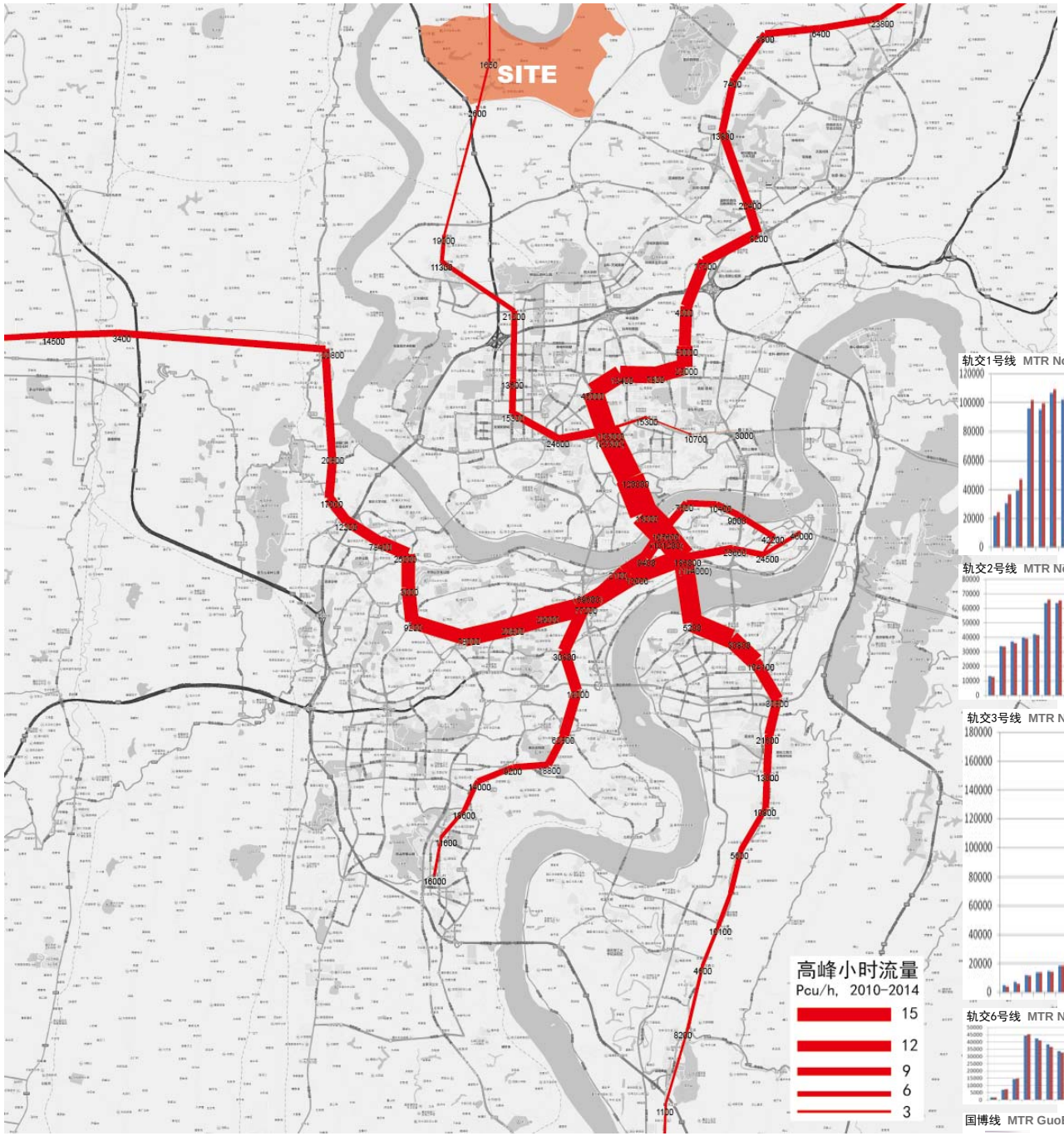
序号	道路名称	高峰小时流量（pcu/h）			
		2010年	2011年	2012年	2013年
1	建新北路	8531	8356	8180	8152
2	红旗大道	8218	8269	9812	8793
3	凯旋路	8134	10801	12700	12066
4	嘉华隧道		5871	7105	7030
5	建新南路	7086	8025	5226	5405
6	石黄隧道		5723	6475	5450
7	八一两郊隧道			5132	5050
8	新南路		5510	6843	4736
9	杨渡大道		7019	4450	4507
10	新南大道	3716	6837	5105	6514
11	中山北路			4514	4536
12	华龙大道			6628	6250
13	西郊路			5196	6215
14	石杨路	6100	5219	5130	3600
15	玉马路	2100	2100	2350	3600
16	石坪桥正街			3445	3106
17	中山二路	3243	3288	3015	2980
18	九滨路			2850	2550
19	泰山大道			3512	2858
20	南滨路			2525	2078
21	沙滨路			2851	2410
22	南坪西路			2817	2050
23	金渝大道			1113	2094
24	杨柳路			2131	1550
25	光电路			1537	1522
26	嘉陵大道			3241	1850
27	红光路			2650	1534
28	土湾路	1114	1152	1305	1833
29	杨家坪正街			1726	1750
30	杨渡路			1588	1668
31	沙坪坝南街			1650	1451
32	巴滨路			1095	1334
33	解放东路			1014	710
34	民安大道		6873	7218	
35	红黄路		7064	7134	
36	建新南路	7108	6837	6220	
37	大石路		5359	5545	
38	小龙坎新街		6052	5042	
39	经纬大道	6821	6650	5585	
40	南区路	3521	3665	5115	
41	学府大道	5820	5105	5168	
42	金松路	3068	5468	4504	
43	渝鲁大道	5097	4946	4512	
44	建新南正街	5800	5203	4530	
45	石小路		4215	4356	
46	松石大道		7837	6325	
47	长江二路		4343	4054	
48	红石南路	4711	4310	3565	
49	陈滨路	3550	4200	3800	
50	杜鹃路	3423	3351	3714	
51	建新西路		3738	3629	
52	北区路		3008	3512	
53	渝州路		3745	3222	
54	星光大道		3400	3200	
55	茶高路		3200	3250	
56	海尔路	2230	3085	3134	
57	北滨路		3305	3052	
58	沙杨路	2813	3245	2958	
59	南城大道		2818	2703	
60	汉施路	2588	2903	2541	
61	站西路		2854	2582	
62	石新路		2855	2497	
63	建新东路		2201	2215	
64	人民路	2317	2652	2236	
65	小龙坎正街		2653	2007	
66	黄山大道		2049	1850	
67	解放路		1977	1883	
68	中山一路		2054	1736	
69	长江一路		7308		
70	人和大道		15088		
71	金开大道		8702		
72	成渝高速二郎段		8704		
73	解放碑街道	2197	2120		
74	观音桥环道	4216	4335	4635	3550
75	沙坪坝环道	2544	2212		
76	杨家坪环道	2700	2800	3350	3652
77	南坪环道	3203	3318		
78	五红路	5336	5410		
79	解放电路	1488	1802		
80	凤天大道	3210	3126		
81	杨渡路	6538	6415		
82	海棠路	4688	3617		
83	南湖路	1226	1345		
84	红光大道	2806	2723		

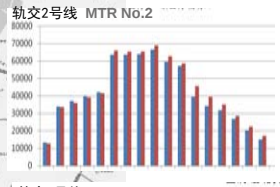
Traffic data from Chongqing Municipality

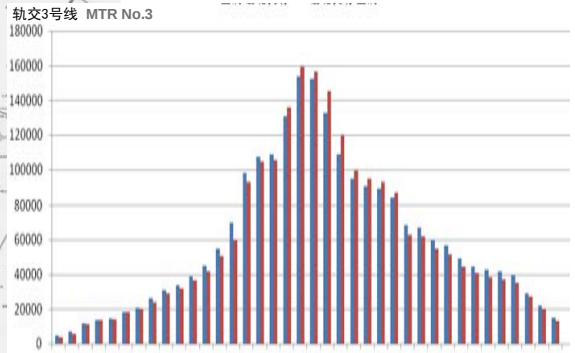
交通基础数据
Traffic Data

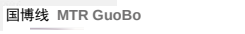
我们有过去三年重庆各主要道路、桥梁和隧道的实测峰值车流量数据。我们的空间模型分析与实测数据有很好的吻合度。

We also have the automobile flow data on major roads, bridges and tunnels in Chongqing in past 3 years. These data fits very well with our spatial model on existing conditions.









现状地铁交通分析
Analysis on Existing Metro Data

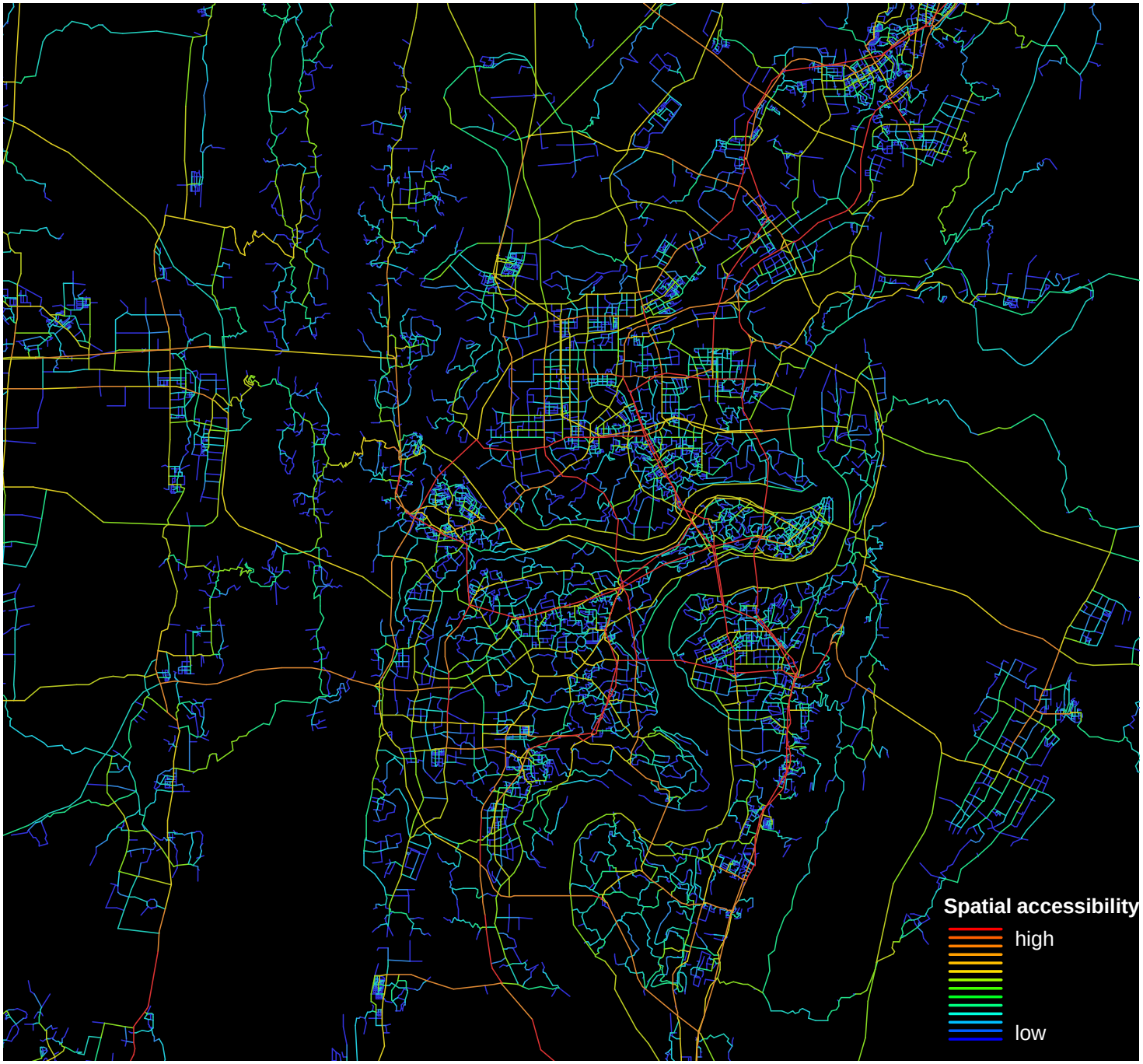
我们收集到大量交通实测数据，这些数据可以验证我们建立的空间模型的有效性，并通过提炼回归方程来更精确的预测未来的流量分布。

We managed to collect many traffic data in Chongqing. These data can verify our spatial model and help to predict the future traffic flows.

左图中为重庆现有所有地铁站每日进出站人流量数据。

The map and bar charts on the left shows the number of passengers in each Metro station in Chongqing.

MRT data from Chongqing Municipality

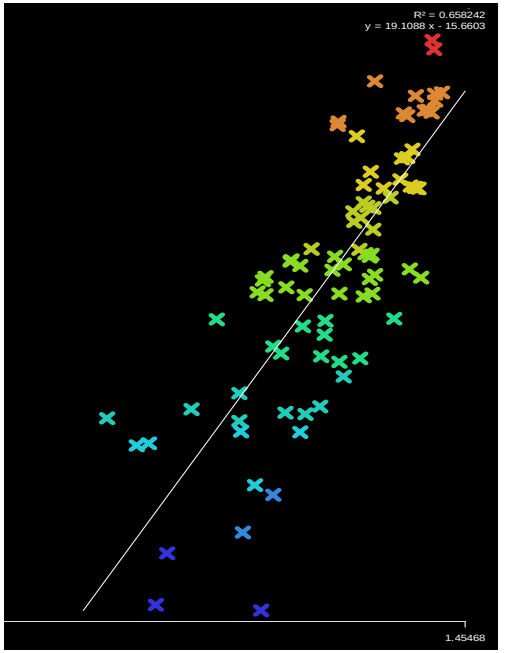


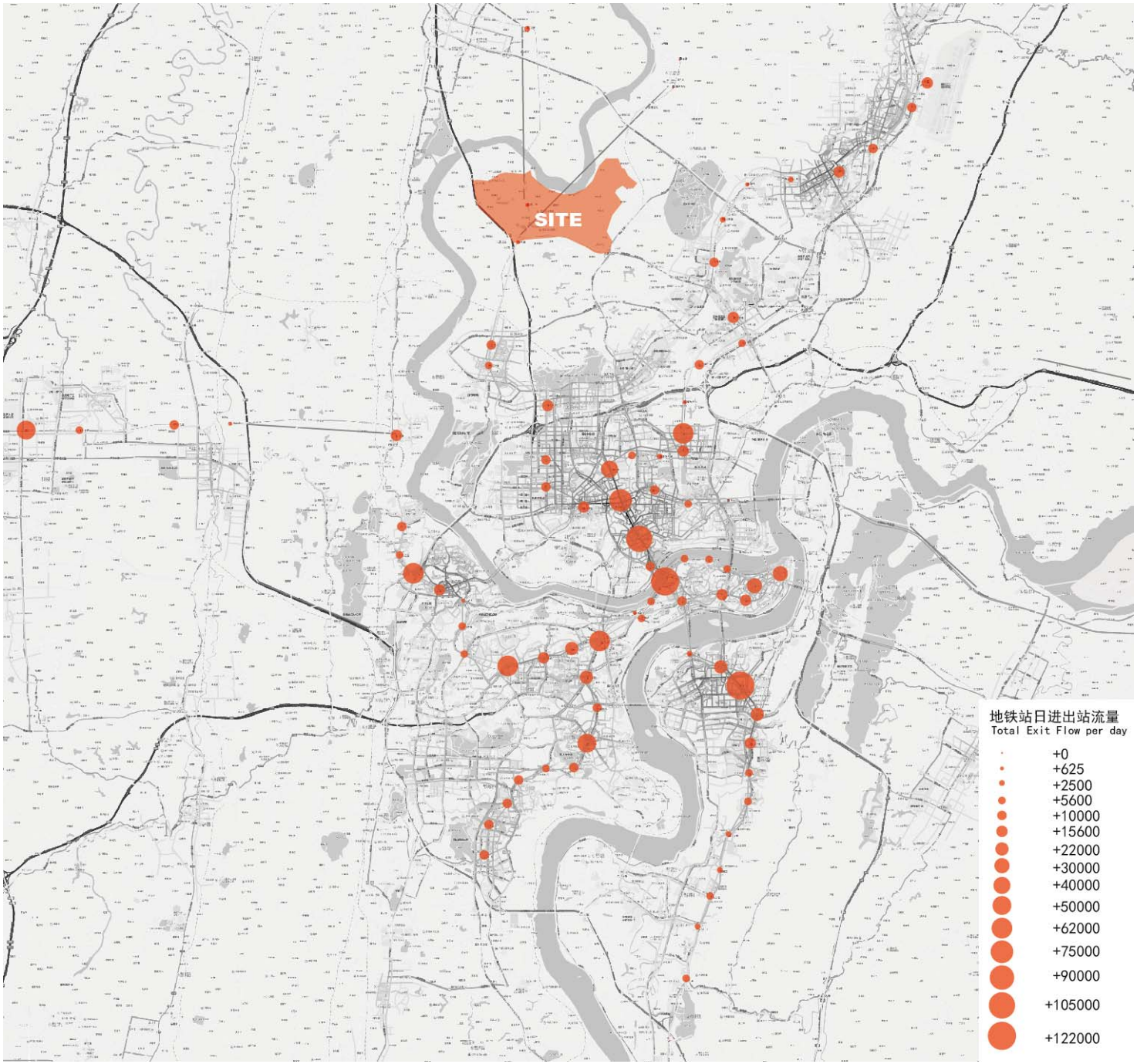
Segment map-NACH R15000

地铁流量数据分析
Analysis on MRT flow data

15公里穿行度指标与地铁实测客流量高度相关，该回归方程将作为我们预测未来地铁线路客流量的基础。

15km Nach value shows strong correlation with the data of passengers. This regression formula will be used as prediction tool for future metro lines.



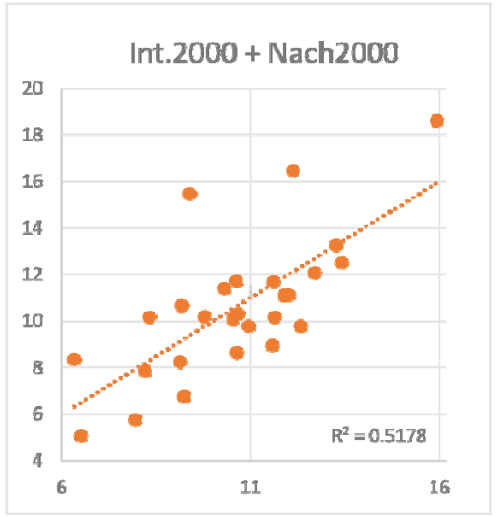


MRT data from Chongqing Municipality

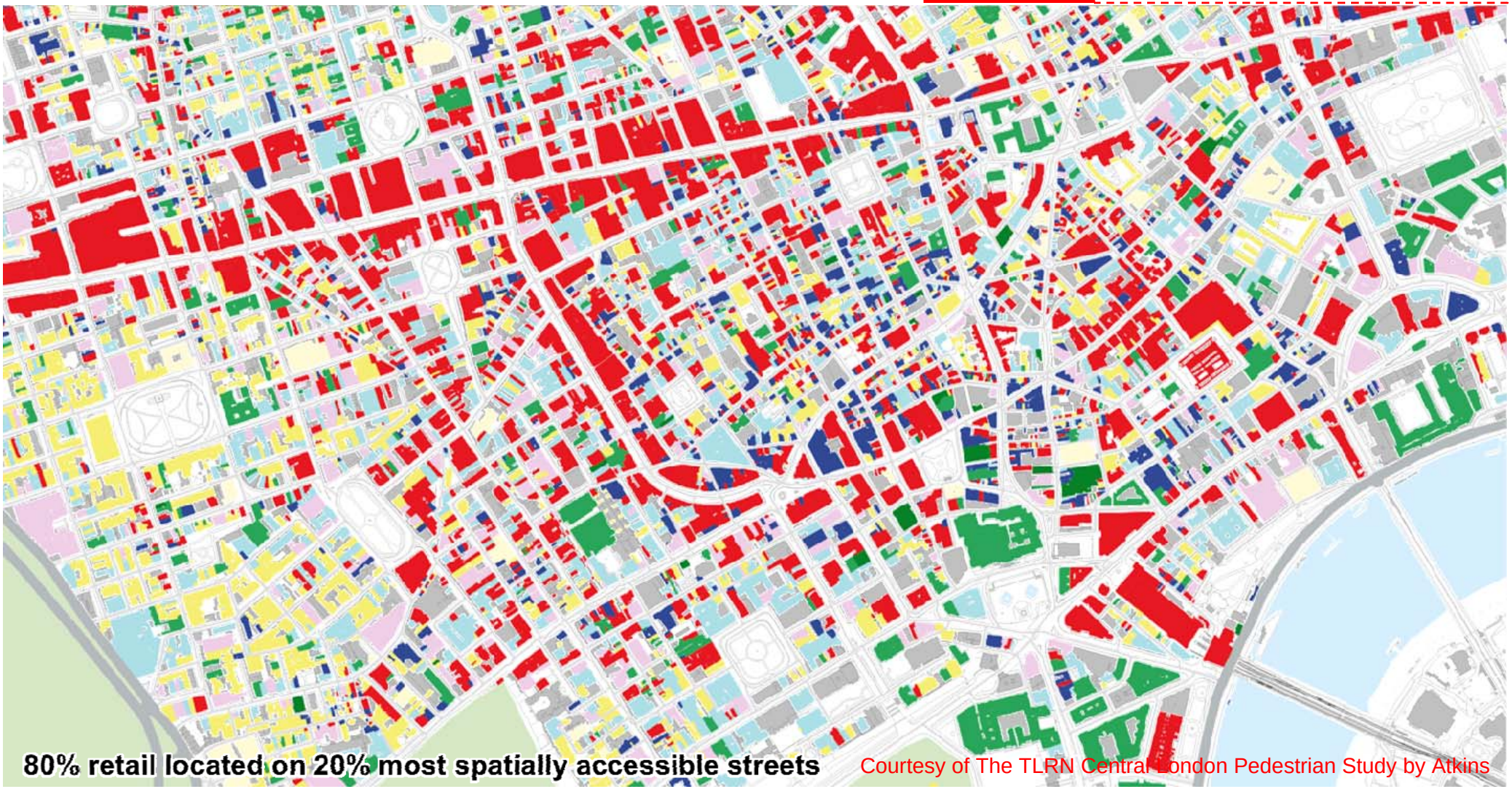
现状地铁交通分析
Analysis on Existing Metro Data

同样的，基于重庆现有各站日均进出站流量我们也建立了相关的回归方程，基于该方程我们可以科学的预测在未来总体规划空间格局下各个新建站点的进出站流量。

Based on the data of passengers at the exits of each station per day, we manage to find very good regression formula to model the existing situation. With this tool we can also predict the number of passengers for each new metro station in the master plan.



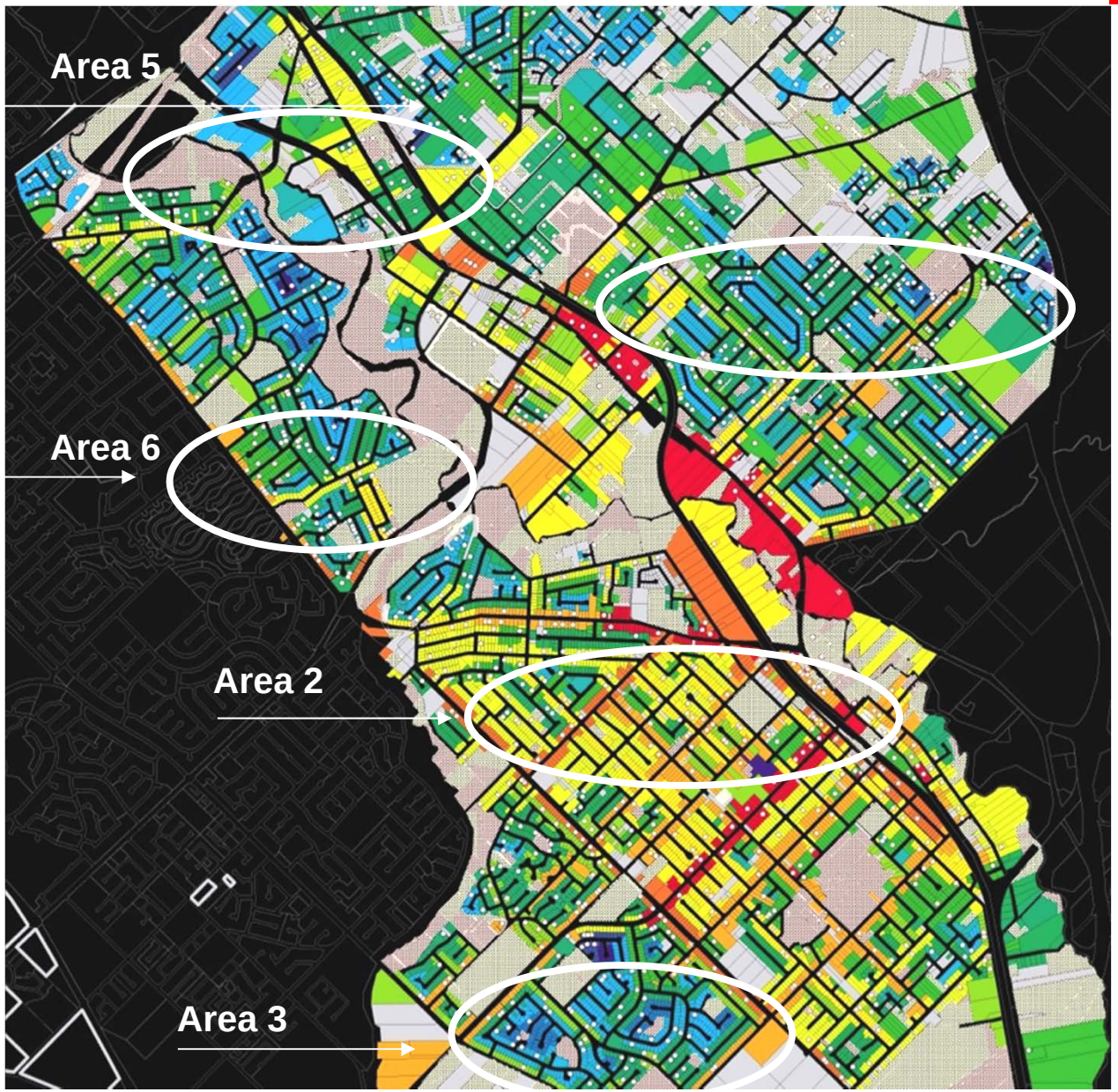
关键发现2 空间布局分配土地使用



事实：80%的零售业聚集在20%“可达性”最高的街道上。

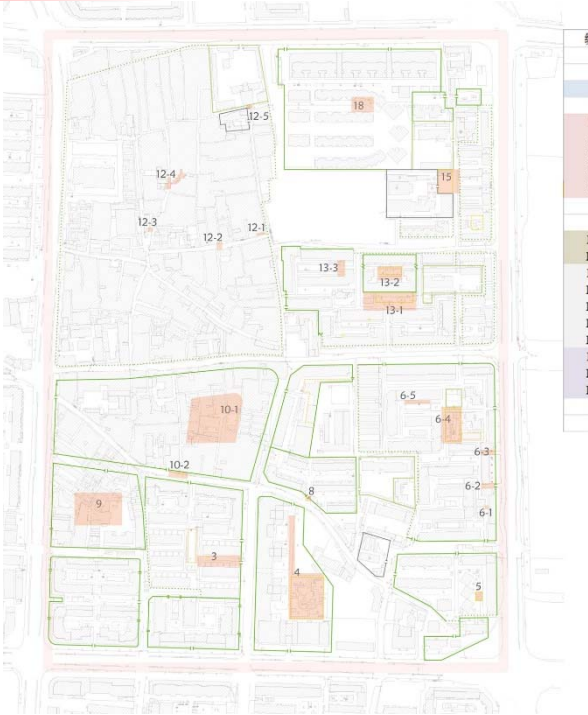
问题：1，如何量化描述进而预测“可达性”？ 2，各商业业态空间分布的差异性？ 3，网络时代地理空间是否还有意义？

关键发现3 空间布局影响社区安全与交往



国际上众多实证研究表明，连接性较好的社区有较低的犯罪率。

Perth, Australia
澳大利亚珀斯
Property crime analysis
财产犯罪分析



编号	均数	LOG	面积(平方米)
3	12.00	**1.08**	1180
4	6.50	**0.81**	5490
5	3.00	**0.48**	155
6-1	2.00	**0.30**	37
6-2	4.00	**0.60**	122
6-3	5.00	**0.70**	167
6-4	10.50	**1.02**	1860
6-5	1.50	**0.18**	228
8	3.00	**0.48**	65
9	8.00	**0.90**	5000
10-1	23.00	**1.36**	5900
10-2	17.00	**1.23**	288
12-1	4.00	**0.60**	54
12-2	2.00	**0.30**	16
12-3	3.00	**0.48**	38
12-4	8.00	**0.90**	227
12-5	2.00	**0.30**	38
13-1	19.00	**1.28**	2312
13-2	6.50	**0.81**	809
13-3	6.00	**0.78**	300
15	6.00	**0.78**	1310
18	5.00	**0.70**	830

R^2=0.32

空间基底面积大小与人群活动强度相关

面积越大，人群活动强度越强。

国内外的研究表明，连接性较好的社区同样容易促发社区居民的交往。与院落空间的面积相比，空间连接性的影响要大一倍。

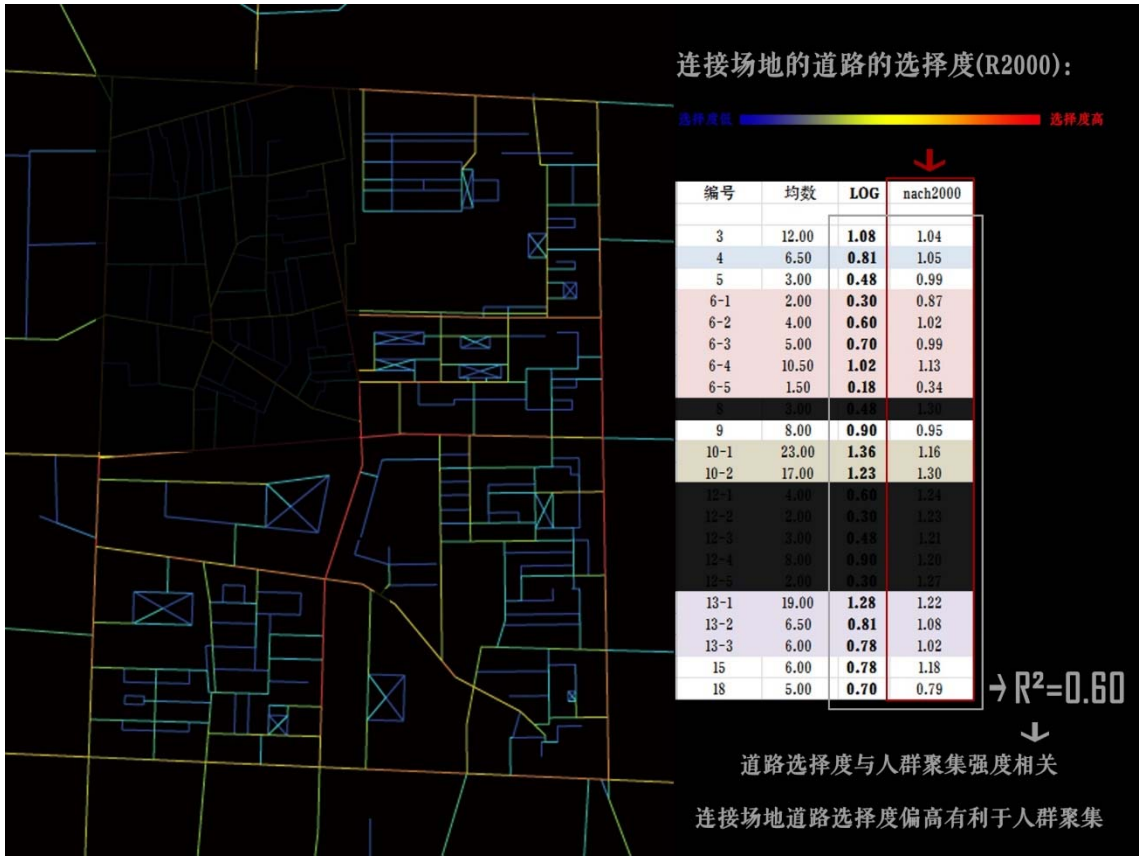
院落层级：

编号	均数	log(均数)	院落
3	12.00	**1.08**	900
4	6.50	**0.81**	900
5	3.00	**0.48**	900
6-1	2.00	**0.30**	200
6-2	4.00	**0.60**	500
6-3	5.00	**0.70**	90
6-4	10.50	**1.02**	160
6-5	1.50	**0.18**	9
9	8.00	**0.90**	2000
10-1	23.00	**1.36**	2000
10-2	17.00	**1.23**	10000
13-1	19.00	**1.28**	400
13-2	6.50	**0.81**	200
13-3	6.00	**0.78**	200
18	5.00	**0.70**	170

R^2=0.5

院落层级与人群活动强度相关

层级偏浅有利于人群聚集



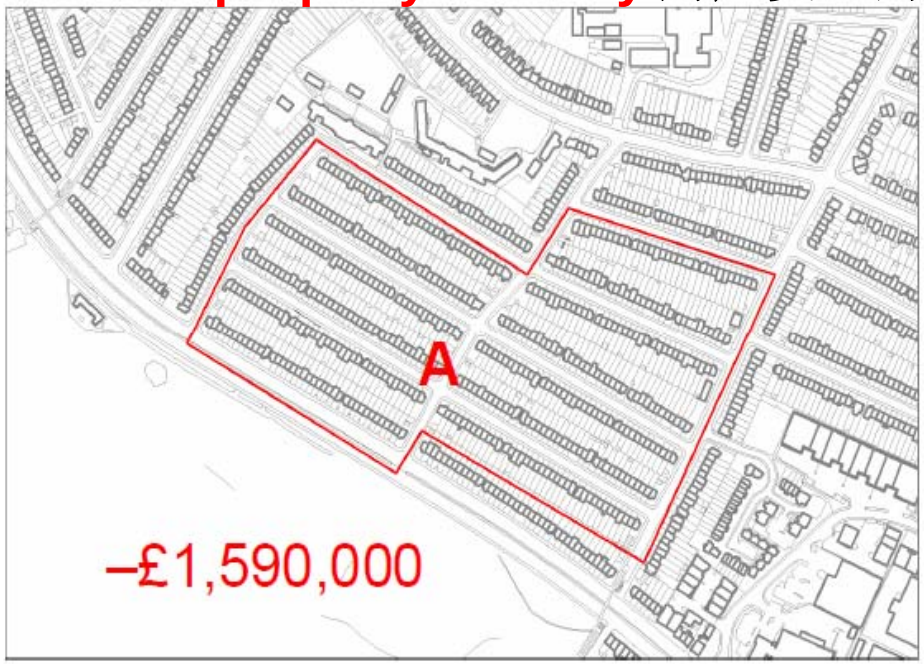
编号	均数	LOG	nach2000
3	12.00	**1.08**	1.04
4	6.50	**0.81**	1.05
5	3.00	**0.48**	0.99
6-1	2.00	**0.30**	0.87
6-2	4.00	**0.60**	1.02
6-3	5.00	**0.70**	0.99
6-4	10.50	**1.02**	1.13
6-5	1.50	**0.18**	0.34
9	8.00	**0.90**	0.95
10-1	23.00	**1.36**	1.16
10-2	17.00	**1.23**	1.30
13-1	19.00	**1.28**	1.22
13-2	6.50	**0.81**	1.08
13-3	6.00	**0.78**	1.02
15	6.00	**0.78**	1.18
18	5.00	**0.70**	0.79

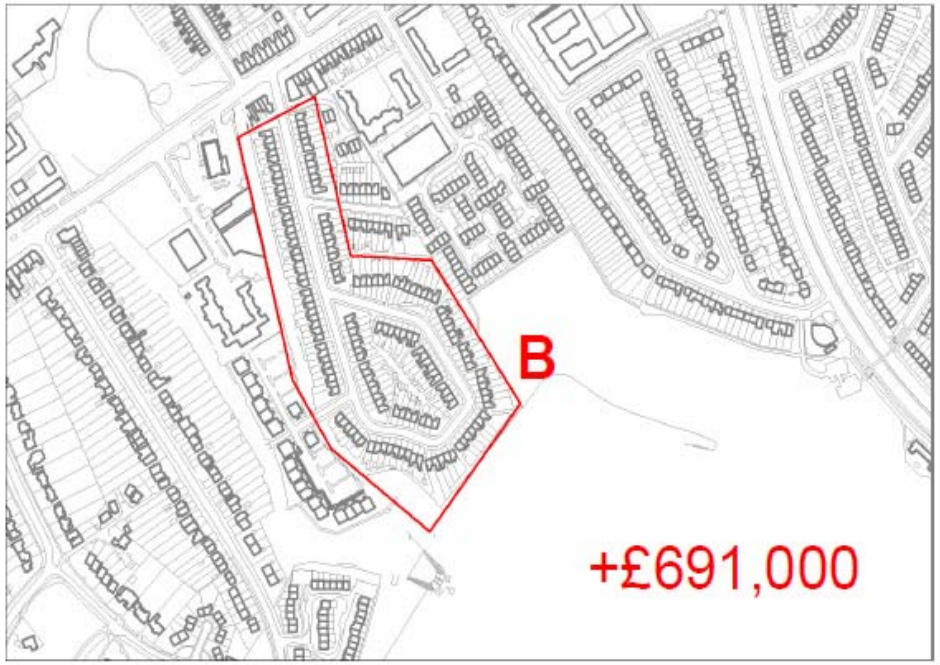
R^2=0.60

道路选择度与人群聚集强度相关

连接场地道路选择度偏高有利于人群聚集

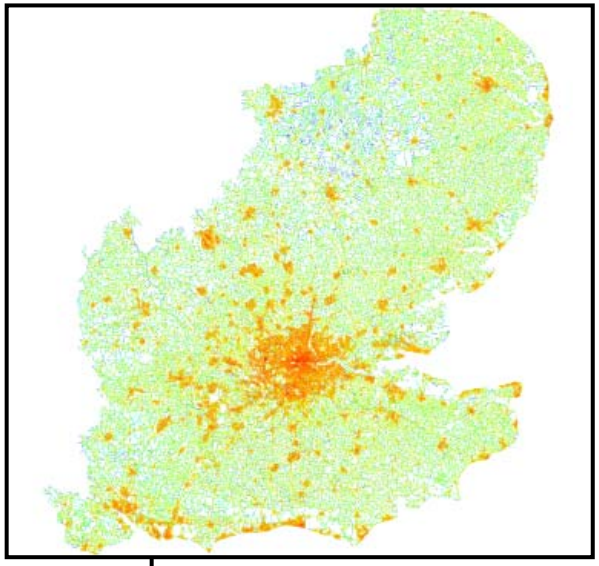
Value of property security 财产安全的价值





	Dwellings	Predicted Burglary number (5 years)	Predicted Cost per household (5 years)	Actual Burglaries number (5 years)	Actual cost per household (5 years)	Excess cost per household (5 years)	Excess cost per household (60 y lifetime)	Excess cost total cost whole area (60 y lifetime)
Area A	482	62	£424	22	£149	–£275	–£3,300	–£1,590,000
Area B	157	20	£424	38	£795	£376	£4,400	+£691,000

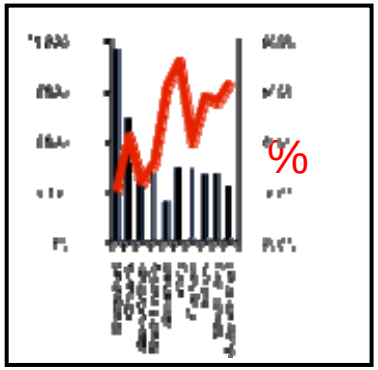
关键发现4 **空间布局决定土地价值**



空间（土地）长效盈利能力= 租赁盈利 + 升值盈利

空间句法的不同计算参数可以在最少输入数据的情况下反应便捷的分析上述两种空间长效盈利能力的强弱。

Urban layout 城市布局

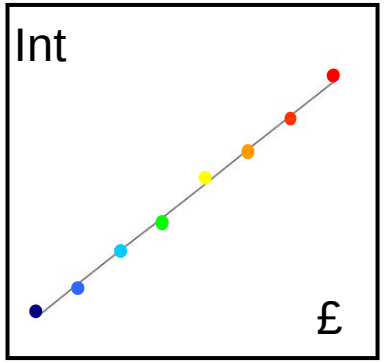


Centre vitality

中心活力

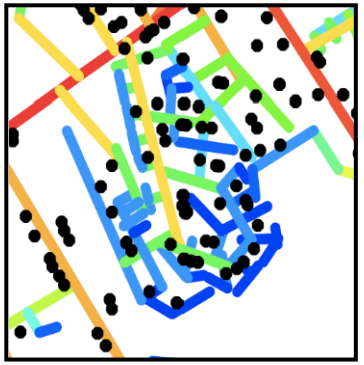
Street quality

街道品质



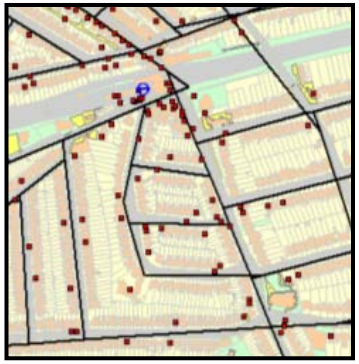
Property value

房地产价值



Residential security

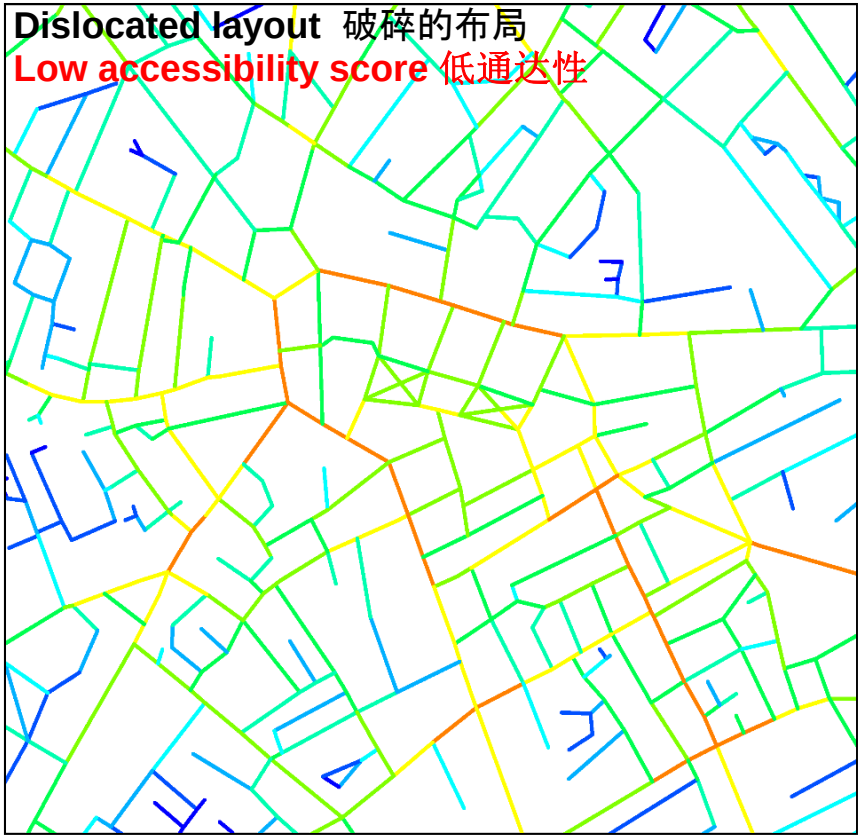
住宅区安全

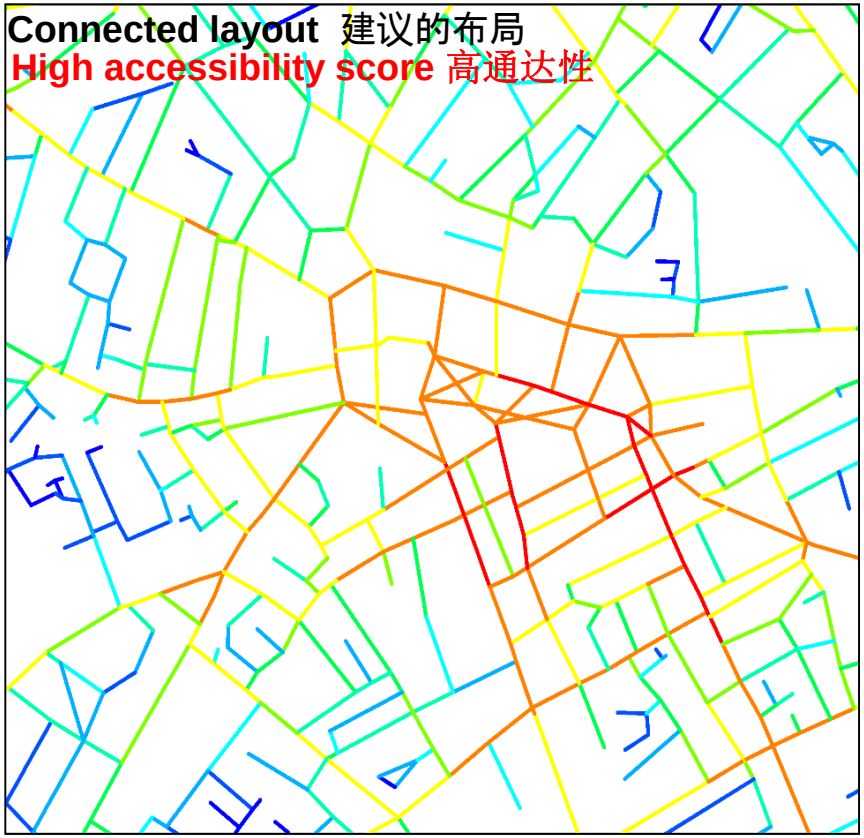


Personal safety

个人安全

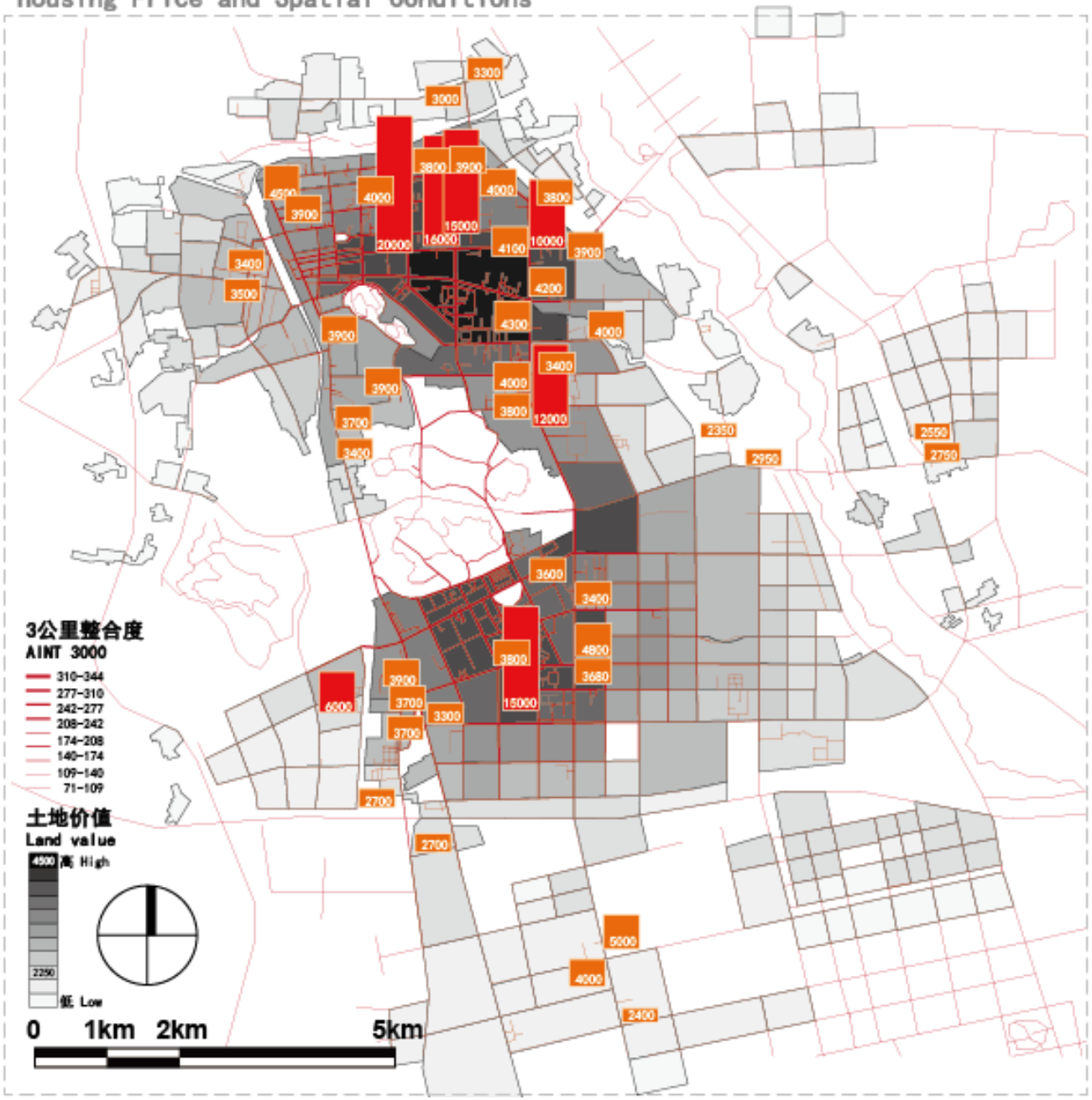
对商业文化娱乐功能用地来说，由于对流量的敏感，空间连接性可以很好的反应各街道空间的投资回报能力。





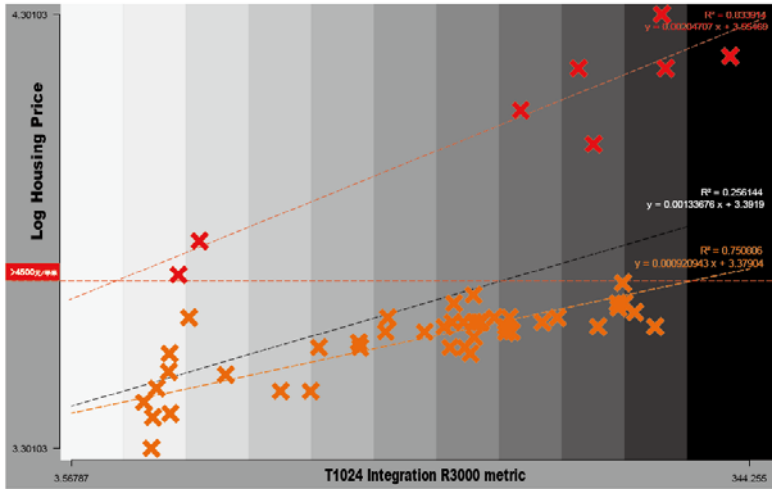
	Dislocated layout 破碎的布局	Connected layout 建议的布局	Difference 差别
IRR 内部收益率	11%	14%	**+ 27%**
NPV 净现值	£47 Million	£ 145 Million	**+ £98 Million**

房价与空间属性
Housing Price and Spatial Conditions



类似的，土地价值也与该地块在城市中的“中心性”相关。随着房地产租售价格在网上的越发透明，根据某地网上楼市的类型，分离高价住宅与平价住宅项目后，空间规律体现的非常明显。

3公里整合度与楼盘分布吻合度很高。



关键发现5 空间布局影响碳痕迹

Disconnected grids increase travel emissions
不连续的路网增加出行的碳排放量

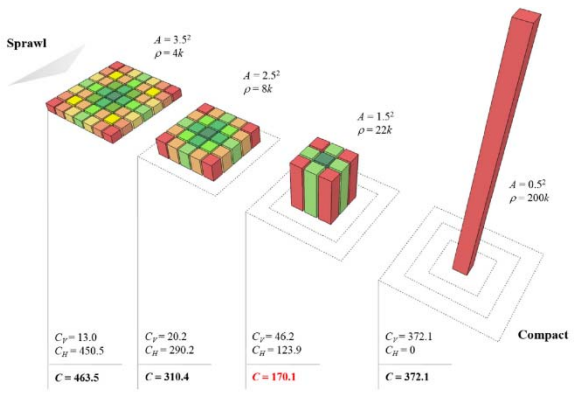
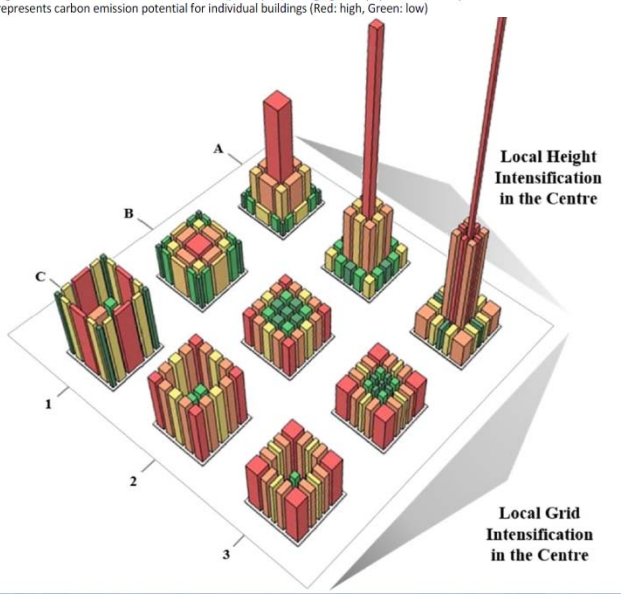
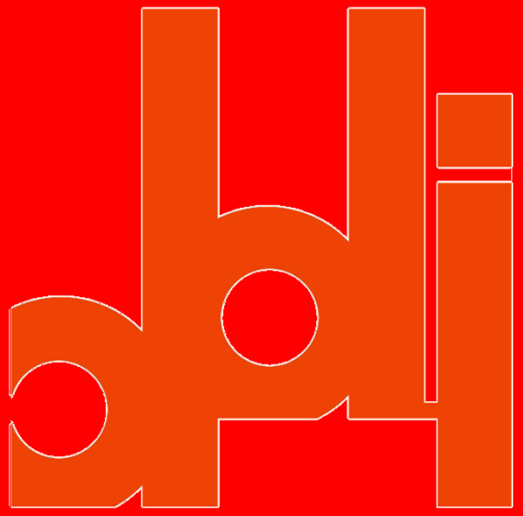


Figure 2: Total amount of carbon emission (per capita) changing with population density. The variation of colour represents carbon emission potential for individual buildings (Red: high, Green: low)



新近的研究表明：地面交通路网与建筑高度（开发强度）之间根据周边既有环境存在着某些特定的优化组合，可以有效的降低出行碳排放量。这为从动态的角度研究低碳城市形态与设计提供了新的视角。


理论、算法、实证
三者的相互支持是空间句法的核心动力。



拓扑空间概念

空间的拓扑学特征带来的认识革命。
空间句法对空间的抽象。

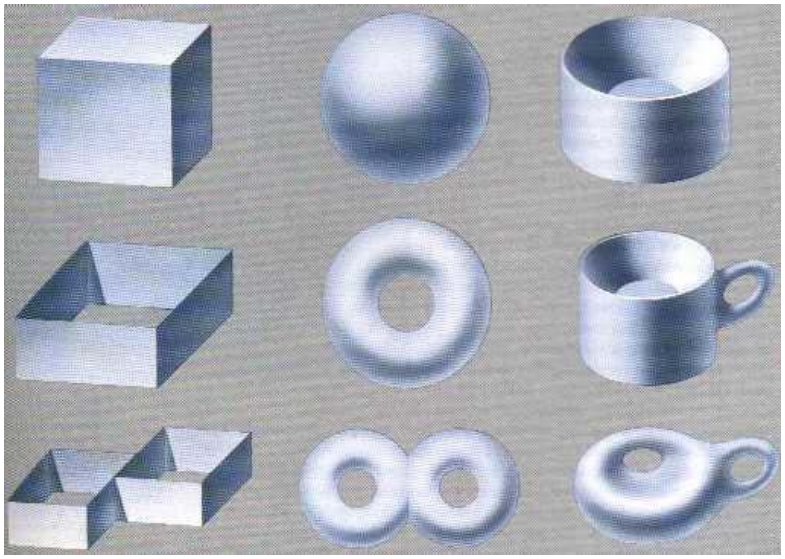
什么是拓扑空间？——拓扑学空间的性质和作用

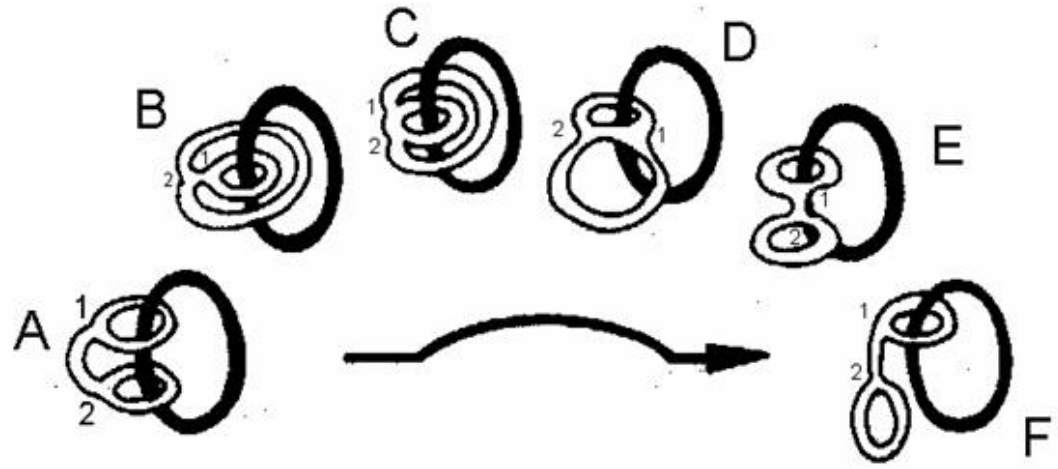
空间不是消极的客观的存在，等待着人类去认识和发现。
空间是多维的，对空间的理解随着人类需求而发展，空间被“发明”出来。

拓扑几何：忽略长度、角度、形状等特性, 研究几何图形在连续变形下保持不变的性质(所谓连续变形，形象地说就是允许伸缩和扭曲等变形，但不许割断和粘合)，仅仅关注 **连续性** 和 **连接性**。

哥尼斯堡七桥问题

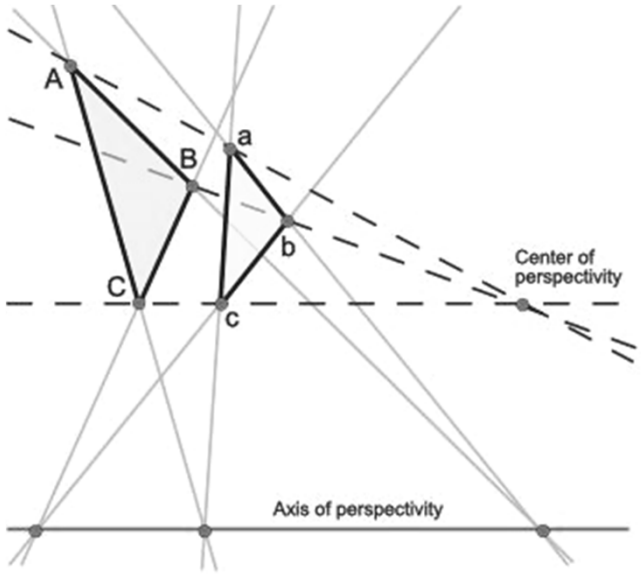
拓扑空间中的等价性与变换实例：





射影几何空间（Projective Geometry)

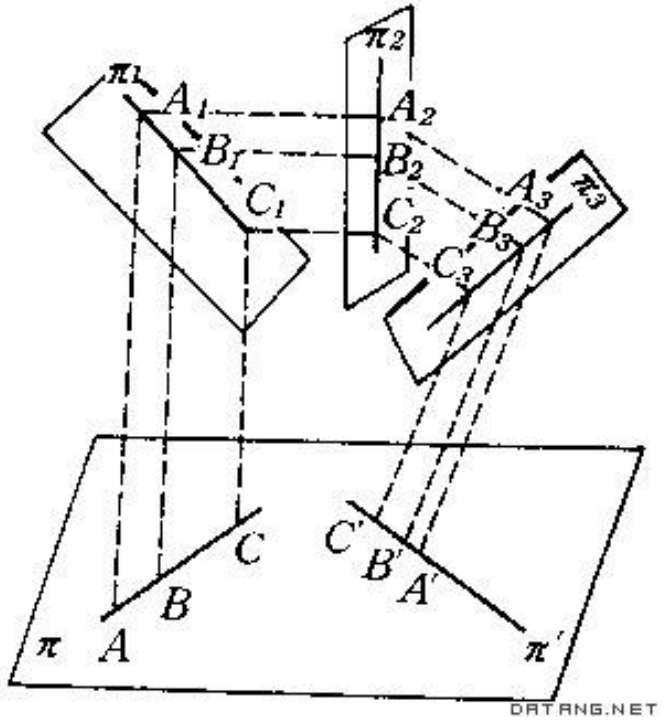
对称性：忽略了角度和长度等特征，无平行概念，仅保留“拐点”形状特征。
所有三角形都相同，所有四边形都相同
……



应用实例：透视学。

仿射几何空间（Affine geometry ）

对称性：忽略了角度和长度等特征，保留平行的概念，以及与之相关的部分形状特征。
所有三角形都相同，所有平行四边形都与正方形相同……

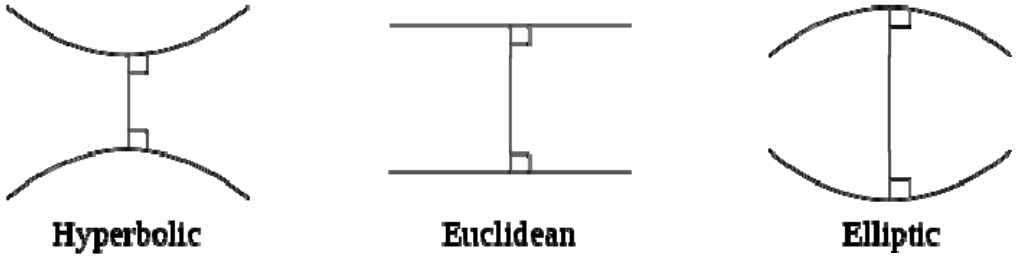


应用实例：轴测图。

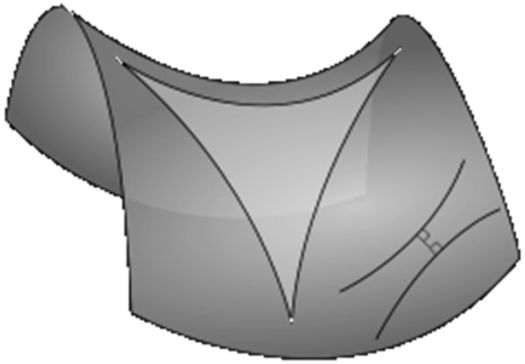
微分几何空间（Differential Geometry)

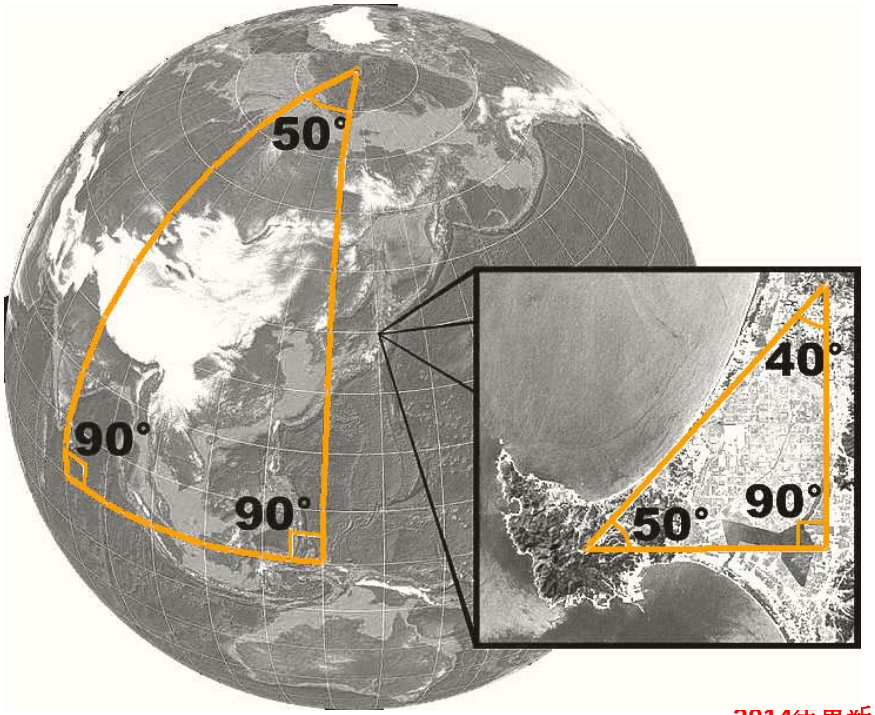
源自针对传统欧式几何平行公理的质疑。

对称性：穿过直线外一点可以做与该直线平行的多条直线（即失去了这些线彼此间的对称性），这直接导致了对曲面空间的关注。



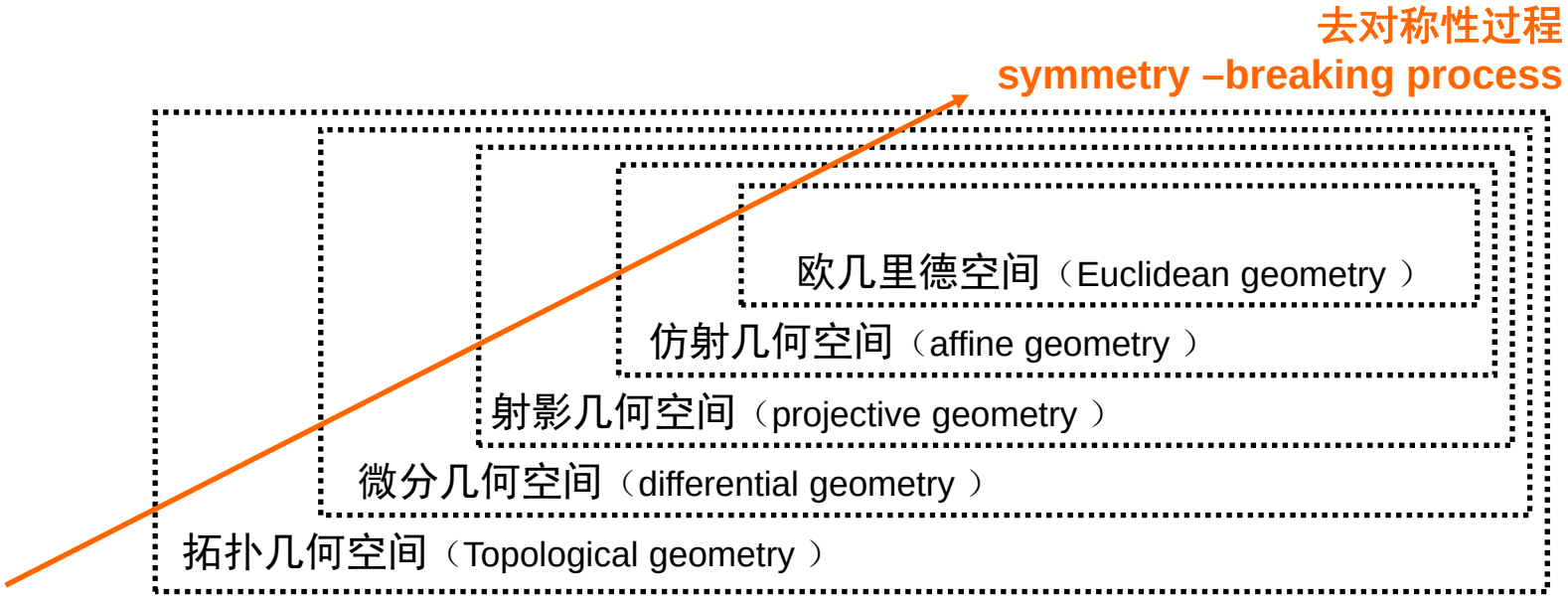
应用实例：地图学，分子几何学等等。





什么是拓扑空间？《道德经》中的描述突出了工具性（器）和目的性（用）。

- 各类型几何空间的层级递进关系

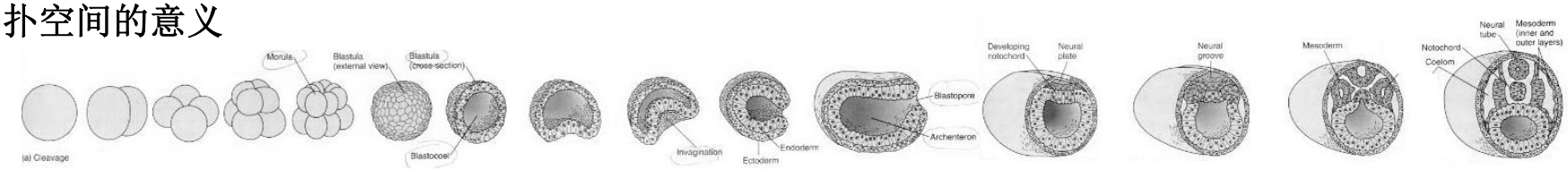


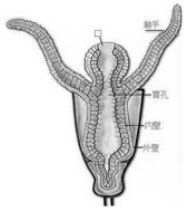
- 空间体系的发展——一个随着经济技术发展需要不断”专业化“（而非低级到高级）的过程：
米制化进程：石器、弓箭、到标准化生产的武器，进而到数字化建造

欧几里德空间也许不代表空间的终极进化方向，而作为基础的拓扑空间的作用也并未消失，而是隐含在一系列的米制化特征之下，有必要发掘其作用。

! 设计要不断的回到原点，探讨空间的本质属性极其对人的影响

- 拓扑空间的意义

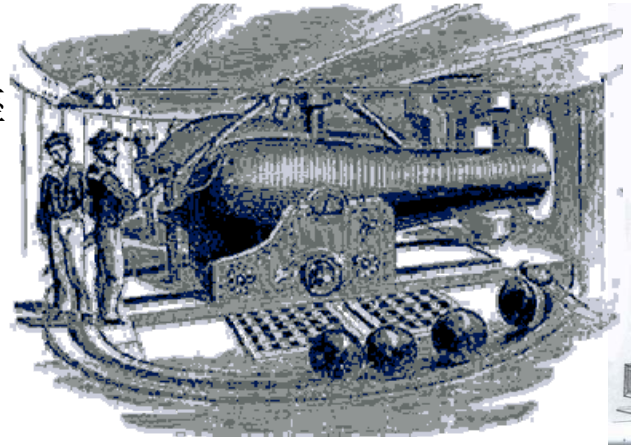


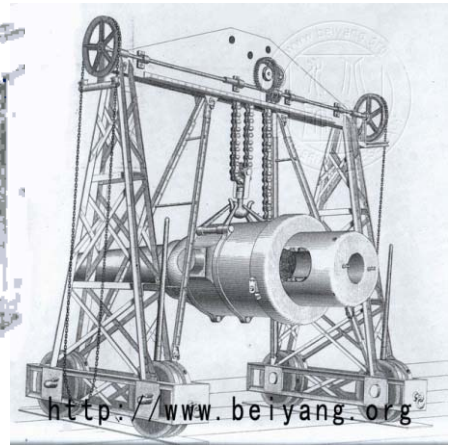


作为最”基本“的空间形态特征，拓扑空间提供了一种新的视角。

生物的进化：水螅到文昌鱼。

器具的进化：前膛炮，后膛炮到无后座力炮和导弹。





! 拓扑结构上的更新往往带来革命性的影响

什么是句法？语言学、结构主义与空间句法的缘起

Environment and Planning B, 1976, volume 3, pages 147–185

Space syntax

B Hillier, A Leaman, P Stansall, M Bedford
Unit for Architectural Studies, School of Environmental Studies, University College London, London, England
Received 10 August 1976

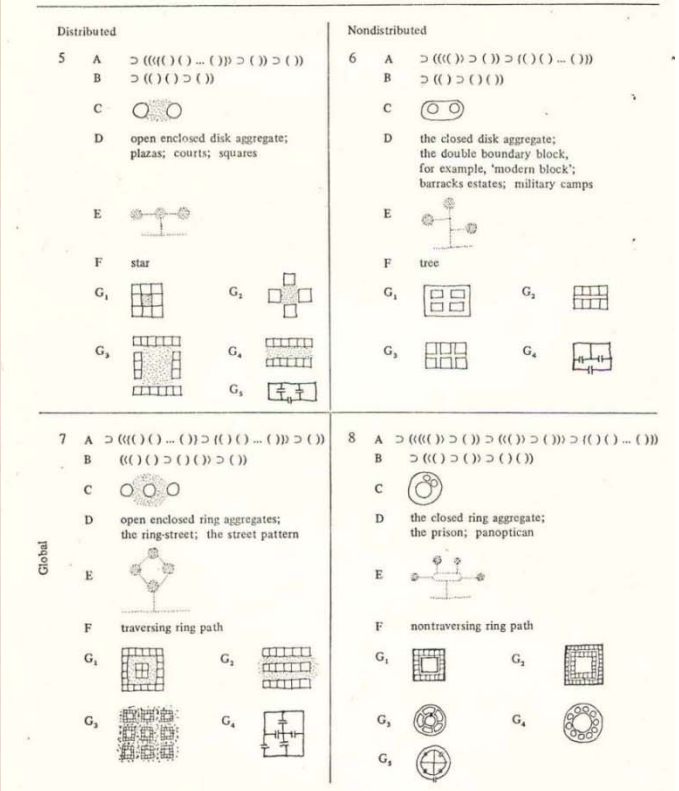
Abstract. This paper addresses itself to the question of how and why different societies produce different spatial orders through building forms and settlement patterns. It consists of three parts. Firstly, at a metatheoretical level, it is suggested that spatial organization should be seen as a member of a family of 'morphic languages' which are unlike both natural and mathematical languages but which borrow properties from each. In general, morphic languages are used to constitute rather than represent the social through their syntax (that is the systematic production of pattern). Secondly, a general syntactic theory of space organization is proposed. It is argued that spatial patterns in both complex buildings and settlements fall into eight major types, which are interrelated in structural ways. Finally, the syntactic theory is used to integrate a number of recent general propositions made in anthropology regarding human space organization.

1 Preliminaries: mathematics and the 'sciences of the artificial'

"We cannot understand the flux which constitutes our human experience unless we realise that it is raised above the futility of infinitude by various successive types of modes of emphasis which generate the active energy of a finite assemblage. The superstitious awe of infinitude has been the bane of philosophy. The infinite has no properties. All value is the gift of finitude which is the necessary condition for activity. Also, activity means the origination of patterns of assemblage, and mathematics is the study of pattern" (A N Whitehead, 1961).

Belief in a mathematical order inherent in nature has always been a fundamental postulate of theoretical science. First put forward by the school of Pythagoras, which developed a numerical theory of natural order from such discoveries as the relation between musical harmonies and numerical proportions, it was linked by Galileo to the experimental method, and together they form the dual foundation of the modern conception of science. Analytical geometry, calculus, group theory, non-Euclidean geometries and perhaps catastrophe theory were all subsequent steps in linking our conceptions of natural order with mathematics. However unreasonable a belief mathematical order in nature may appear in principle, the 'unreasonable effectiveness' of mathematics in the natural sciences leaves no doubt that it has been amply justified by events.

But the sciences of man-made entities like settlement patterns, societies, and languages, have no such record of success to confound the sceptic. Moreover, the claims of these sciences to be excused for their poor mathematical development on account of their extreme youth sounds more and more uneasy as decades pass. However, the root reason for the lack of mathematical theories in the 'sciences of the artificial' may be that they are not sought after, since the fundamental postulate justifying the intervention of mathematics in these sciences is not a belief in a mathematical order inherent in the objects of study, but simply a belief in the power of mathematics as an instrument. In principle such a reduced claim appears justified. Even if nature does work mathematically, this does not imply that man the artificer also does.



3-syntax: E, the path morphology results from the dense aggregation of 'through permeable' objects. This implies that eventually there is another way back to the carrier path, hence the concept of a through permeable sequence, or nonlimit sequence. *4-syntax*: G_5 gives the simplest path realisation of the concept of a 'to-permeable' sequence, or limit sequence. *5-syntax*: E, the path morphology is a result of the aggregate controlling permeability to the open-enclosed disk, and thus to the aggregate of closed disks giving the 'star' form, and the 'inward looking' aggregate. *6-syntax*: E, the 'tree' morphology interprets the concept of 'sequence' for a nontraversing path system. *7-syntax*: G_4, the aggregate resembles the 3-syntactic 'nonlimit sequence' but there is a difference. In 7, there is one space that is traversed twice in traversing the whole system, making a complete ring independent of the carrier path. *8-syntax*: G_4, this is drawn without its aggregates of small enclosed disks, because of the complexity of the form.
(c) Path forms here are related by formula analogy to the space forms. A parallel theory of path morphology is in preparation which is somewhat richer.

Figure 19 (continued)

Hillier B, Leaman A, Stansall P, Bedford M, 1976, "Space syntax" *Environment and Planning B: Planning and Design* ***3 147-185***

Hillier B, Hanson J, Peponis J, Hudson J, Burdett R, 1983, "Space syntax, a different urban perspective" *Architects' Journal* ***178 47-63***

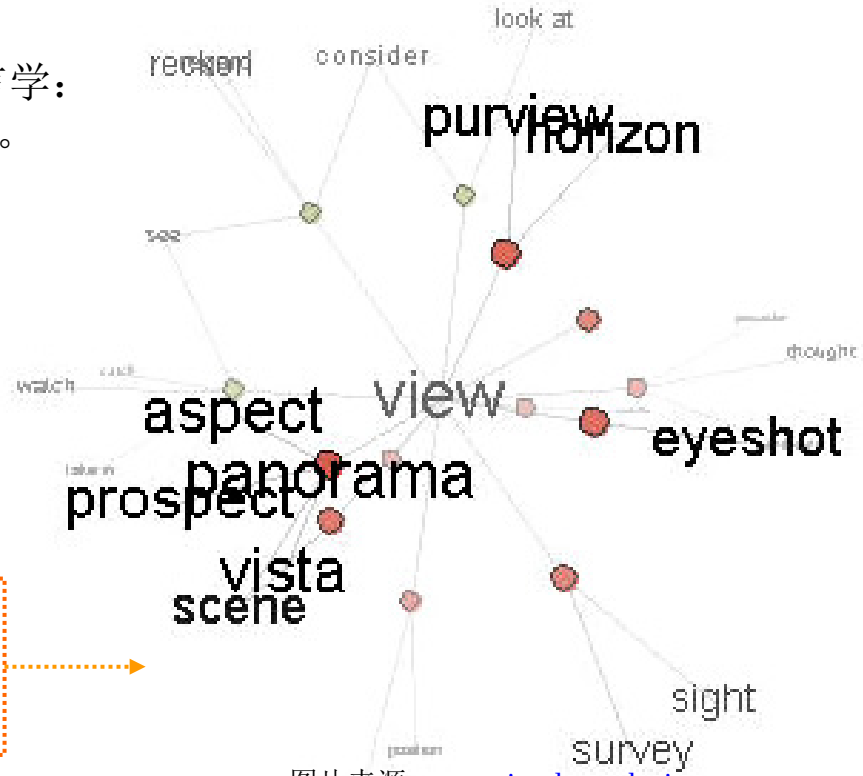
什么是句法？现代语言学的发展与ANT的缘起

中国的动物分类法：“动物可分为：a. 属皇帝所有的；b. 涂过香油的；c. 驯良的；d. 乳猪；e. 赛棱海妖；f. 传说中的；g. 迷路的野狗；h. 本分类法中包括的；i. 发疯的；j. 多的数不清的；k. 用极细的驼毛笔画出来的；l. 等等；m. 刚打破了水罐子的；n. 从远处看像苍蝇的。”

——福科《词与物》

从维特根斯坦的“家族相似理论”看定义和分类的困境词与义、定义与分类的困境。

设想一种打破了分类基础的，非乔姆斯基式的语言学：以联系和动态过程为基础，Harris的语言结构模型。



图片来源：www.visualcomplexity.com

! 设想一种展现词语间联系的字典，并以此来分析各个民族句法结构间的差别？该模型扑捉的就是“关联性网络空间的（拓扑）连接性”

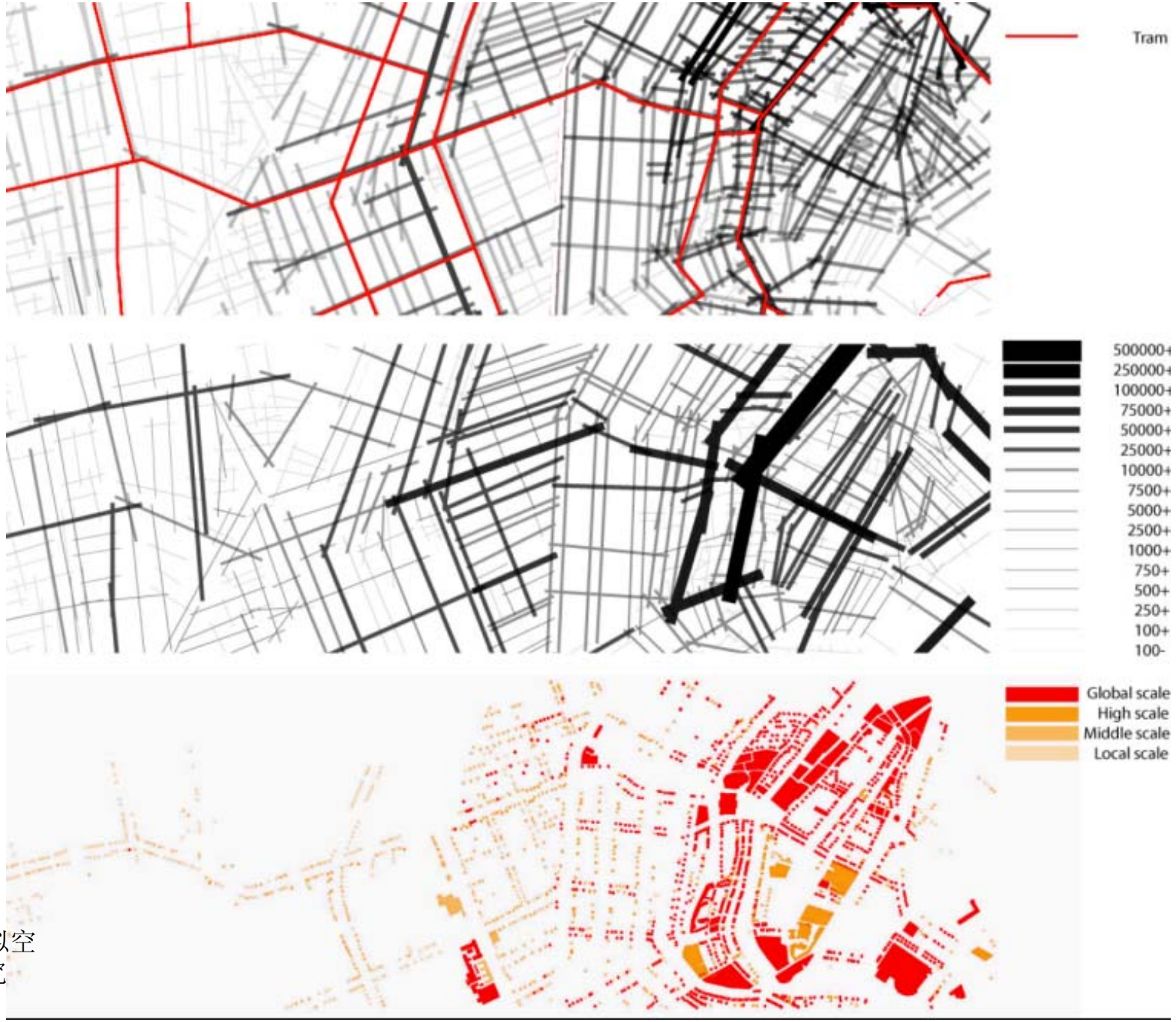
关联性网络空间

从网络的视角来重“新”审视我们生活的世界。不同技术网络的叠加和自我强化过程。


从夜景看城市化进程

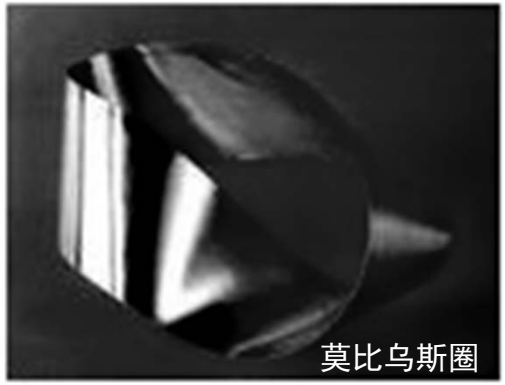
Facebook 的社交网络覆盖

各个关联性网络空间之间的关联性



Amsterdam城市空间、虚拟空间和商业空间网络对比研究

拓扑空间带来的思考——新的建筑形式？


莫比乌斯圈


克莱因瓶（三维的莫比乌斯圈）

莫比乌斯住宅（UN Studio）

拓扑空间带来的思考——空间逻辑与地域差异

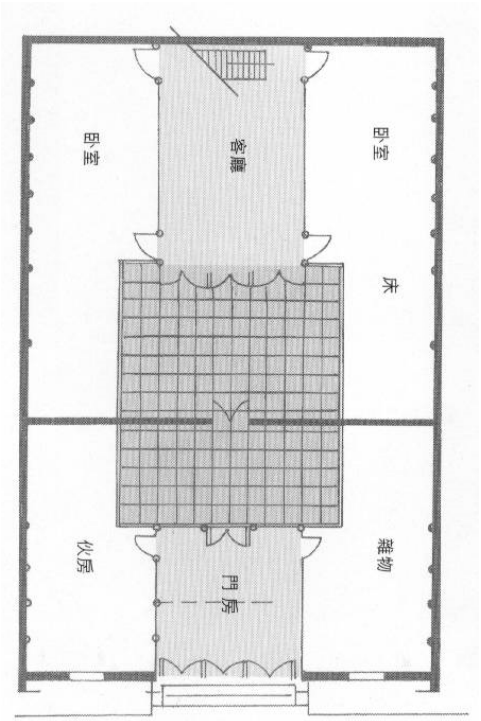
浙江民居

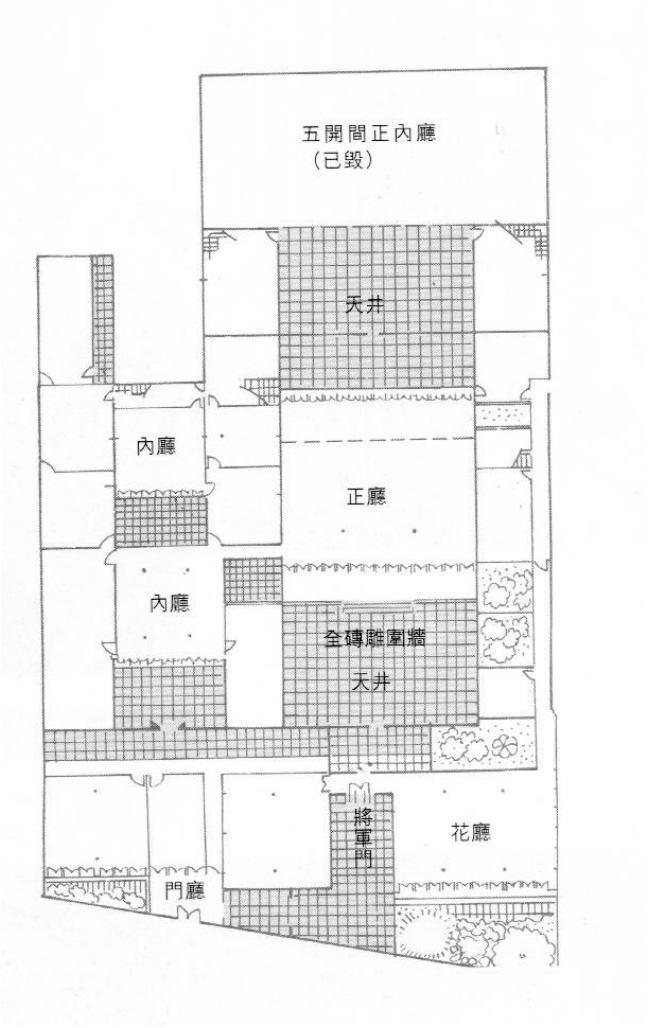
北京民居

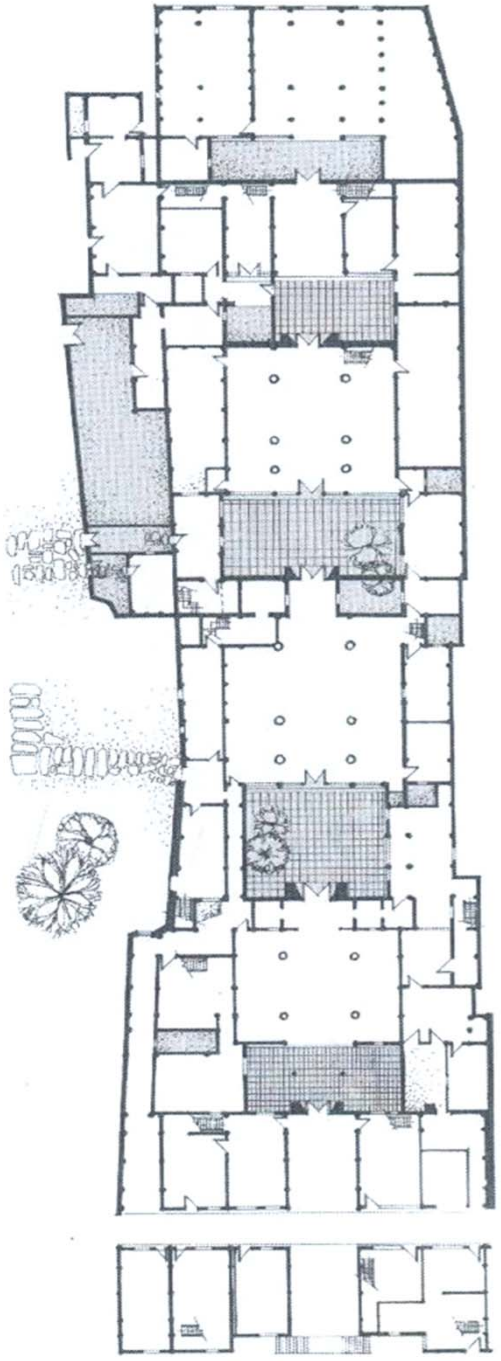
建筑形式及建构方式的相似性掩盖了二者空间组织的不同……

拓扑空间带来的思考——空间逻辑与地域差异

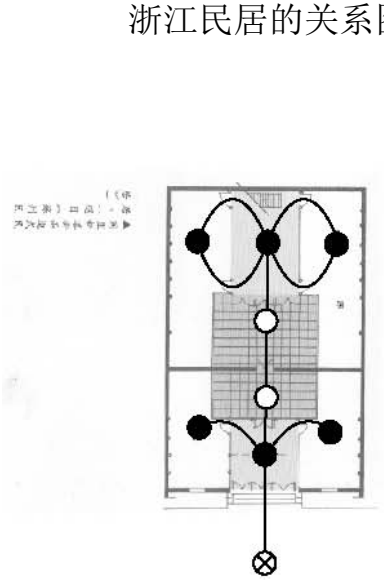
浙江民居

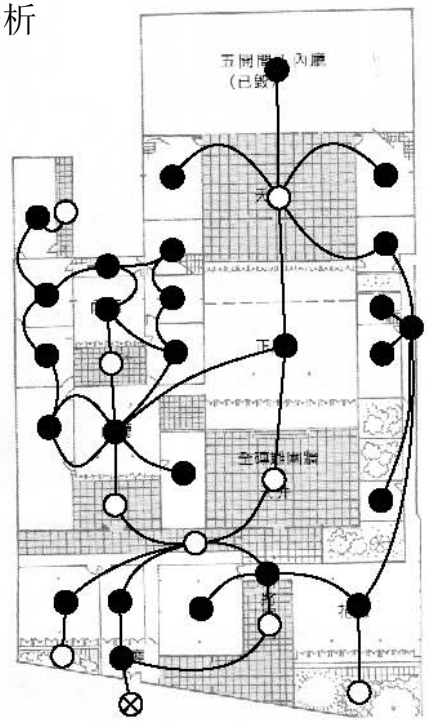


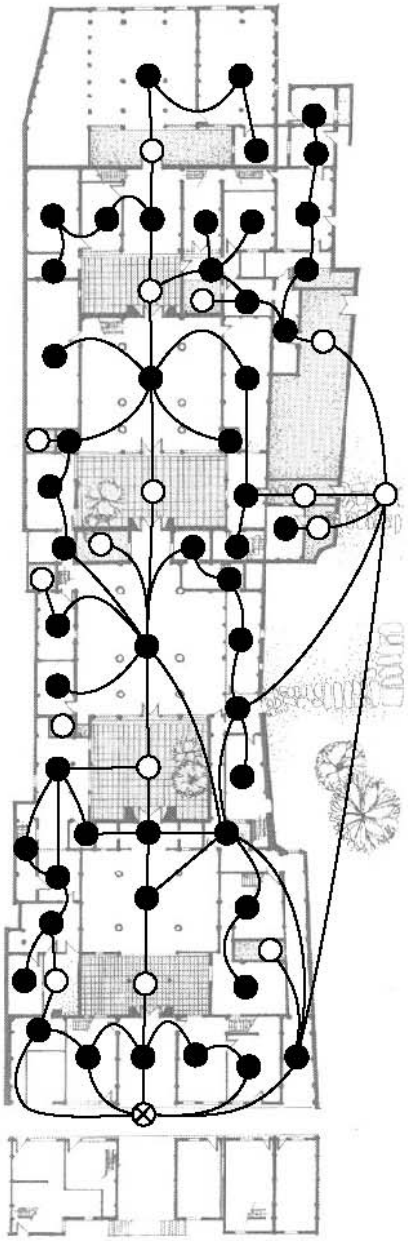




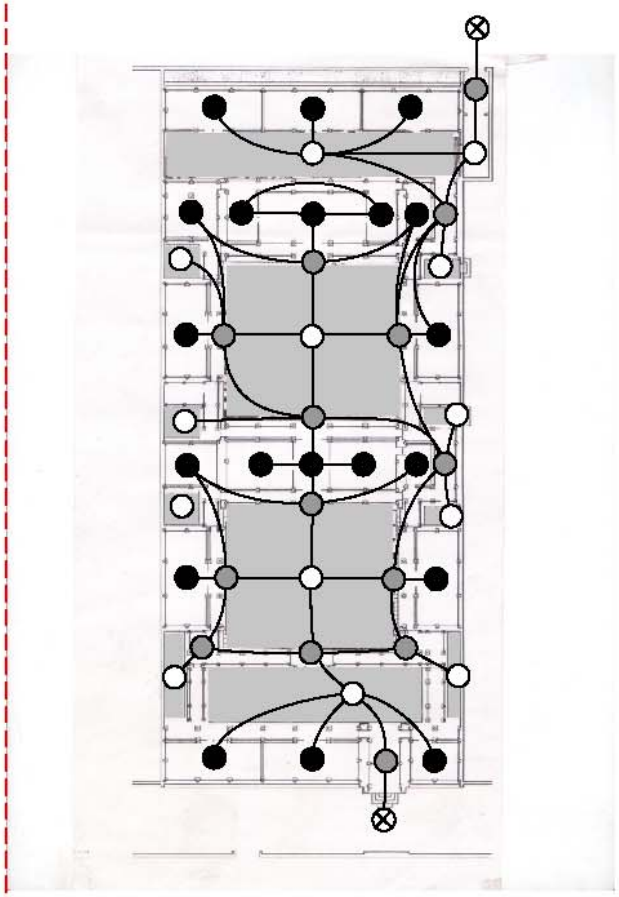
浙江民居的关系图解分析





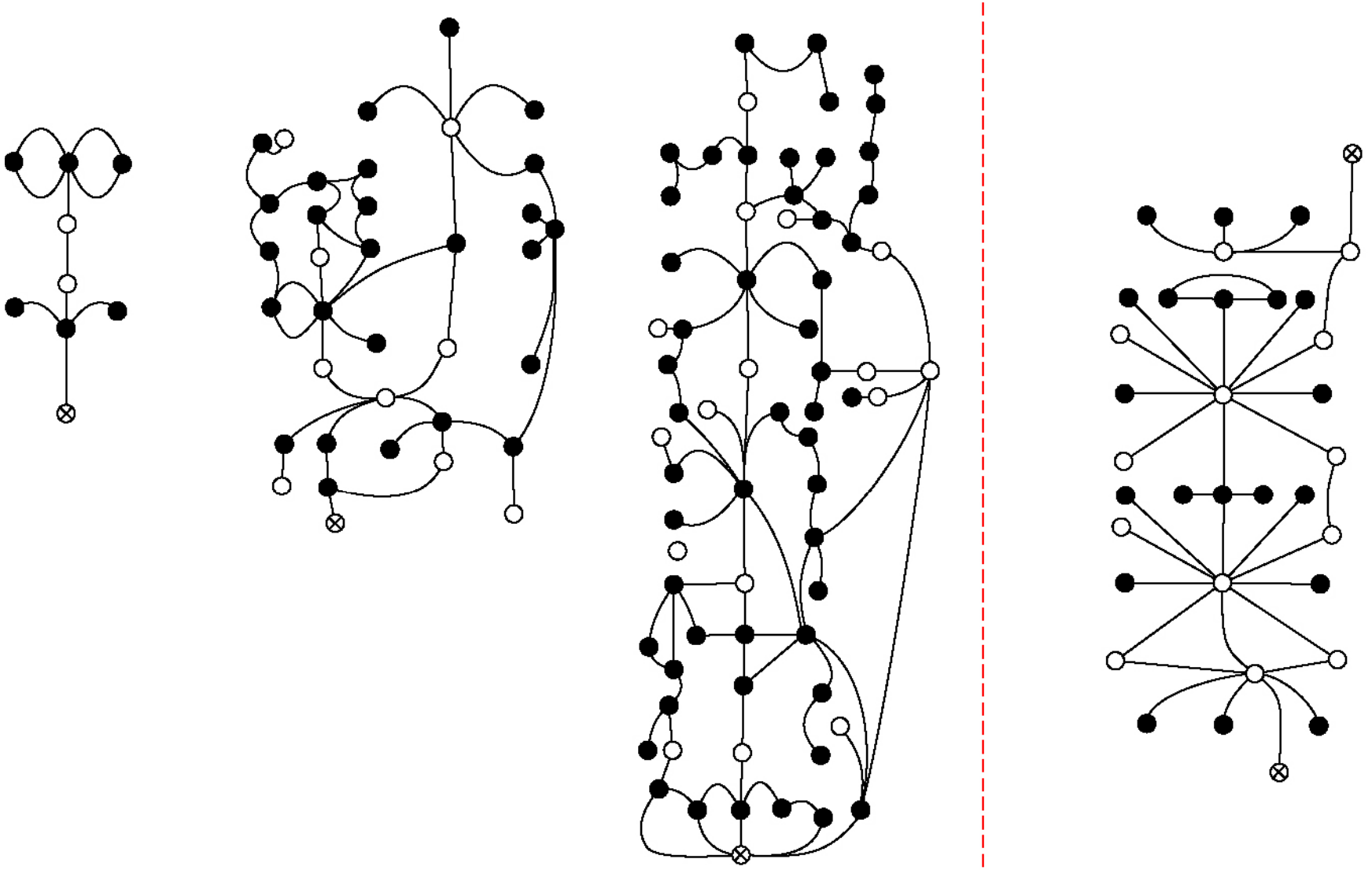


北京民居的关系图解分析

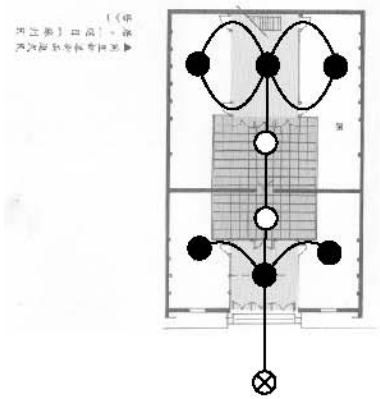


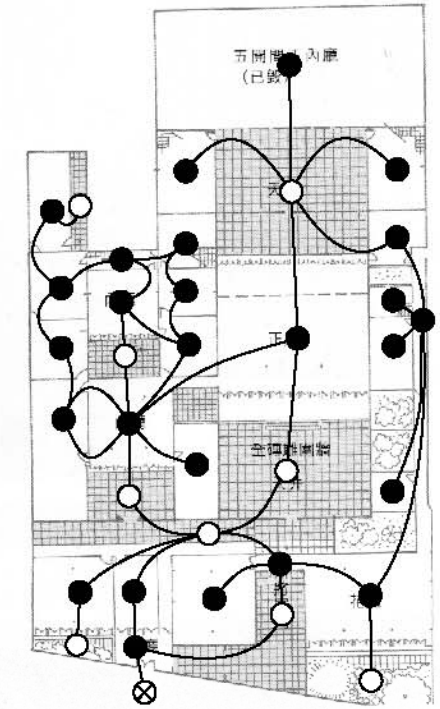
Courtyard housing in South China | Courtyard housing in North China

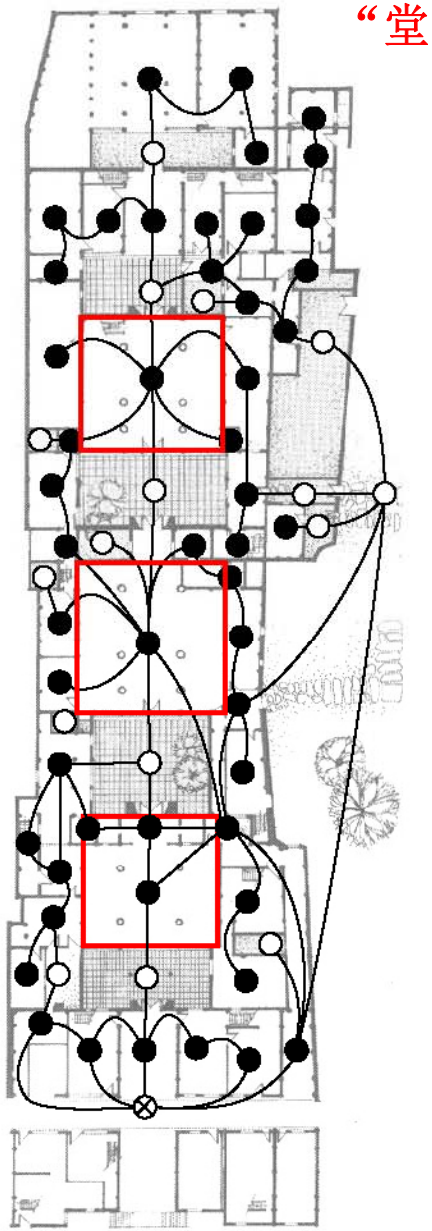
南北方的民居具有迥异的”泛基因型“（Gene-type)而这对居民的空间使用有何影响？



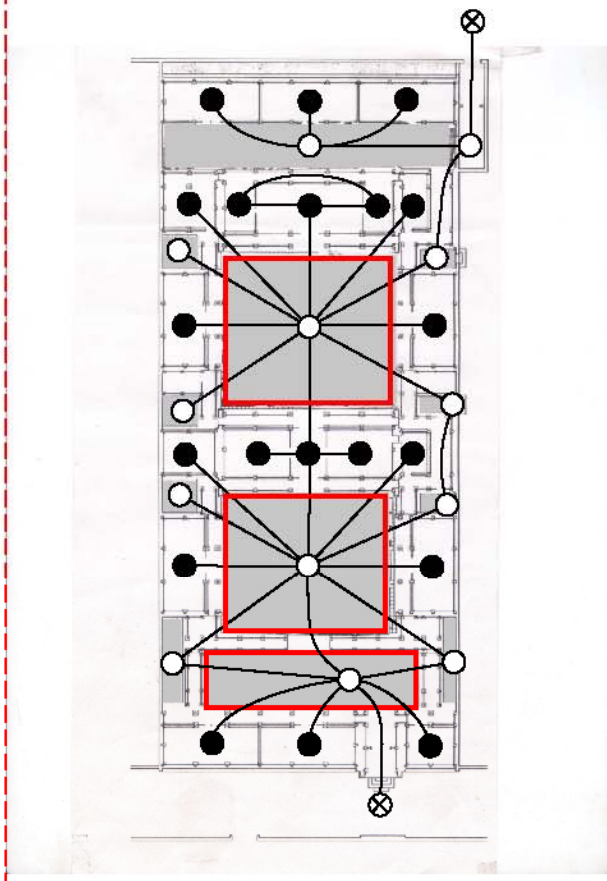
Courtyard housing in South China | Courtyard housing in North China







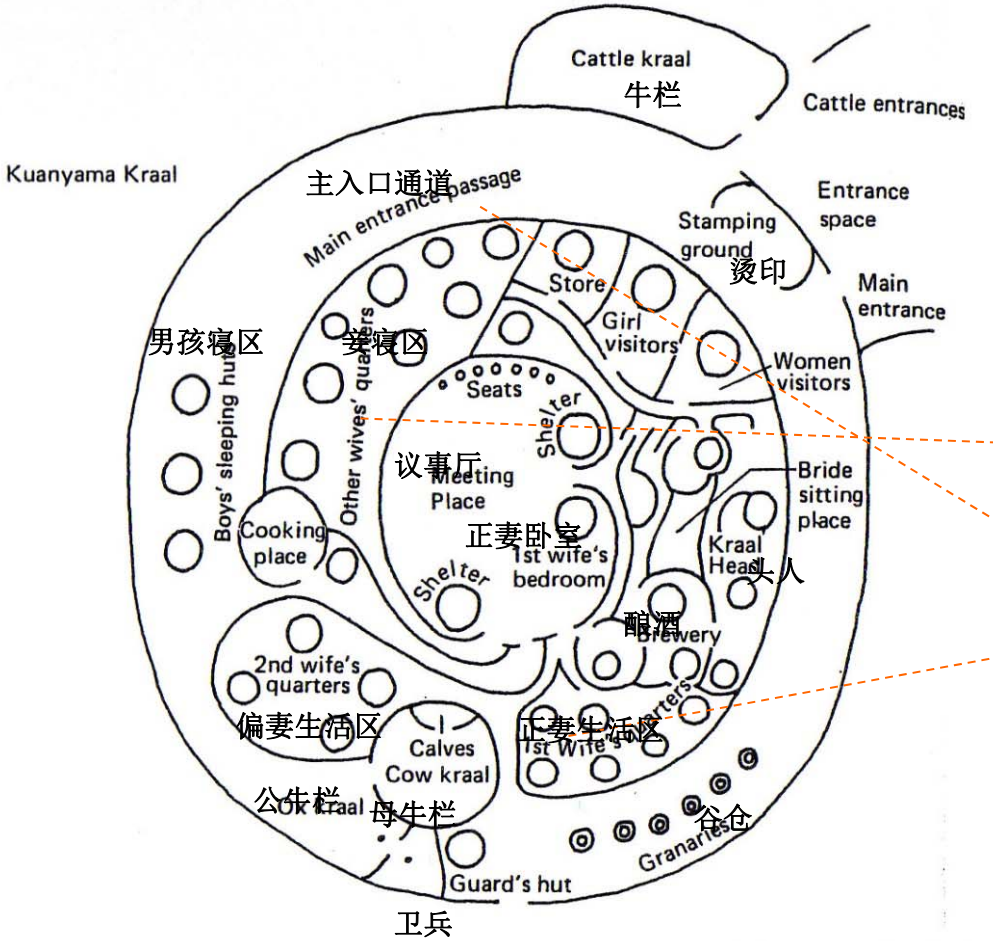
“堂”=“院”？



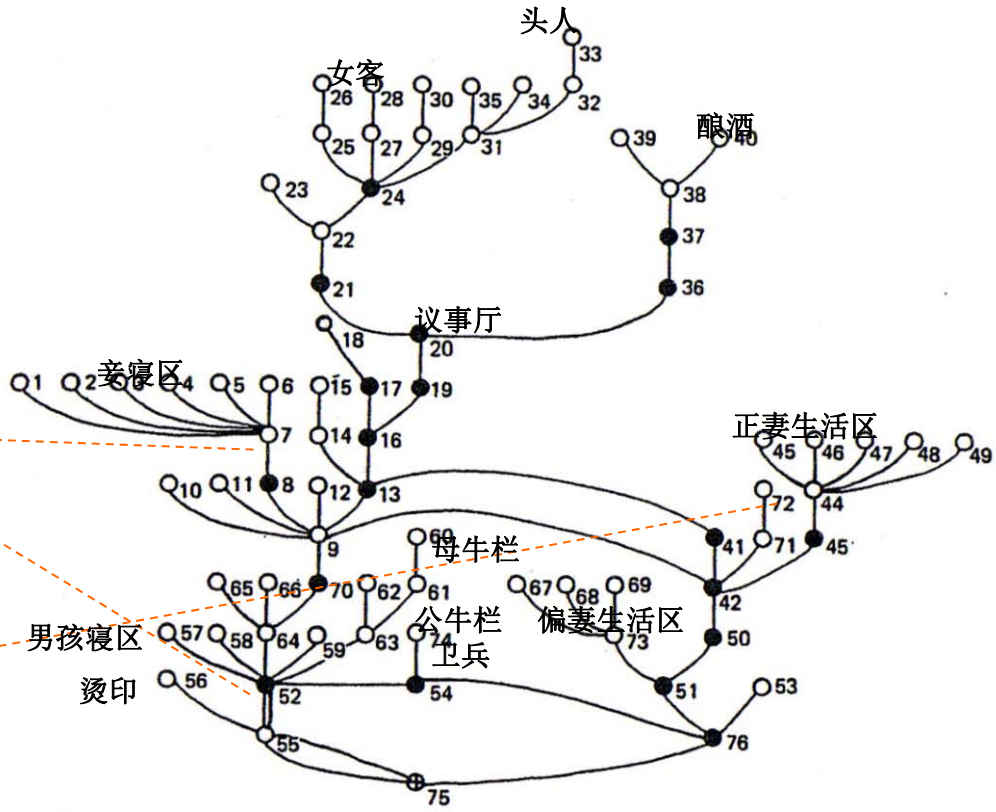
Courtyard housing in **South** China

Courtyard housing in **North** China

拓扑空间带来的思考——社会学的空间表达



'Chiefly' kraal of the Ambo people, after Walton.



7 other wives
9 meeting place
28 girl visitors
33 kraal head
40 brewery
44 first wife
52 main entrance passage
55 entrance space
57 boys sleeping
61 ox kraal
60 cow kraal
73 second wife
• passages
75 carrier

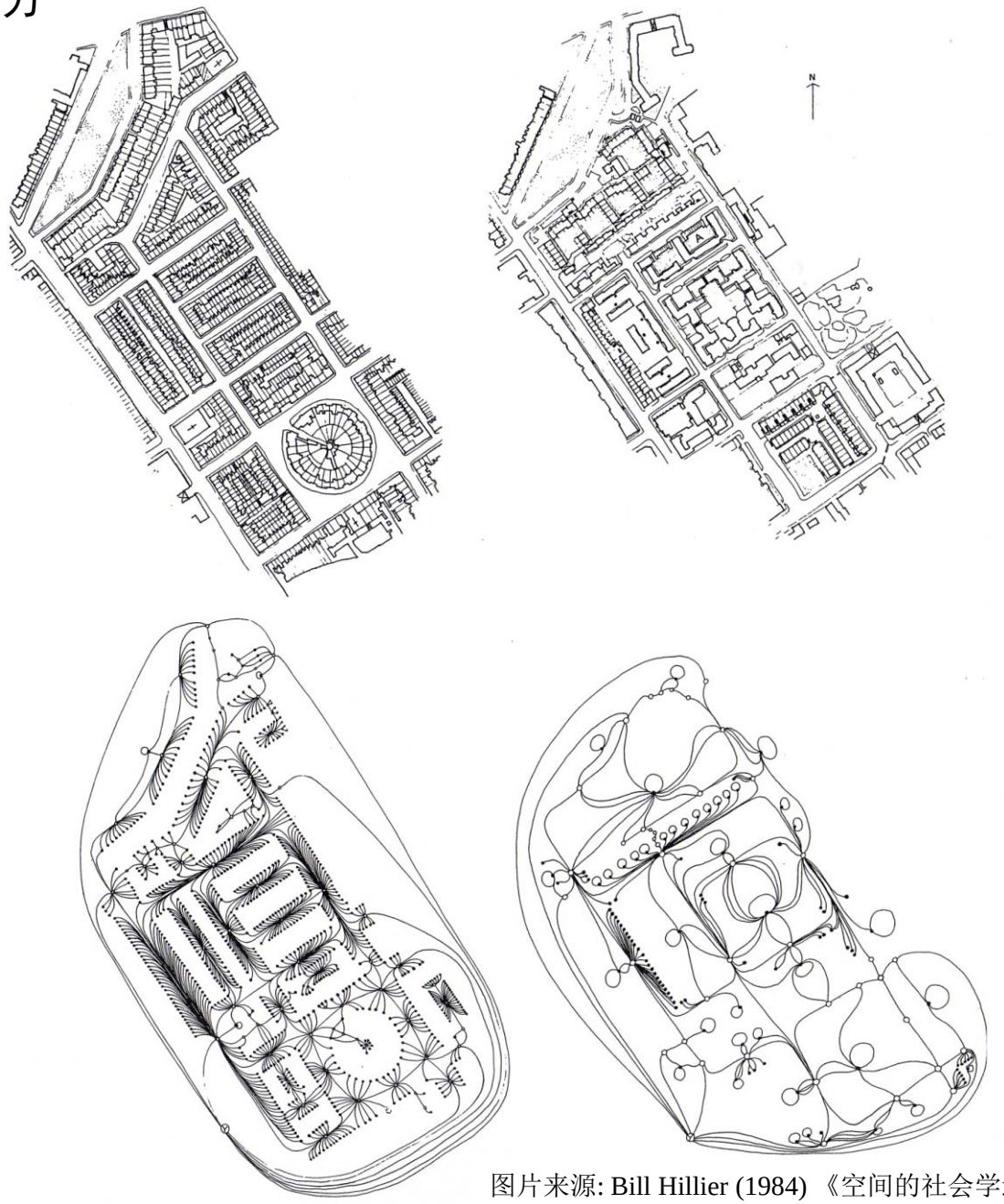
构形的直观描述——关系图解（justified graph, **J-graph**）

图片来源: Bill Hillier (1984) 《空间的社会学逻辑》

拓扑空间带来的思考——城市空间形态与活力

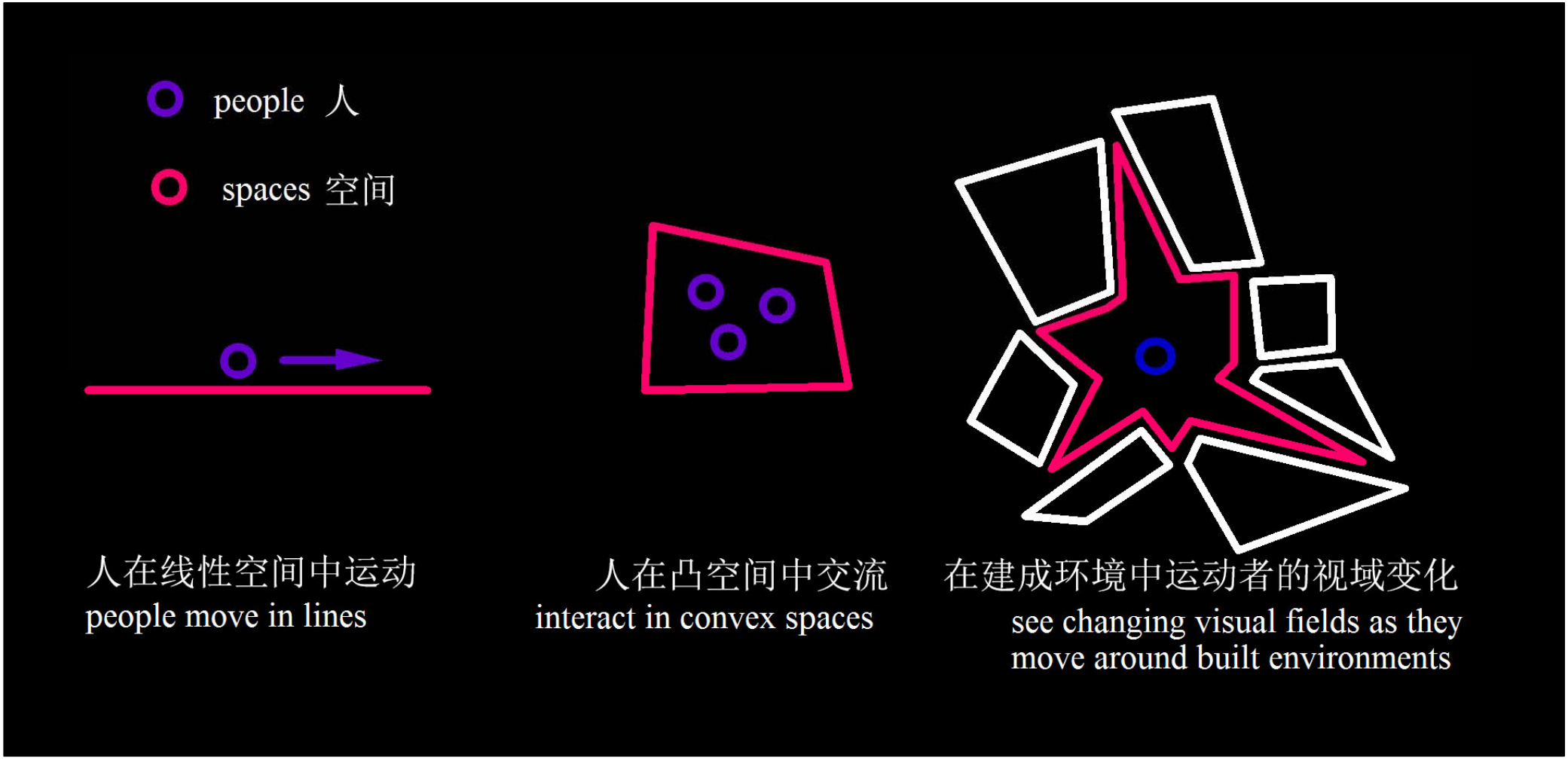
伦敦一居住区二战前后空间J-graph的对比，
战后大量性社会住宅造成的公共空间活力
丧失也许与之有关？

（传统对这个问题的批判集中于图底分析
或空间尺度等方面）



图片来源: Bill Hillier (1984) 《空间的社会学逻辑》

空间句法的空间基本分析单元与行为的关系

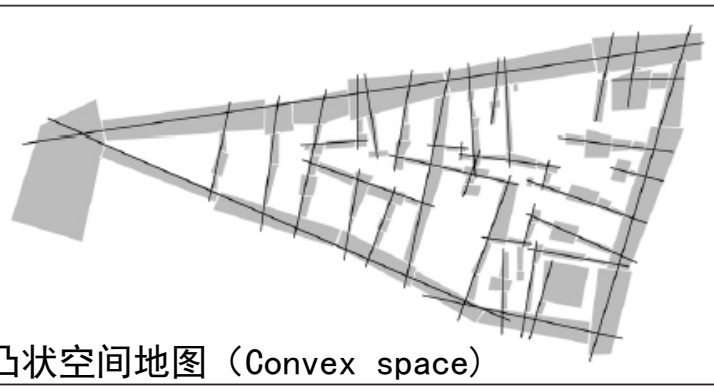


空间句法对空间的处理 （如何抽象真实的空间？）

伦敦的图底关系地图

图底关系是真实空间二维化的抽象，空间句法在后期才在视域分析中体现了对这种具象空间的拓扑分析方法。

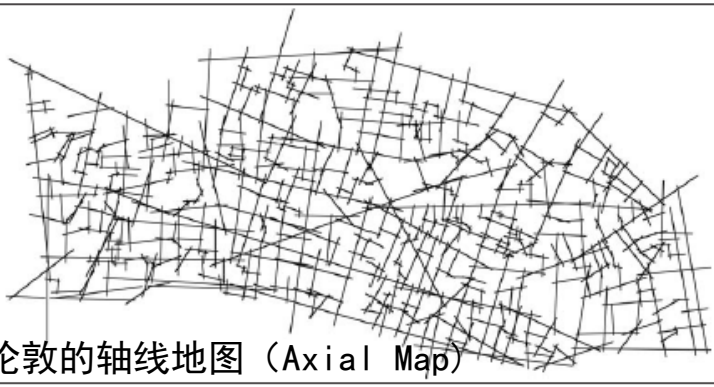
视域分析



凸状空间地图（Convex space）

凸状空间分析是一种基本的将真实空间抽象为拓扑空间的方式，它应用于计算纯粹的拓扑关系，目前已较少应用。

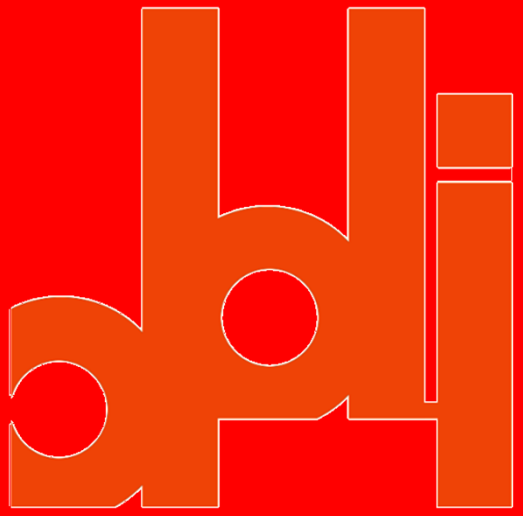
凸空间分析



伦敦的轴线地图（Axial Map）

轴线地图分析(Axial Map)是空间句法在城市空间分析中最常用的空间处理方法，日后进一步发展为基于线段地图的分析方法（Segment map）。

轴线分析



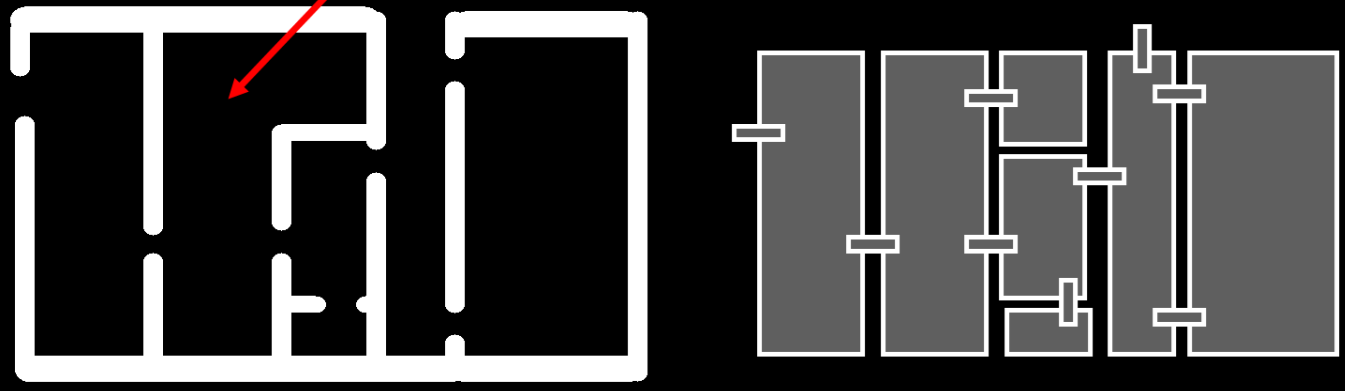
凸空间分析

凸空间的概念
拓扑深度的算法
凸空间分析简例

凸空间概念图解

凸状空间（convex space）---- 完全互視（static， all see all）之外凸空間

注意：一個 L形空間必須分割成兩個空間單元



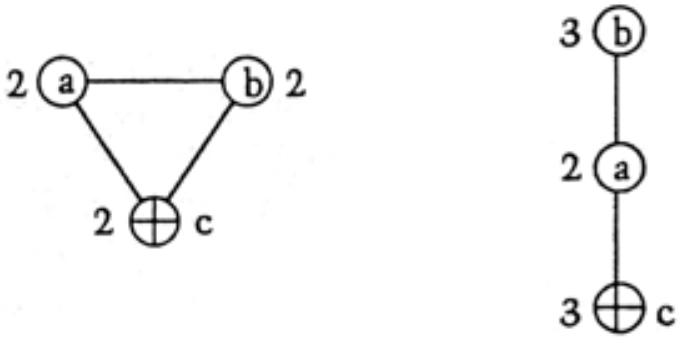
建筑平面简图
PLAN

凸空间抽象后的空间单元
CONVEX BREAK-UP

从对空间的描述到图论

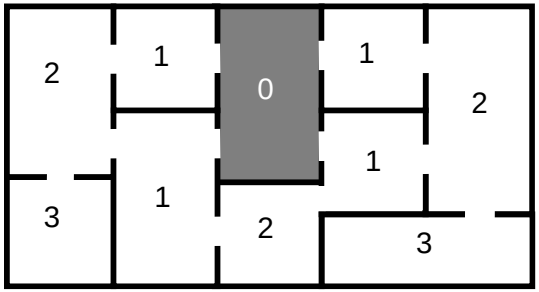
两个不同的空间布局

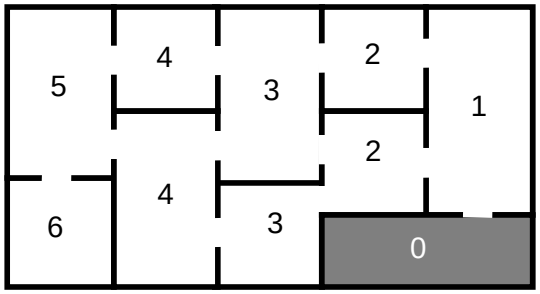
两种不同的空间关系图解（Justified Graph）



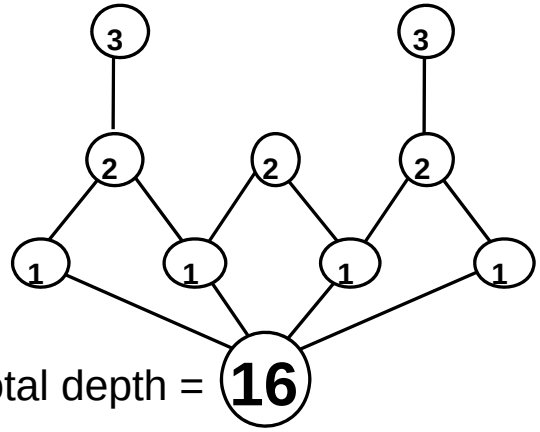

庭院深深几时许？ 中国文化对空间深度的描述和认识与空间句法理论中拓扑深度的概念是契合的。

从描述空间到测度空间的 深度
From Describing space to Measuring depth in graphs

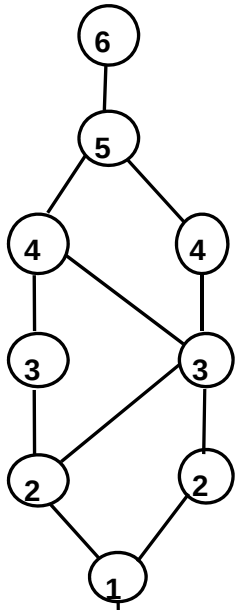




深度是一个“系统度量”，随一个空间到另一个空间的连接关系而变化。
Depth is a ‘system metric’ and varies from place to place in the spatial layout.

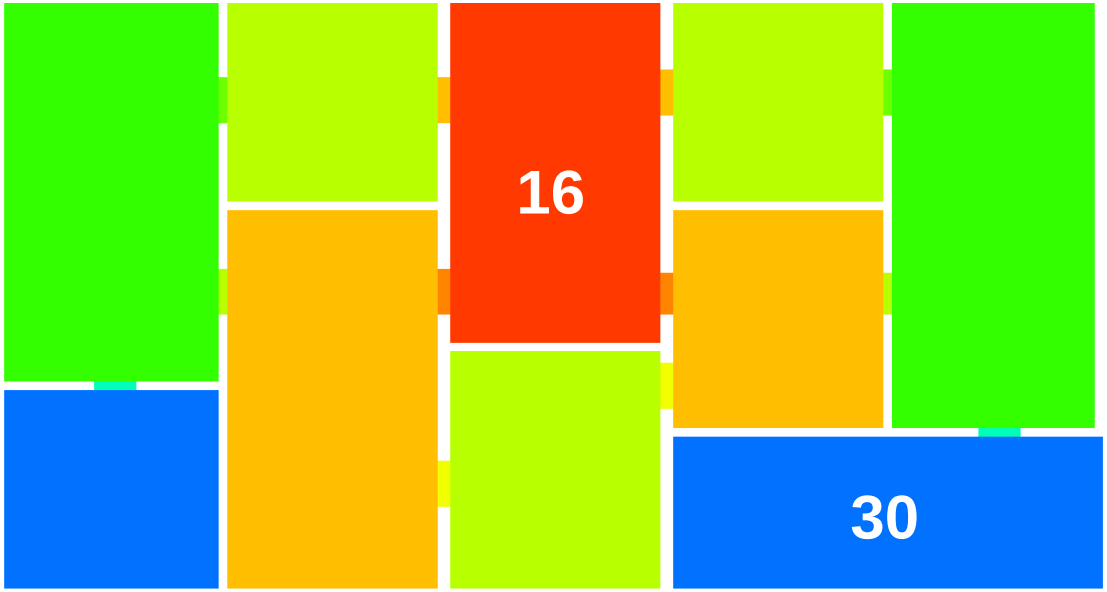


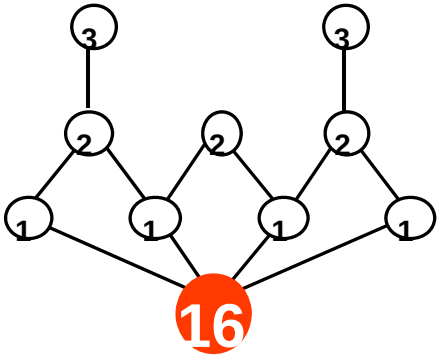
总深度 Total depth = **16**

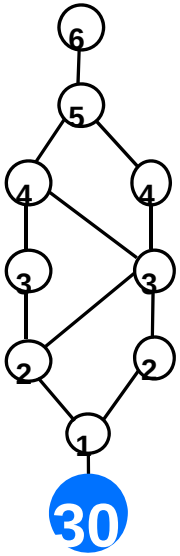


总深度 Total depth = **30**

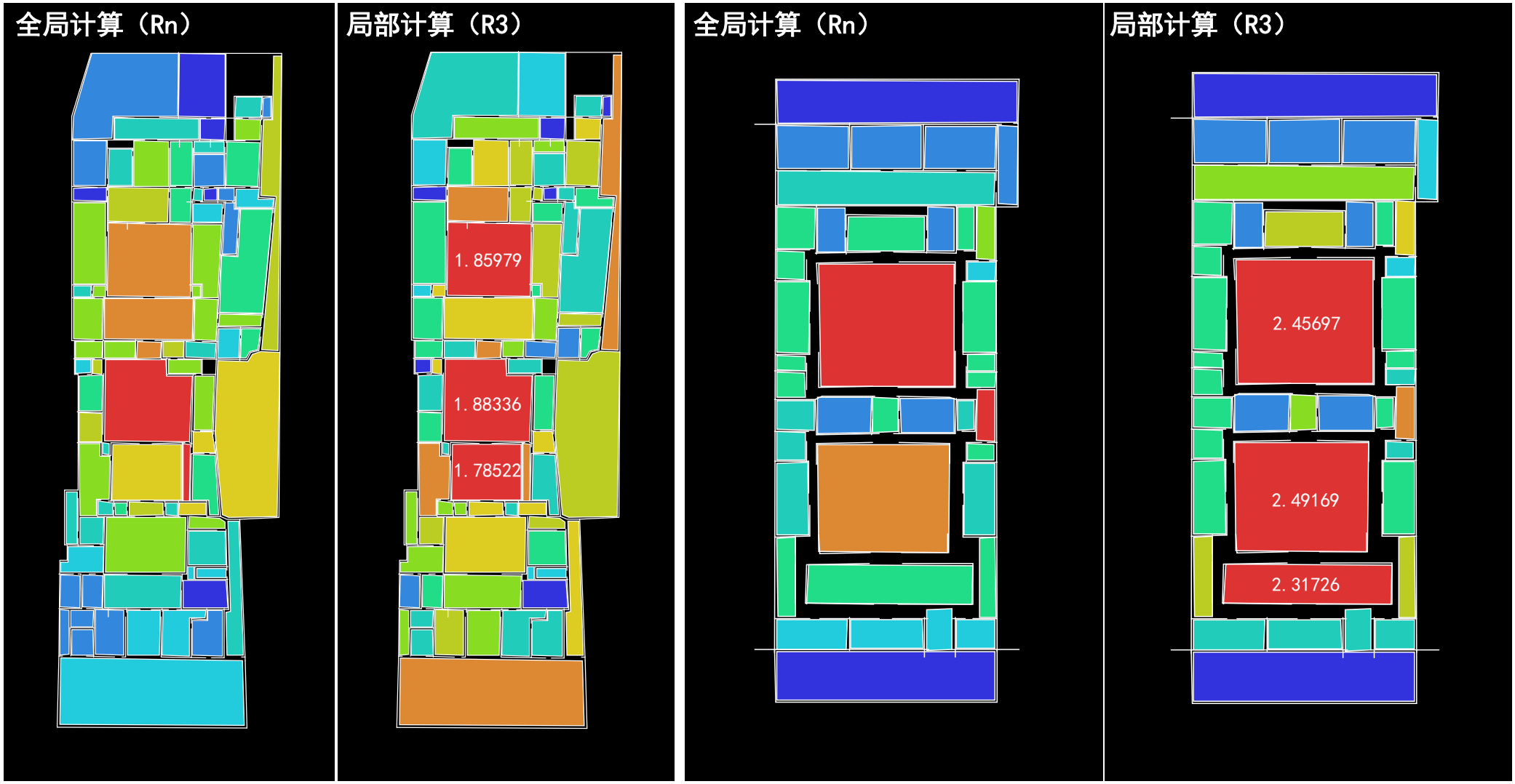
Describing space Representing simultaneous relations
描述空间 代表同时的联立关系







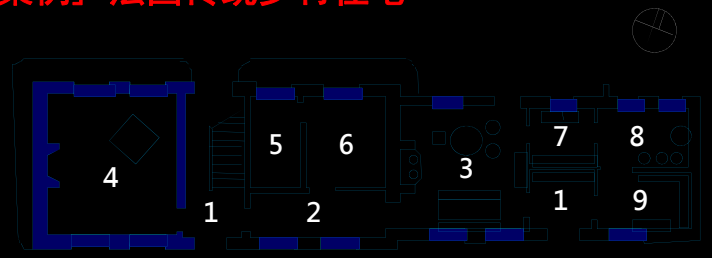
[案例]浙江民居与北京四合院的空间深度分析比较



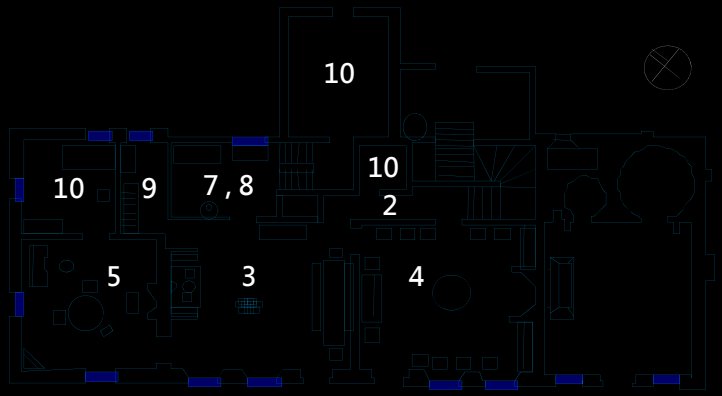
不同分析半径的差别：仅考虑3步深度联系的分析结果更能体现出它们的空间等级结构。

通过计算呈现空间的关系！

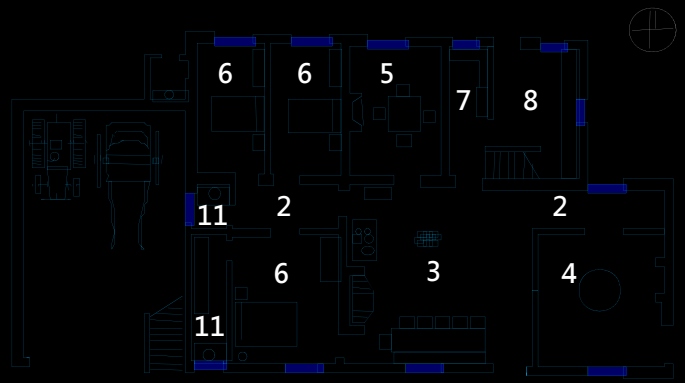
［案例］法国传统乡村住宅



FRENCH HOUSE --- A



FRENCH HOUSE --- B

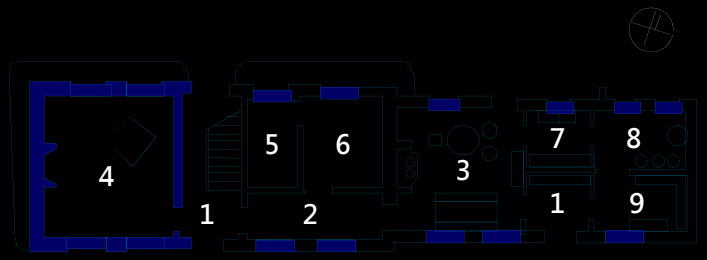


FRENCH HOUSE --- C

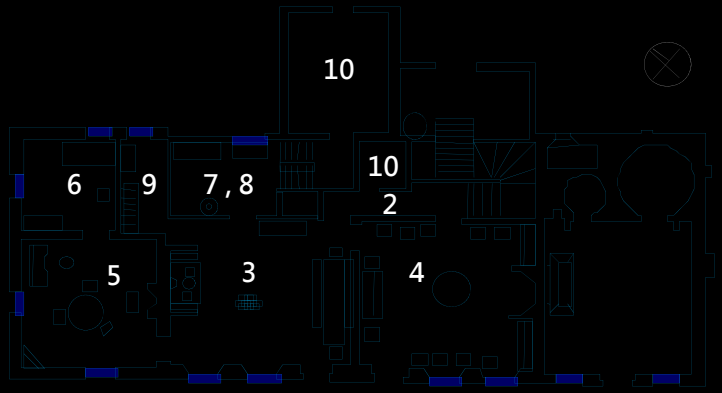
0. --- outdoors	戶外空間	6. --- bedroom	臥室
1. --- entrance hall	入口門廳	7. --- washing room	洗衣間
2. --- corridor	室內廊道	8. --- freezer	冷凍室
3. --- living & cooking	廚房起居	9. --- preserving food	食物儲藏
4. --- reception room	接待客廳	10. --- storage	儲藏室
5. --- study room	主人書房	11. --- toilet	盥洗間

就表層空間型態而言，如長寬比例關係，空間單元排列型式等， B 與 C 為兄弟　而 A 則為遠親。

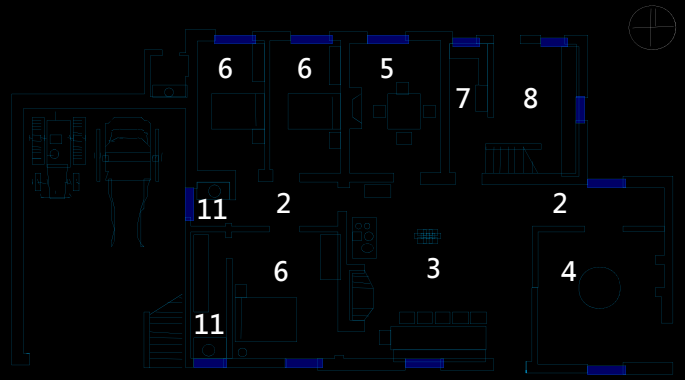
［案例］法国传统乡村住宅



FRENCH HOUSE --- A



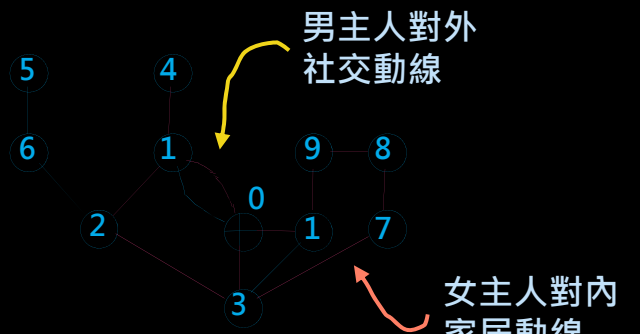
FRENCH HOUSE --- B



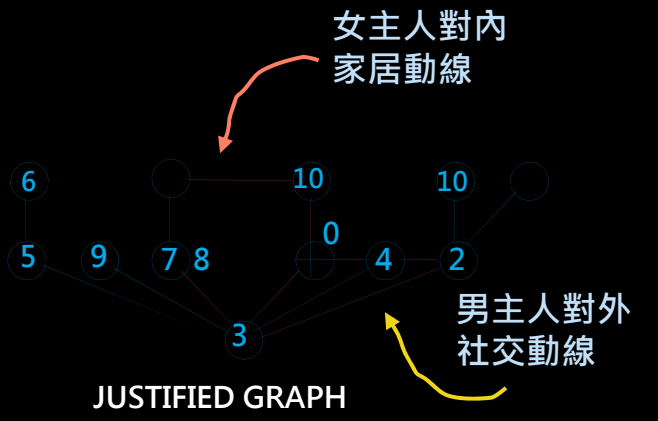
FRENCH HOUSE --- C

戶外空間僅視為一空間單元，不分前、後、左、右

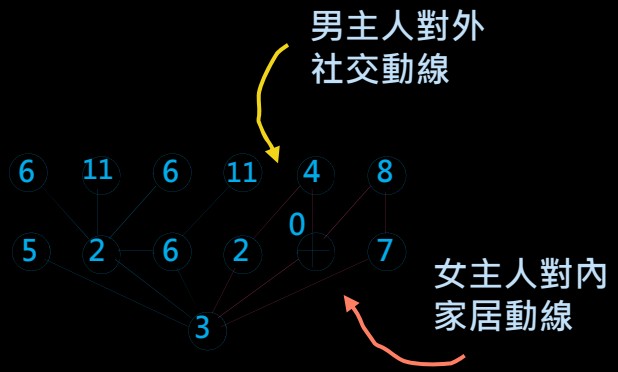
0. --- outdoors
1. --- entrance hall
2. --- corridor
3. --- living & cooking
4. --- reception room
5. --- study room
6. --- bedroom
7. --- washing room
8. --- freezer
9. --- preserving food
10. --- storage
11. --- toilet



JUSTIFIED GRAPH

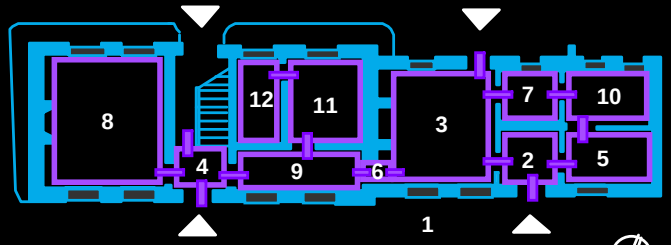


JUSTIFIED GRAPH

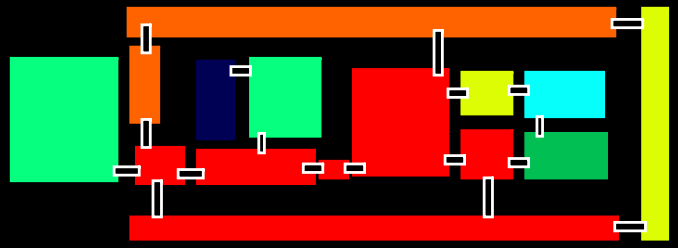


JUSTIFIED GRAPH

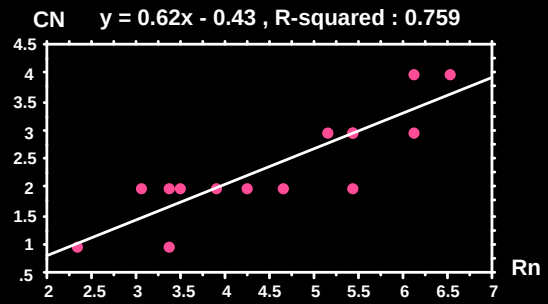
［案例］法国传统乡村住宅



CONVEX BREAK-UP HOUSE --- A



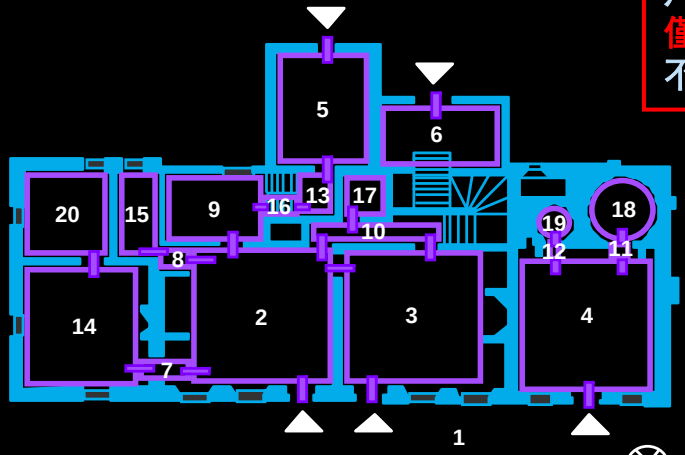
CONVEX INTEGRATION



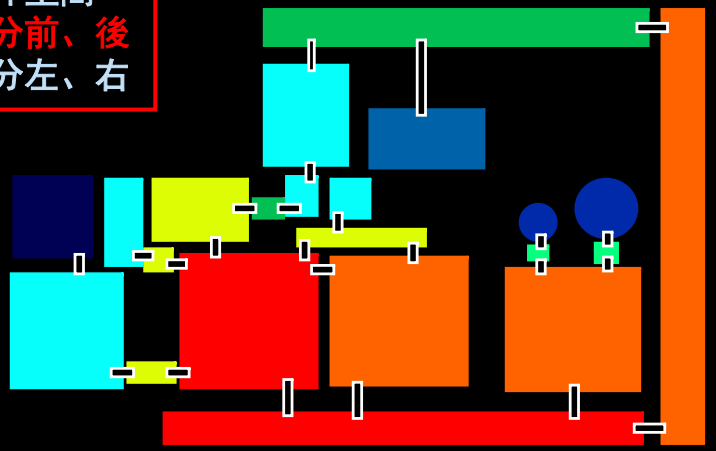
CONVEX INTELLIGIBILITY

戶外空間
僅分前、後
不分左、右

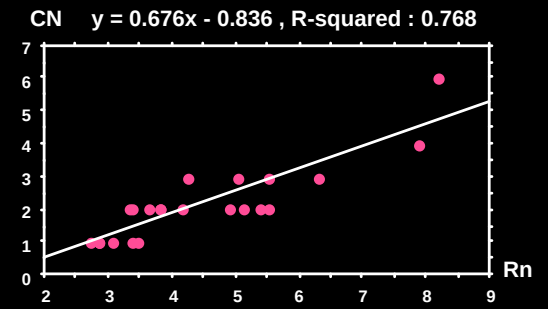
A 与B 空间可理解度高 ： A 与 B 为兄弟，而 C 则为远亲



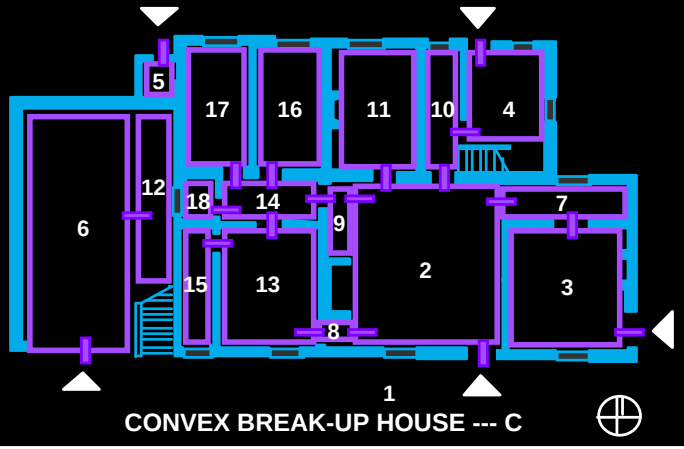
CONVEX BREAK-UP HOUSE --- B



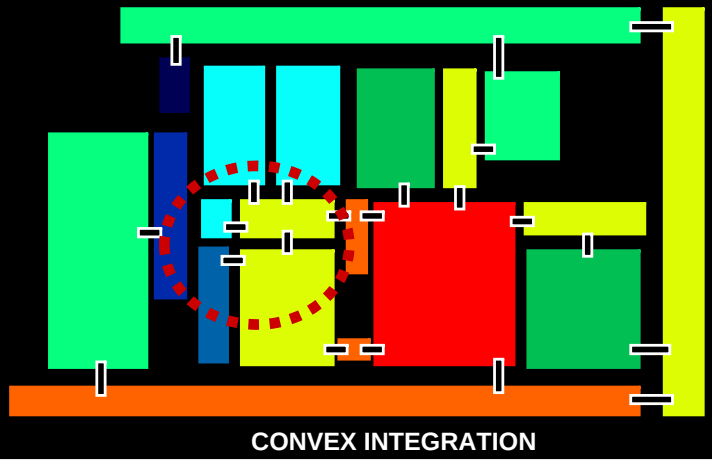
CONVEX INTEGRATION



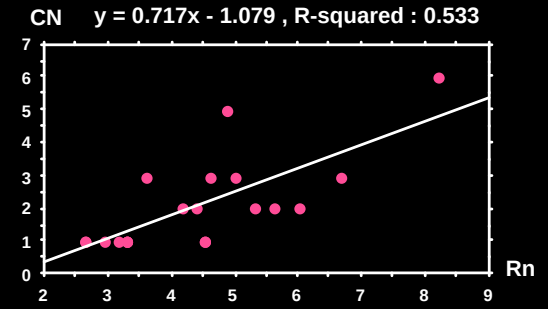
CONVEX INTELLIGIBILITY



CONVEX BREAK-UP HOUSE --- C

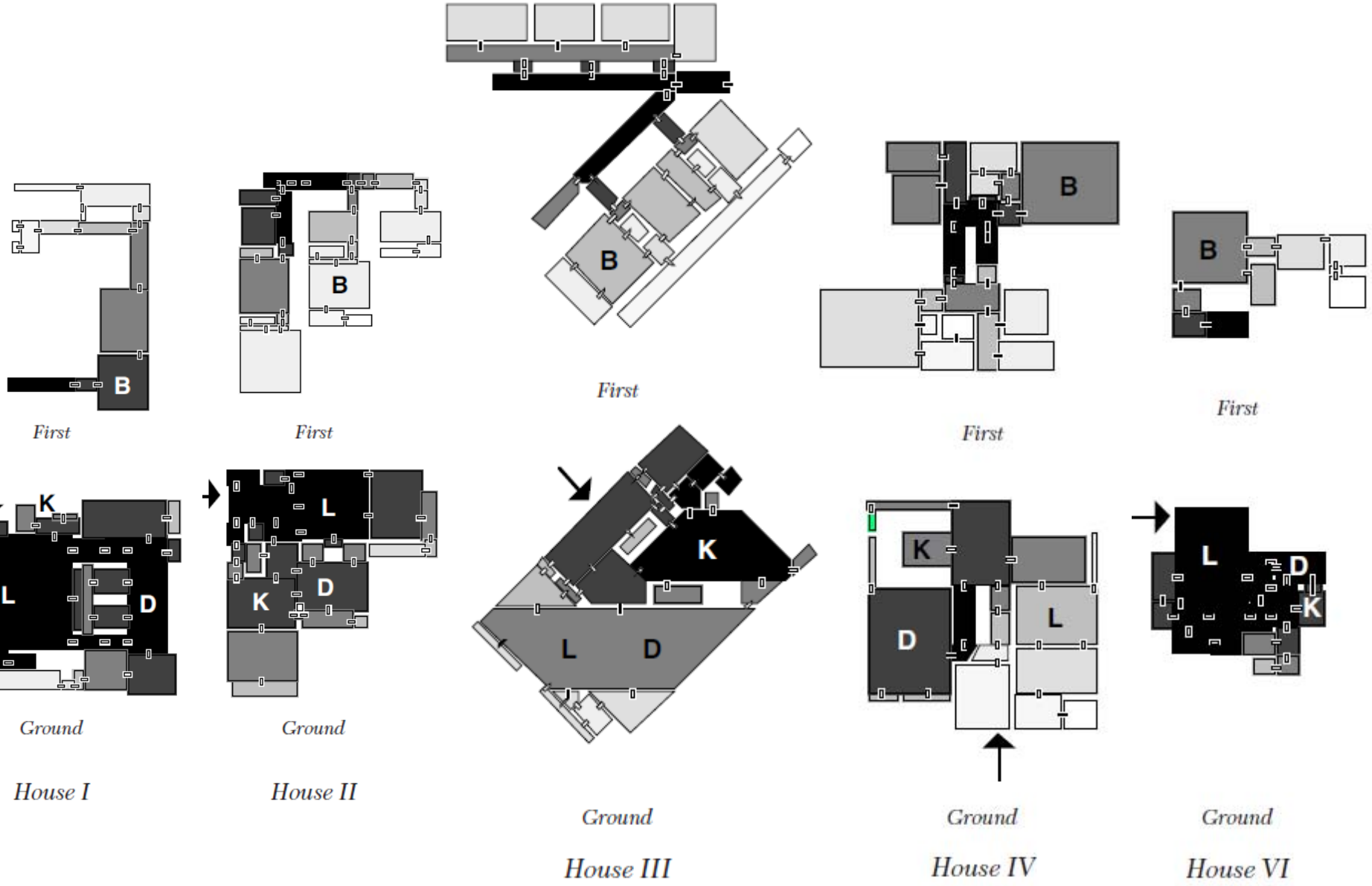


CONVEX INTEGRATION



CONVEX INTELLIGIBILITY

［案例］对艾森曼5个实验住宅的室内空间整合度分析

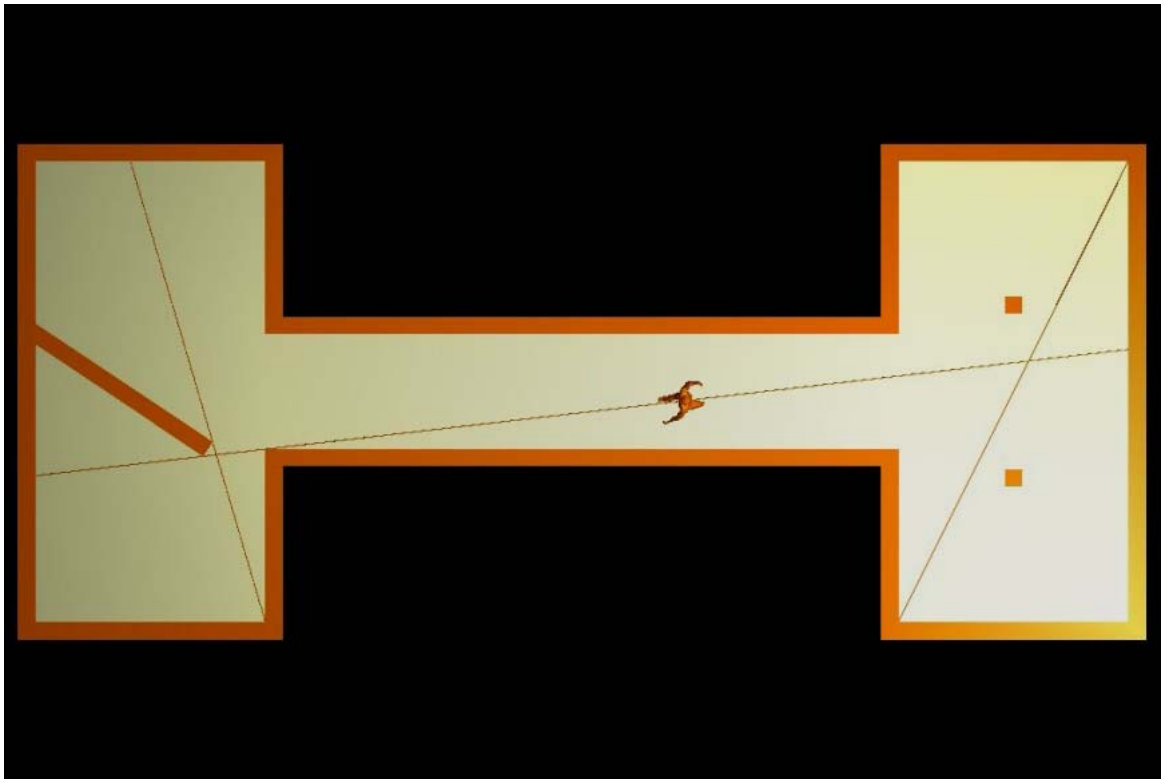


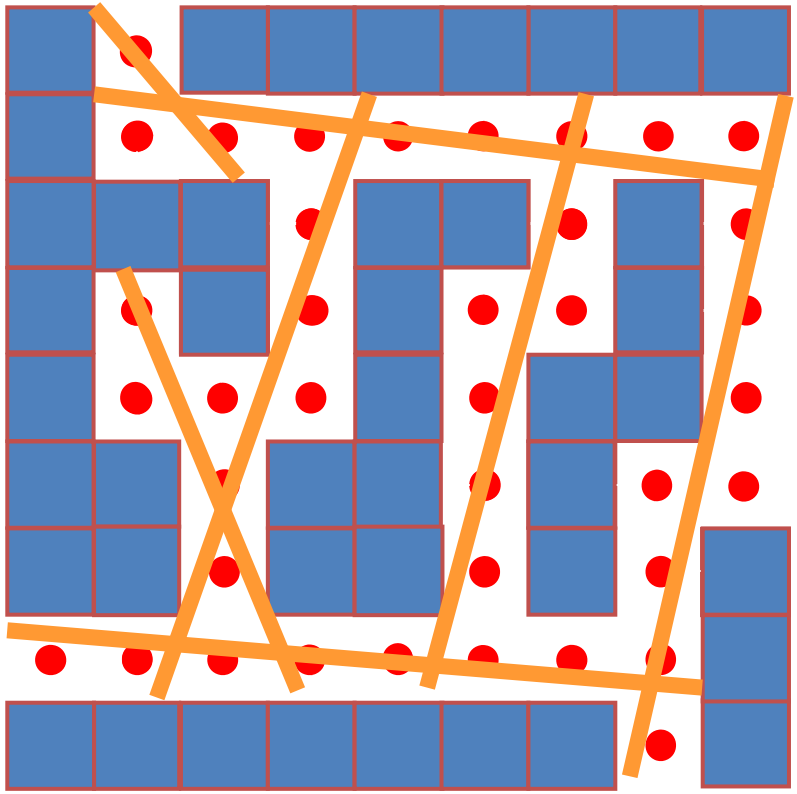
轴线分析

轴线地图画法
整合度算法及其意义
轴线分析实例

什么是轴线图？

建筑 公共空间界面





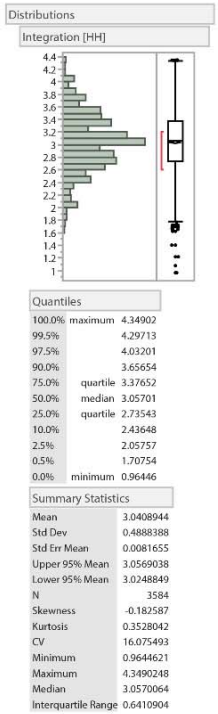
轴线图（axial map)的数学定义：串联一个空间系统全部空间单元的**最长**且**最少**数量的轴线相互连接图.

行为含义： 以运动和视知觉认知一个空间拓扑结构的路径集合。

评价：轴线图及轴线分析是空间句法在城市空间分析中最重要最基本的工具，尽管目前更多的使用线段分析模式来分析轴线地图，但作为一种最接近反应抽象拓扑关系的算法，它仍有重要的理论意义和继续开发潜力。

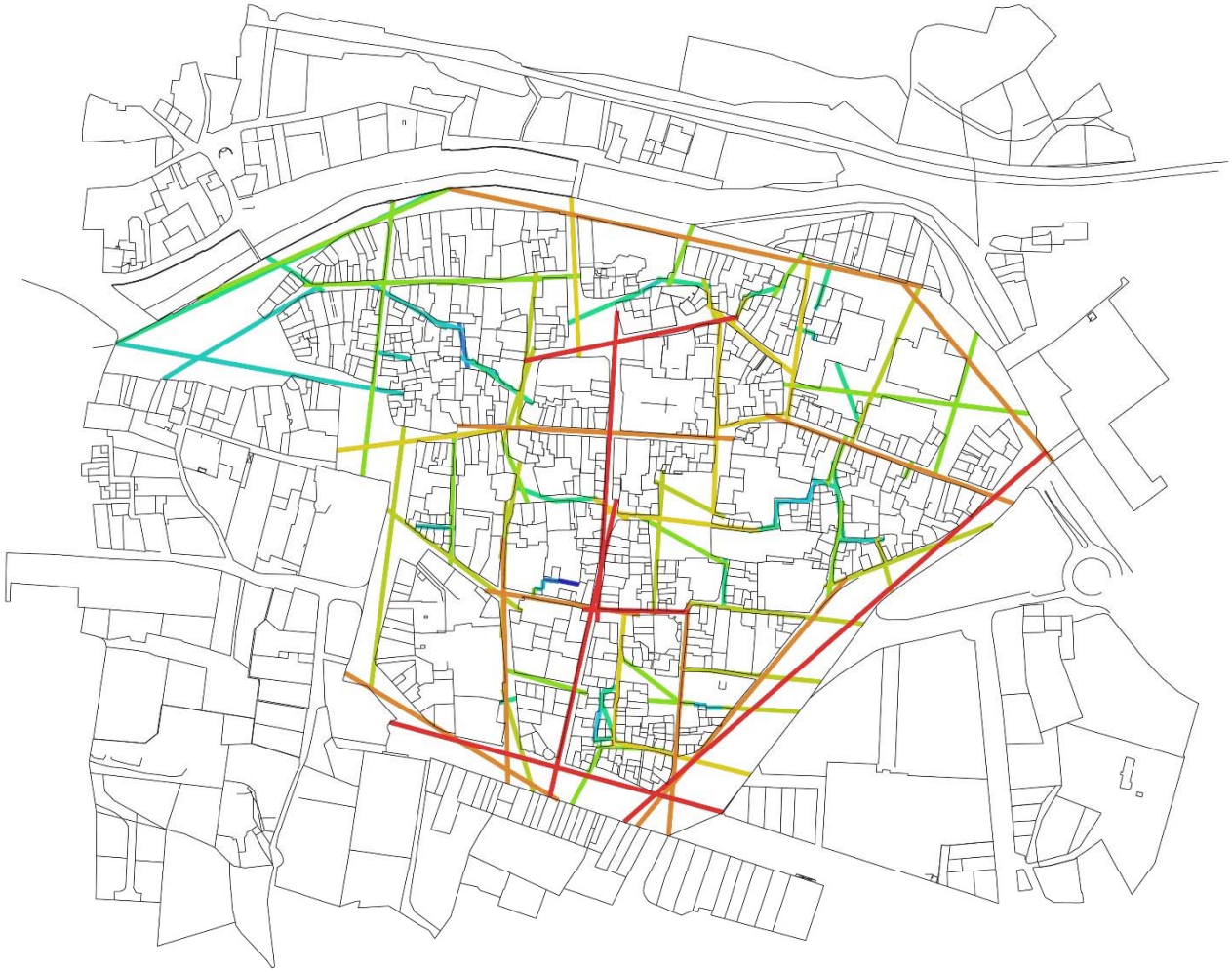
Turner A, Penn A, Hillier B, 2005, "An algorithmic definition of the axial map" *Environment and Planning B: Planning and Design* ***32 425-444***
Peponis J, Wineman J, Bafna S, Rashid M, Kim S H, 1998, "On the generation of linear representations of spatial configuration" *Environment and Planning B-Planning & Design* ***25 559-576***

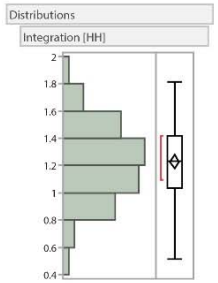
Automatically generated
“all lines” map



Turner A, Penn A, Hillier B, 2005, "An algorithmic definition of the axial map" *Environment and Planning B: Planning and Design* ***32 425-444***
Peponis J, Wineman J, Bafna S, Rashid M, Kim S H, 1998, "On the generation of linear representations of spatial configuration" *Environment and Planning B-Planning & Design* ***25 559-576***

"All lines" Integration
More integrated lines in red;
less integrated lines in blue





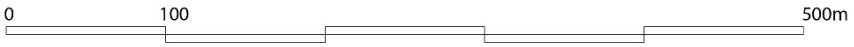
Quantiles

100.0%	maximum	1.81621
99.5%		1.81621
97.5%		1.76455
90.0%		1.5863
75.0%	quartile	1.41964
50.0%	median	1.23243
25.0%	quartile	1.03365
10.0%		0.8714
2.5%		0.64745
0.5%		0.51387
0.0%	minimum	0.51387

Summary Statistics

Mean	1.2286083
Std Dev	0.2723442
Std Err Mean	0.0263285
Upper 95% Mean	1.2808071
Lower 95% Mean	1.1764095
N	107
Skewness	-0.058458
Kurtosis	-0.256038
CV	22.166881
Minimum	0.5138657
Maximum	1.8162135
Median	1.2324306
Interquartile Range	0.3859838

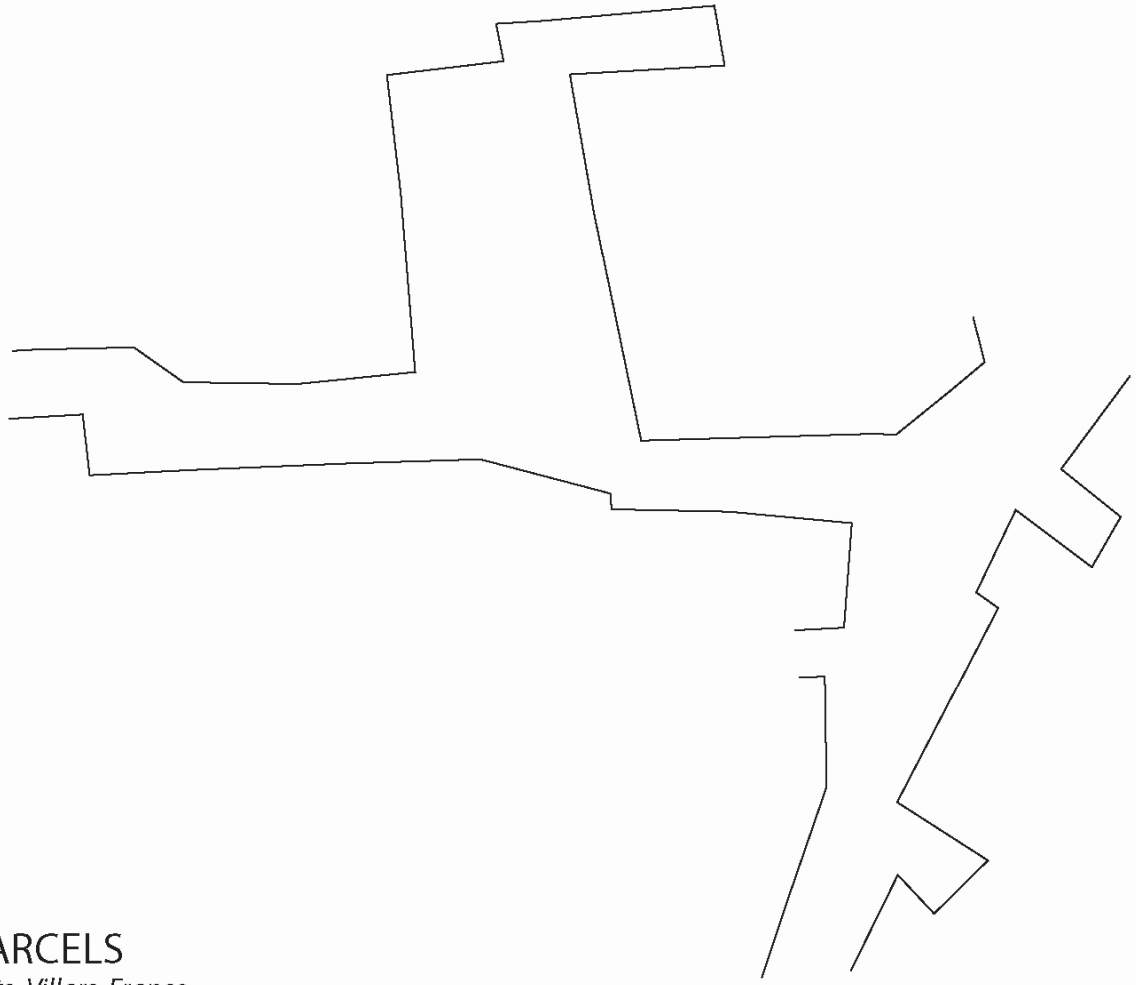
Turner A, Penn A, Hillier B, 2005, "An algorithmic definition of the axial map" *Environment and Planning B: Planning and Design* ***32 425-444***
Peponis J, Wineman J, Bafna S, Rashid M, Kim S H, 1998, "On the generation of linear representations of spatial configuration" *Environment and Planning B-Planning & Design* ***25 559-576***



Automatically generated
“fewest lines” map – Integration
More integrated lines in red;
less integrated lines in blue

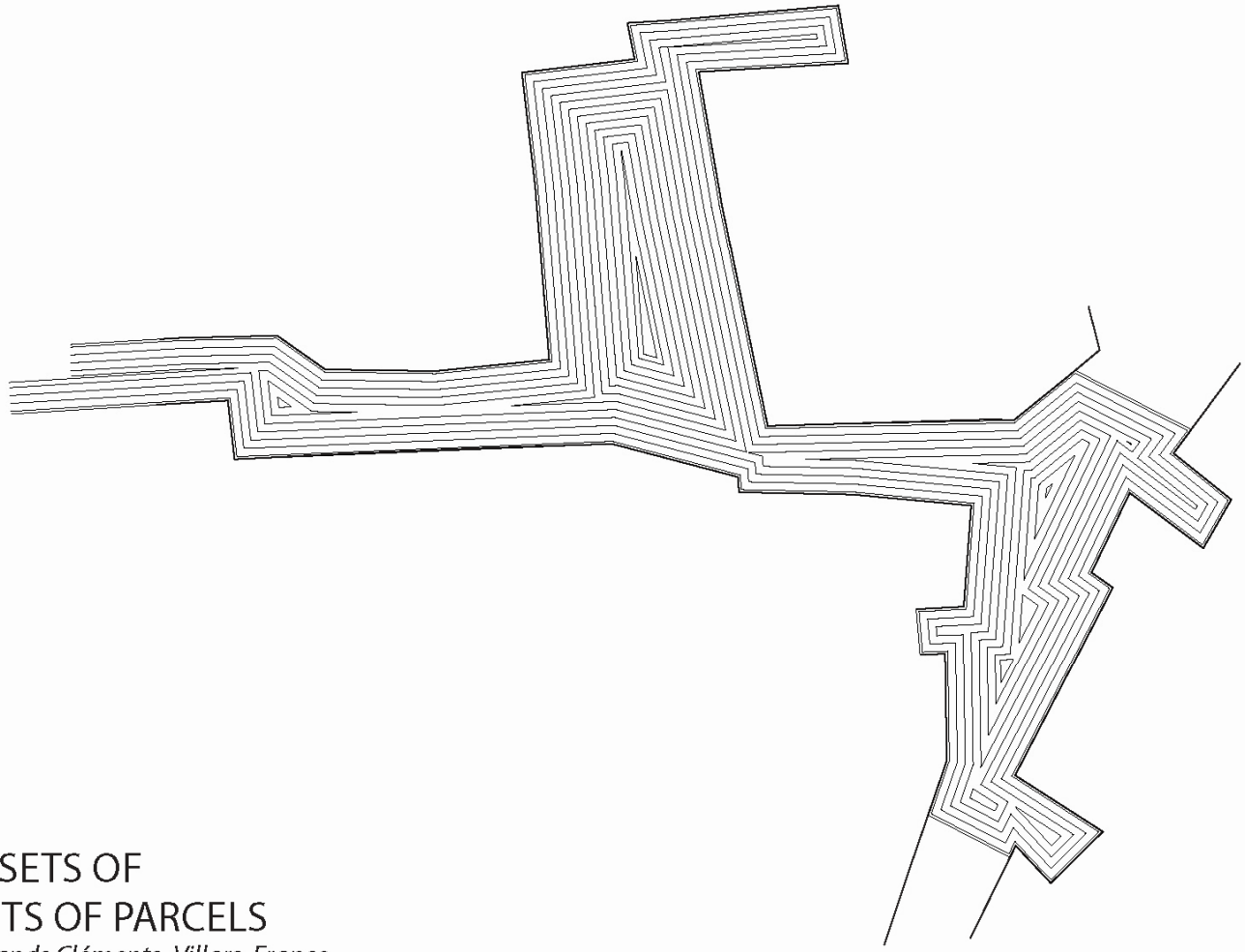
Straight Skeleton

Step by Step

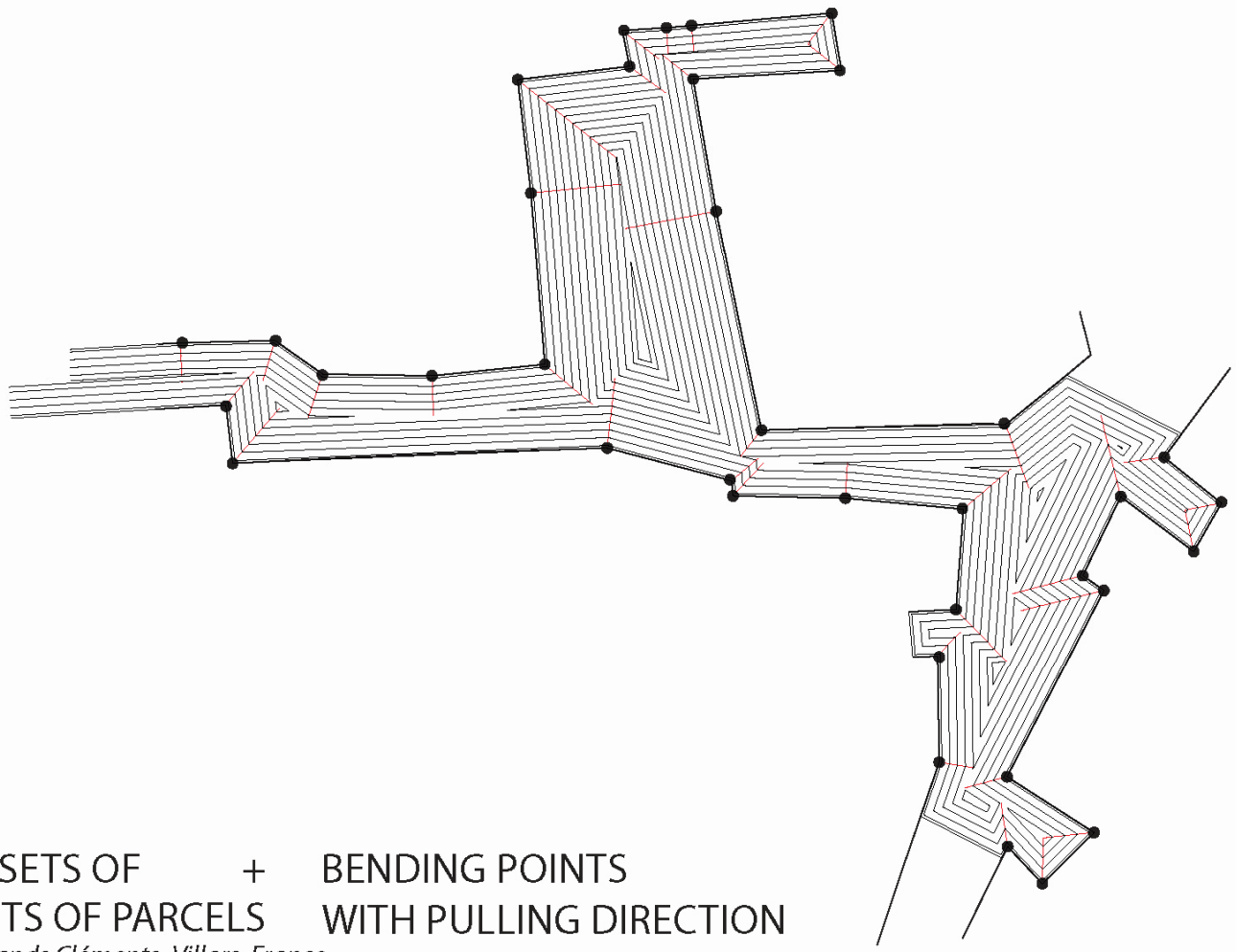


LIMITS OF PARCELS

Les Grands Cléments, Villars, France

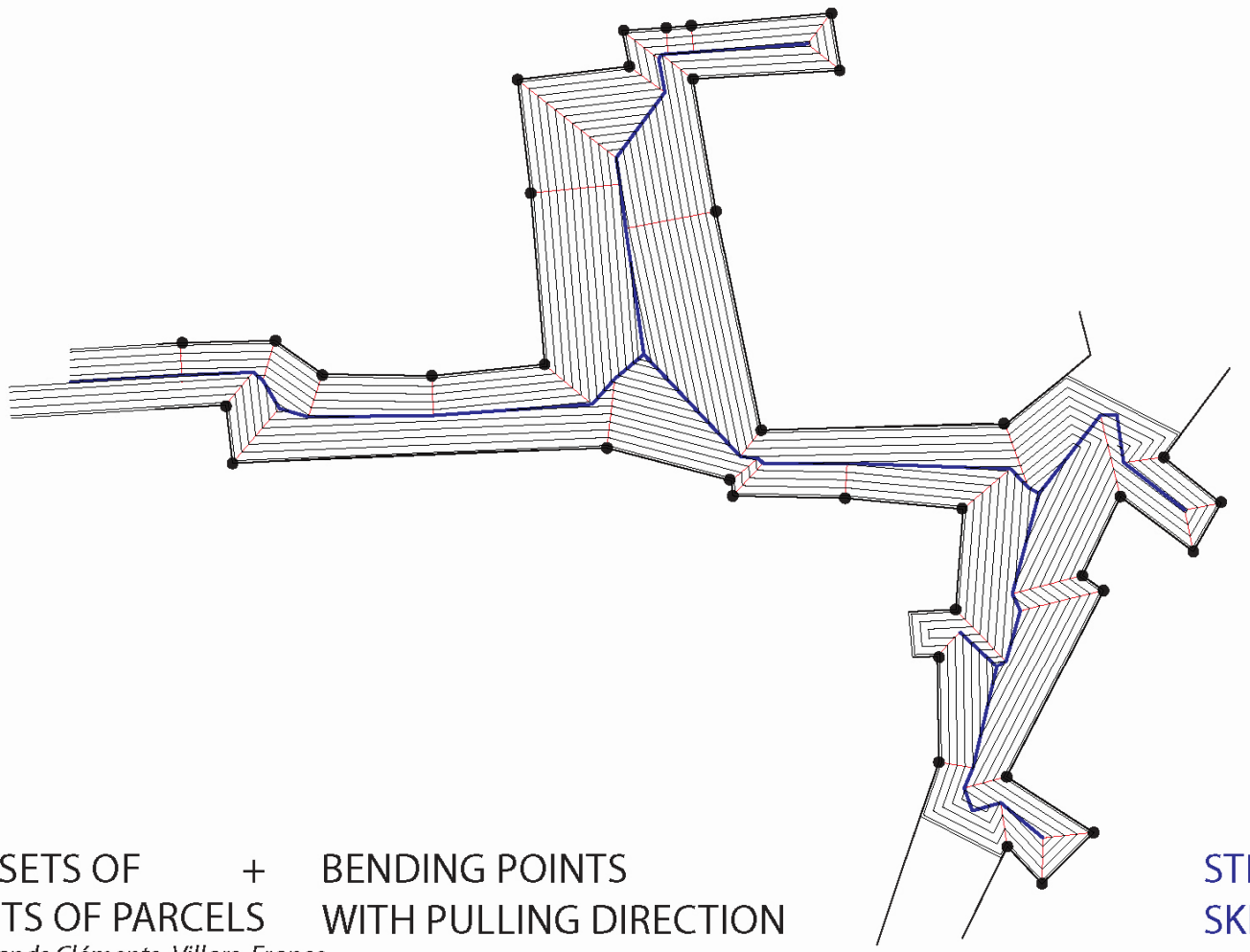


OFFSETS OF
LIMITS OF PARCELS
Les Grands Cléments, Villars, France



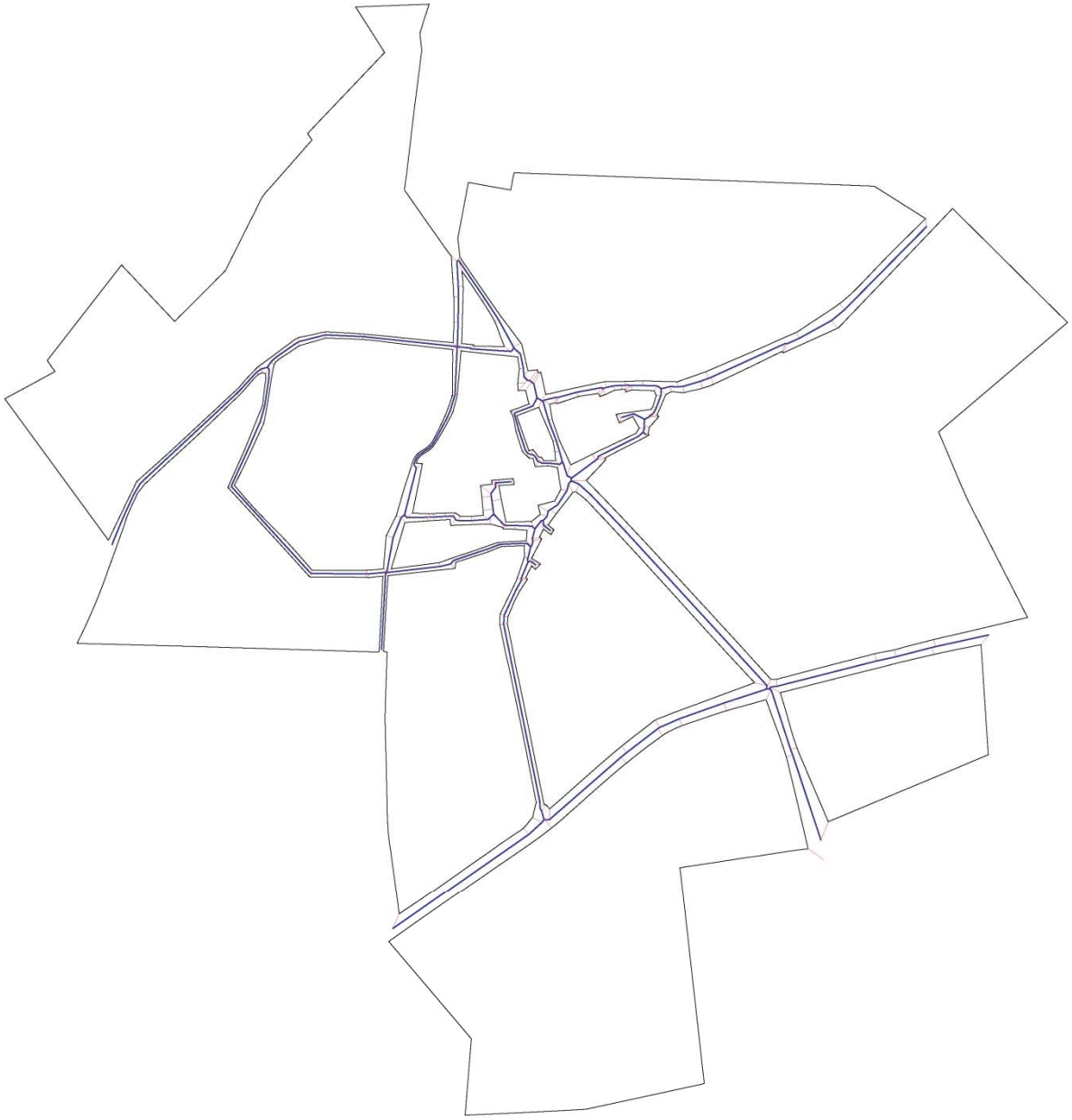
OFFSETS OF LIMITS OF PARCELS + BENDING POINTS WITH PULLING DIRECTION

Les Grands Cléments, Villars, France



OFFSETS OF LIMITS OF PARCELS + BENDING POINTS WITH PULLING DIRECTION → STRAIGHT SKELETON

Les Grands Cléments, Villars, France



STRAIGHT SKELETON
(hand drawn)

MedialAxis2/3.gh

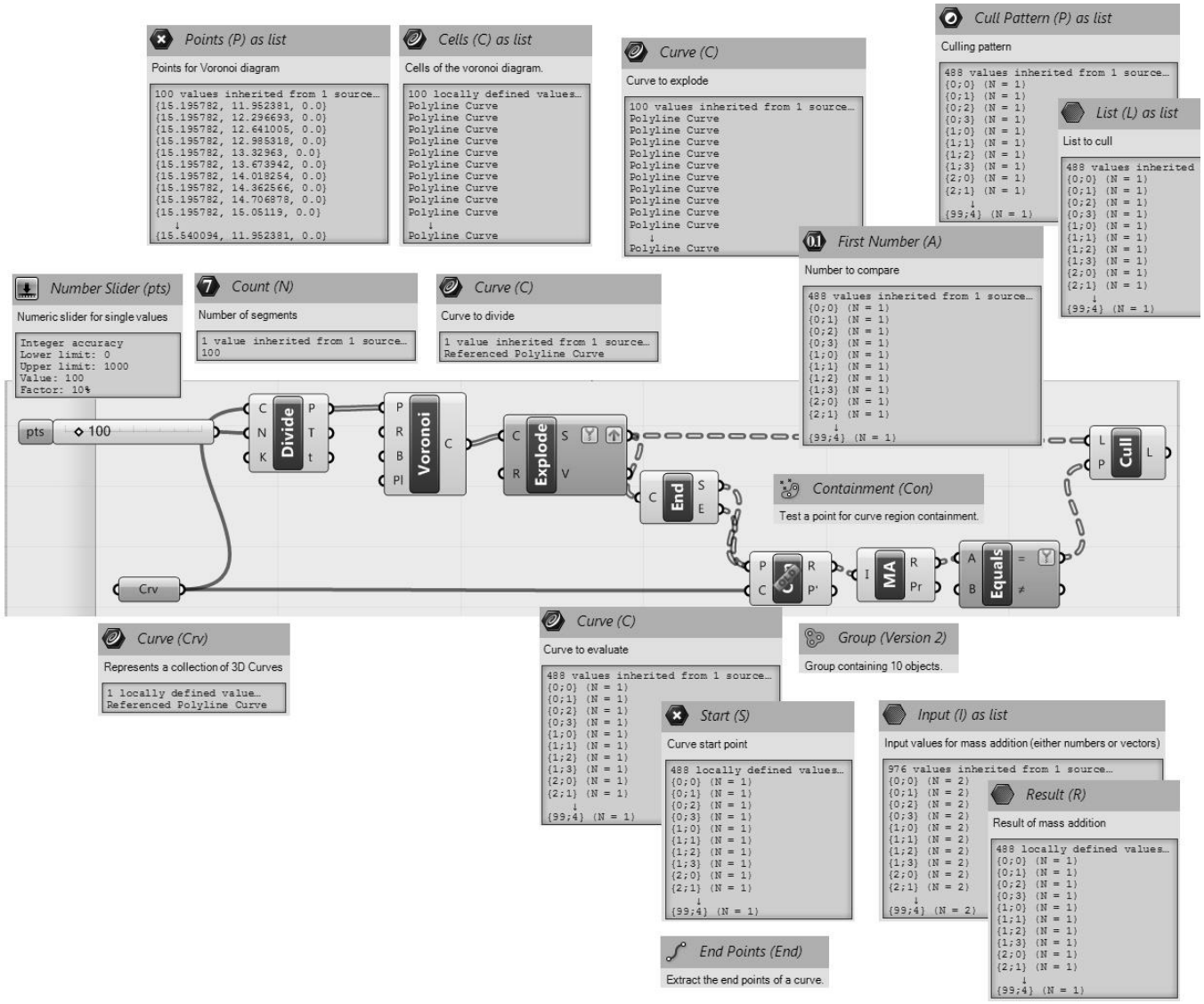
Grasshopper script.

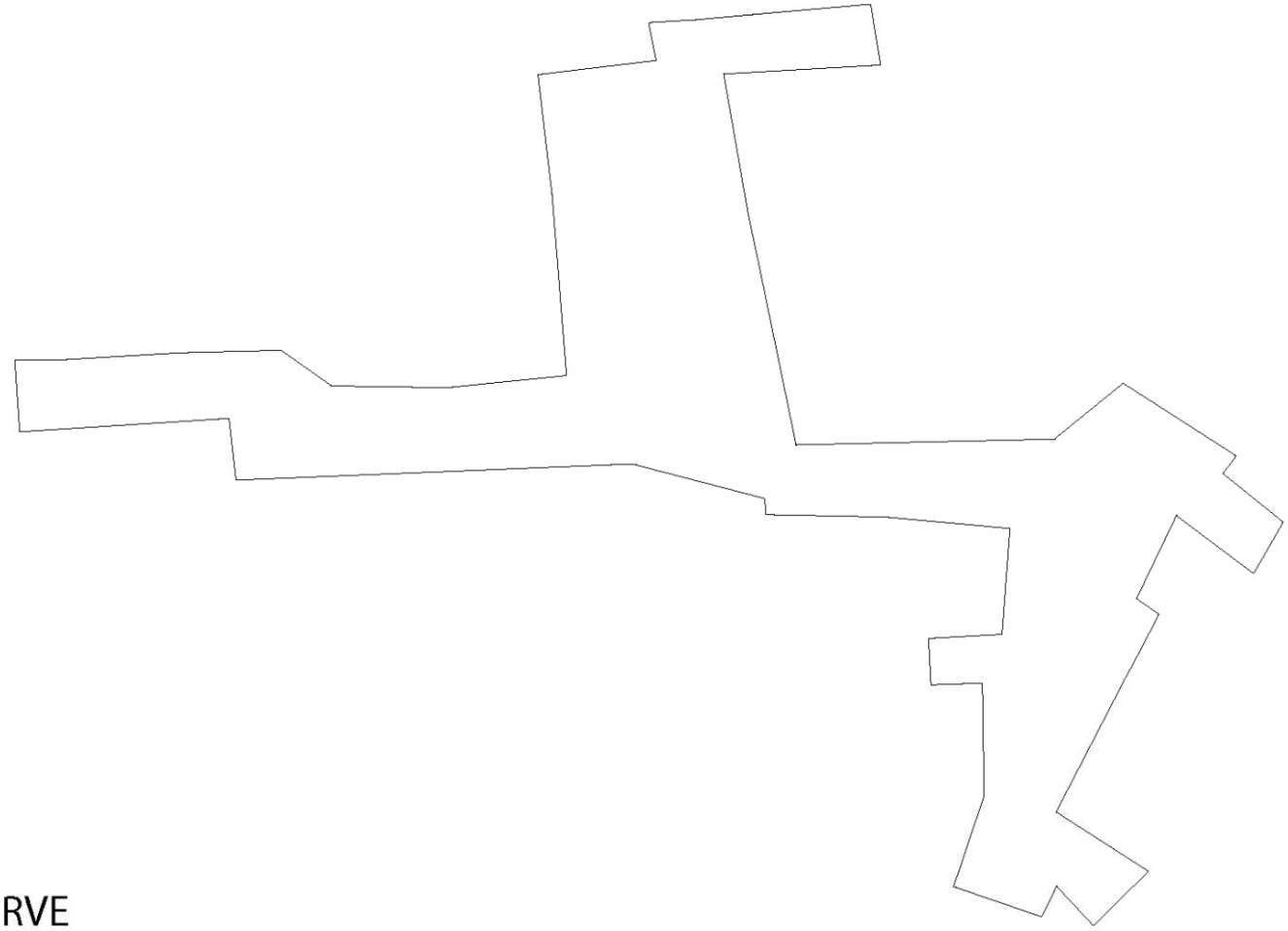
http://spacesymmetrystructure.wordpress.com/2009/10/05/medial-axes-voronoi-skeletons/

http://www.grasshopper3d.com/group/coffee-and-grasshopper/forum/topics/may-25th-2012-medial-axis

Posted by Daniel

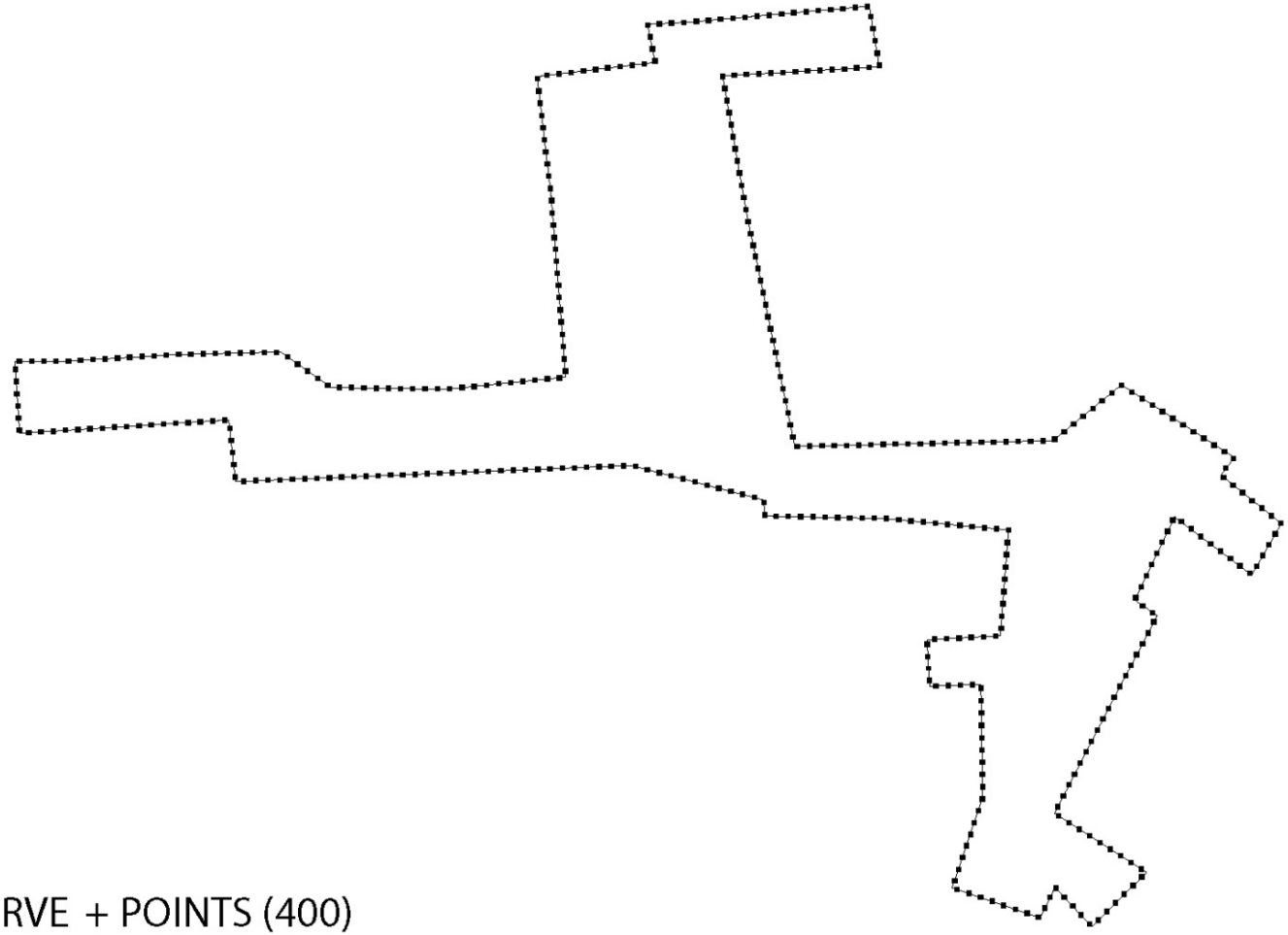
100 points





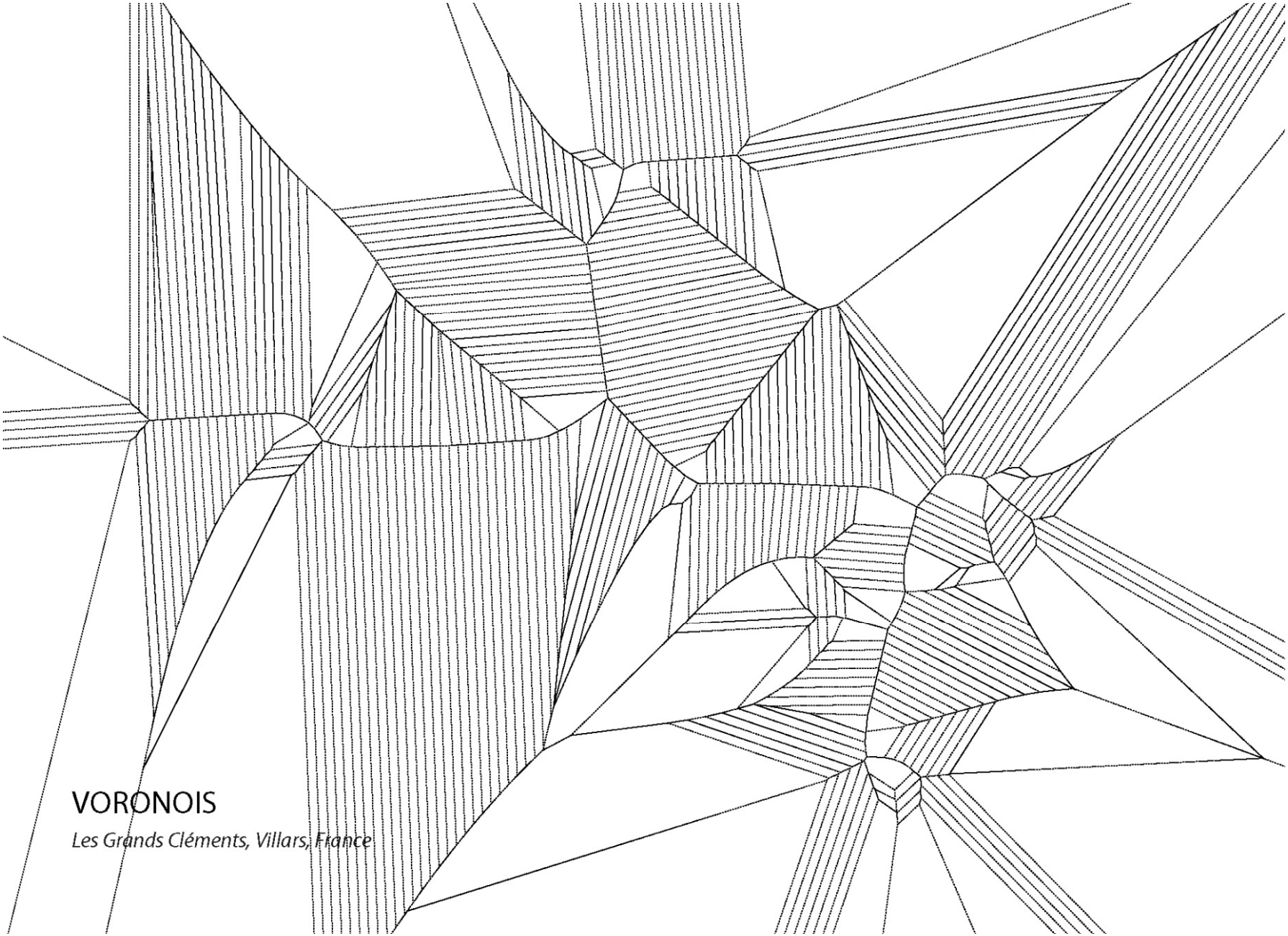
CURVE

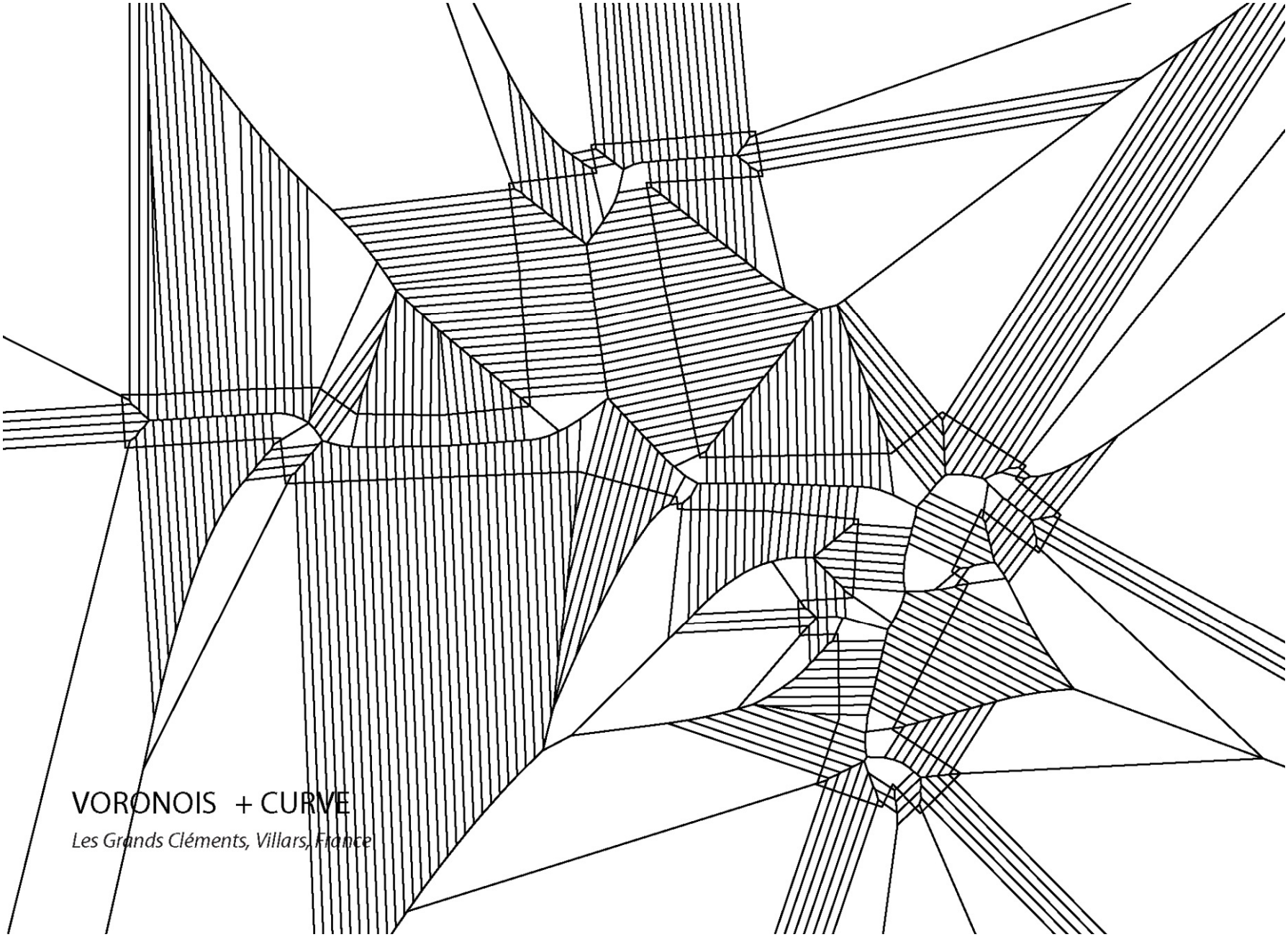
Les Grands Cléments, Villars, France

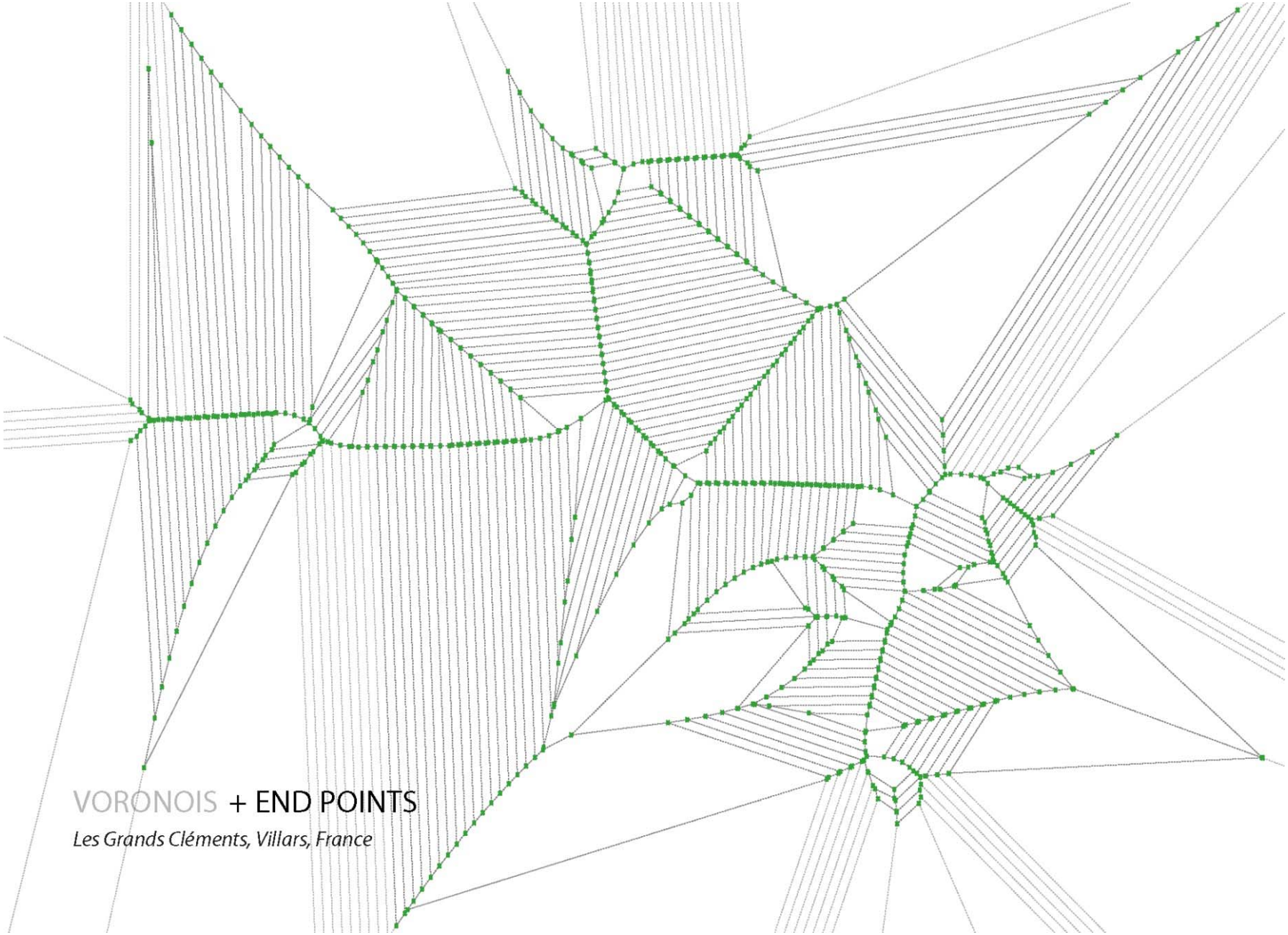


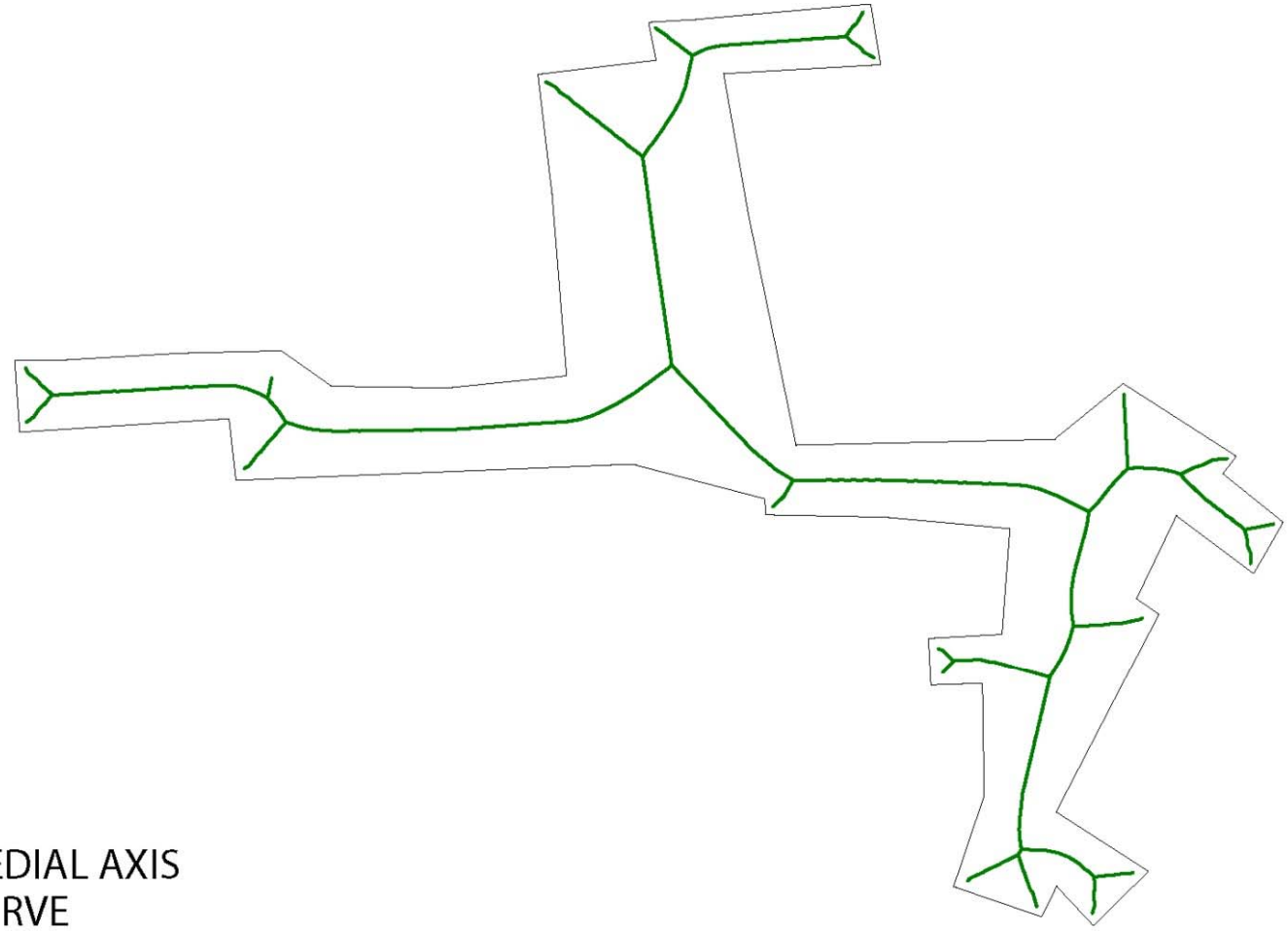
CURVE + POINTS (400)

Les Grands Cléments, Villars, France


VORONOIS
Les Grands Cléments, Villars, France


VORONOIS + CURVE
Les Grands Cléments, Villars, France


VORONOIS + END POINTS
Les Grands Cléments, Villars, France



MEDIAL AXIS
CURVE

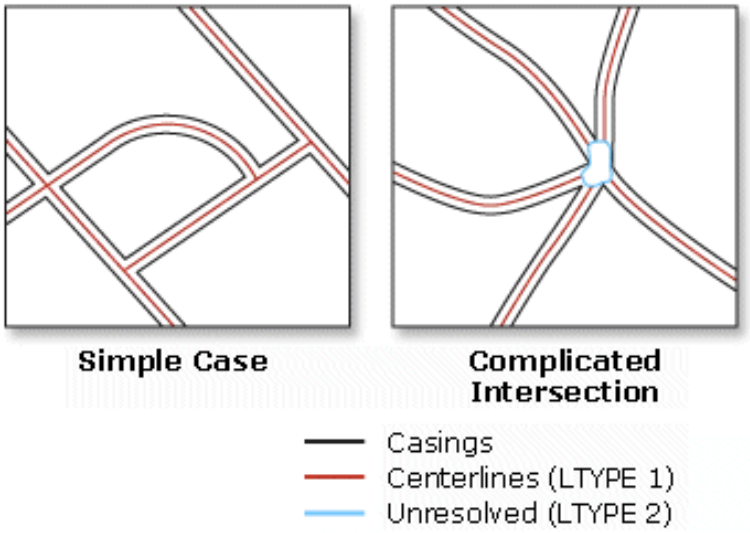
Les Grands Cléments, Villars, France

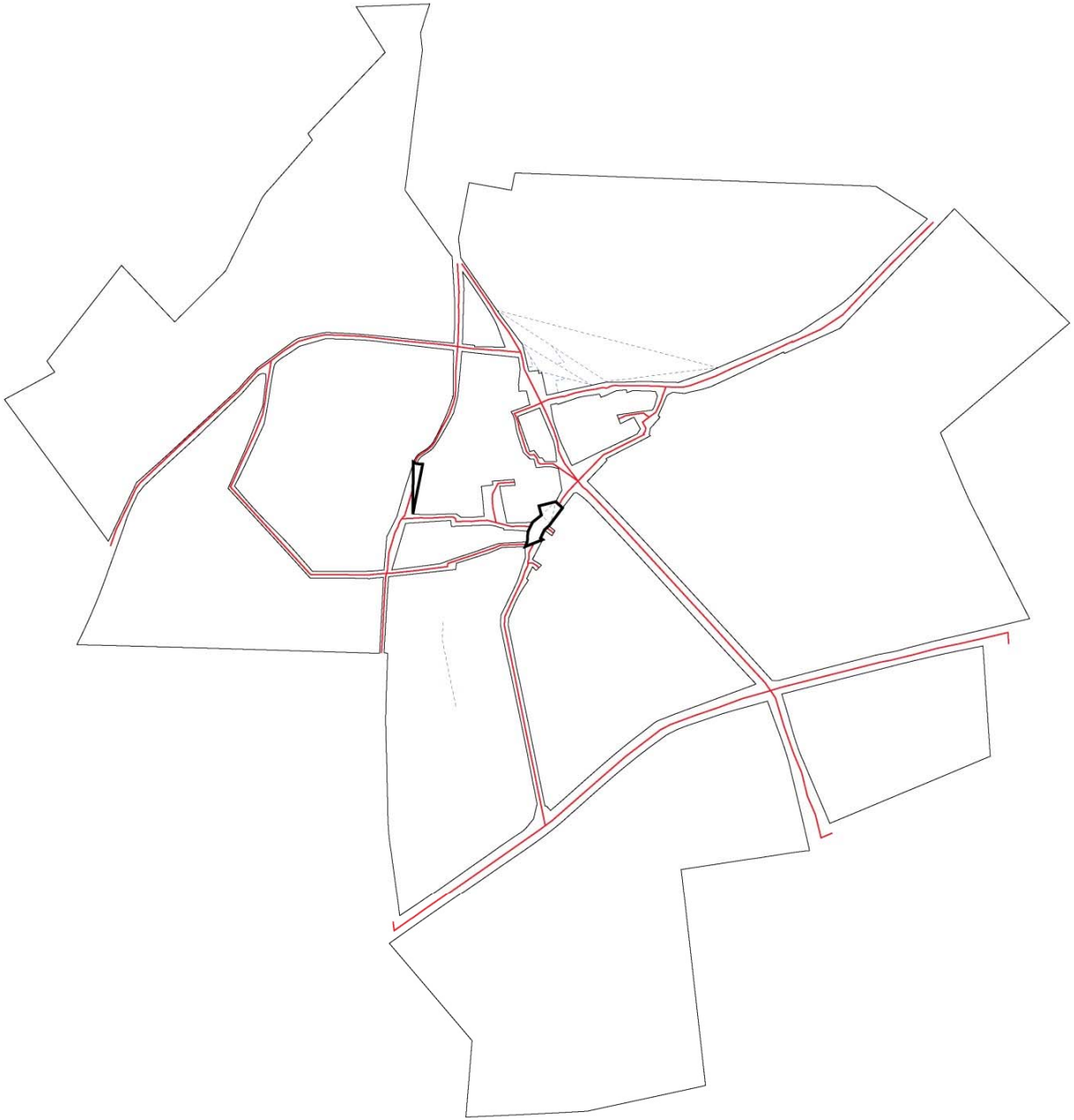
TOPOLOGICAL SKELETON
MEDIAL AXIS (Grasshopper)

Collapse Dual Lines To Centerline (Cartography)

ArcGIS_builtIn
http://resources.arcgis.com/en/help/main/10.1/index.html#//00700000000t000000

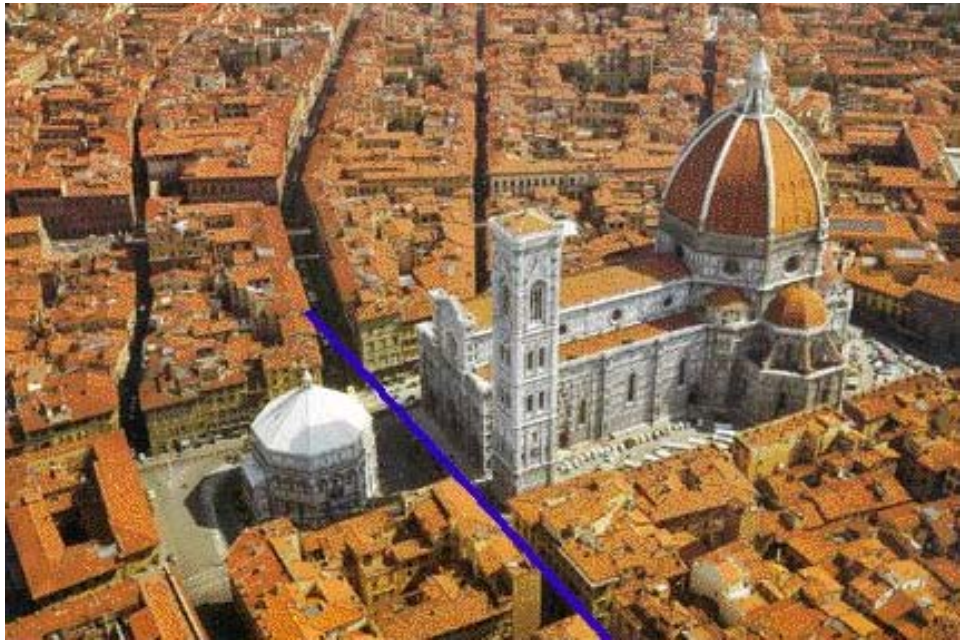
Derives centerlines from dual-line (or double-line) features, such as road casings, based on specified width tolerances.

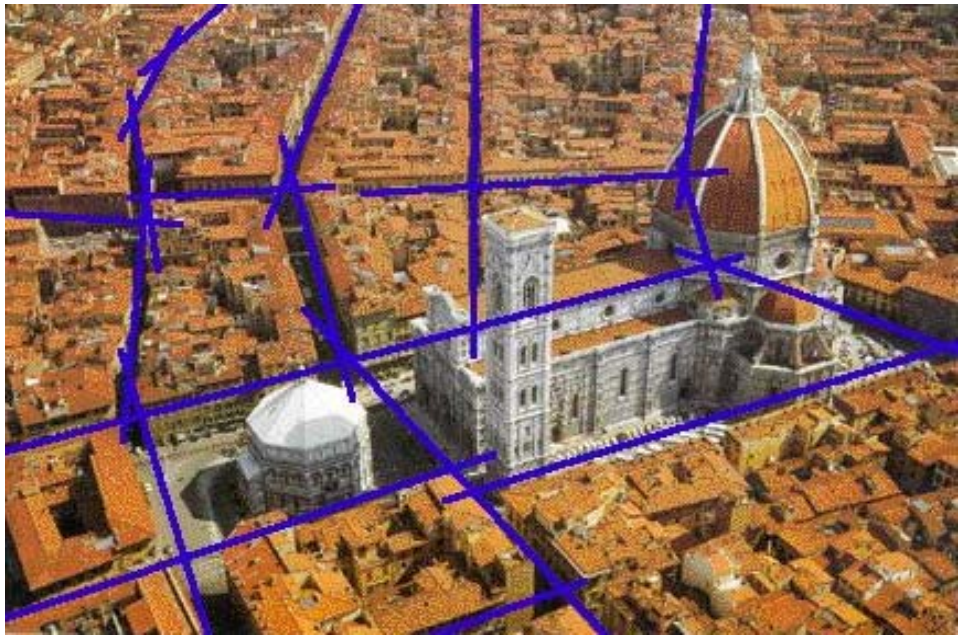




COLLAPSE DUAL LINES
INTO CENTERLINES (ArcGIS)

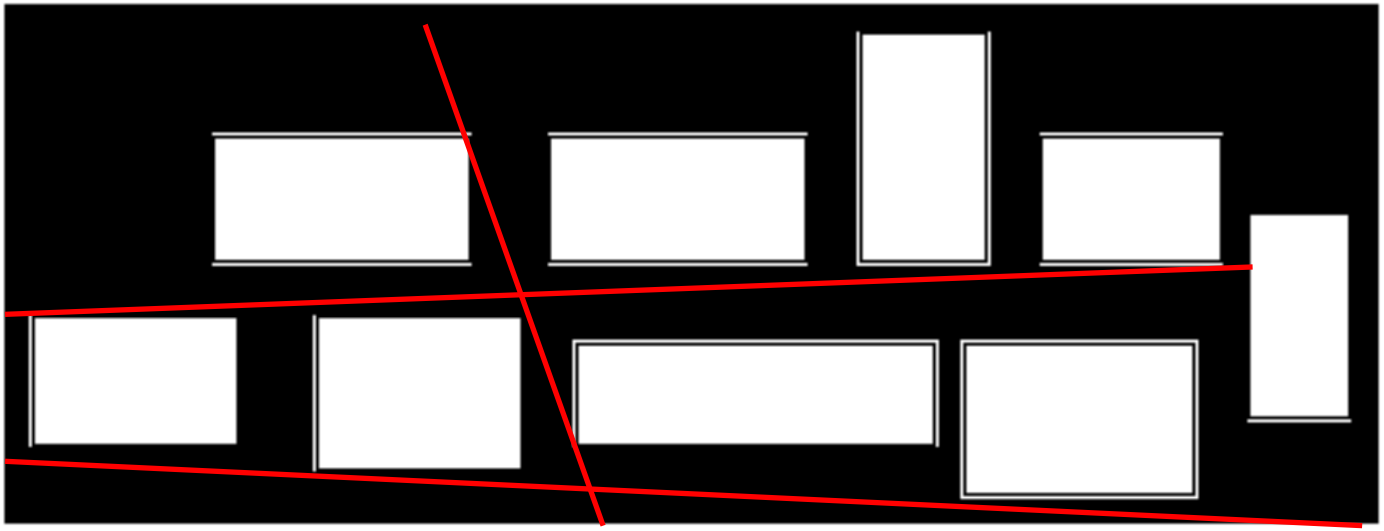
如何绘制轴线地图（Axial map）

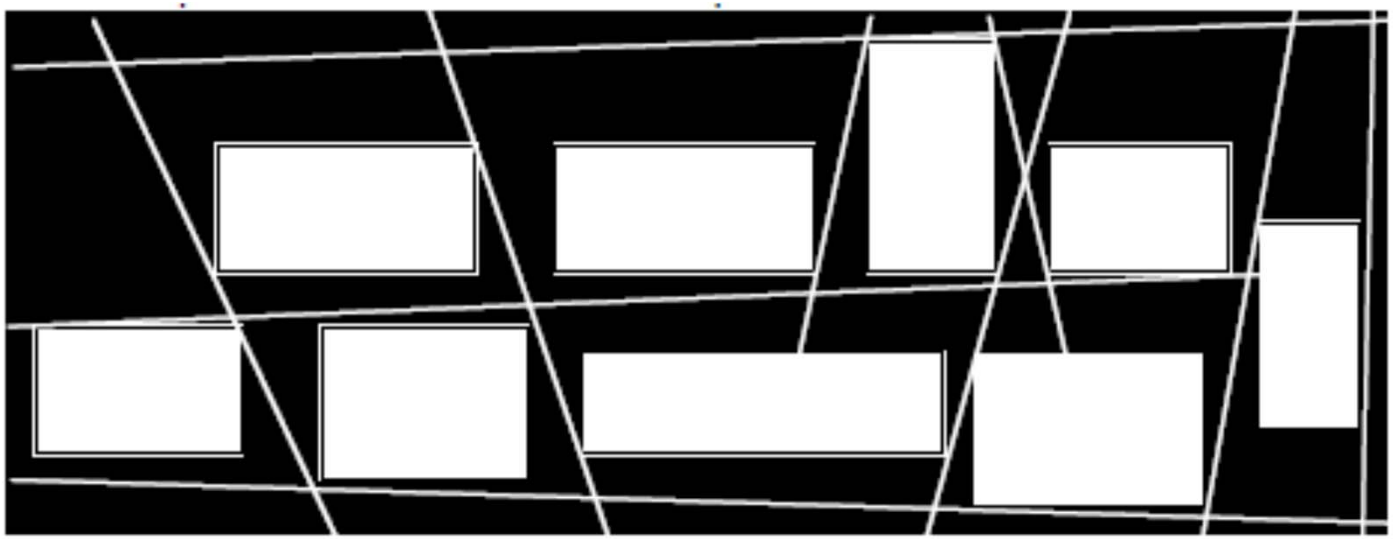


如何绘制轴线地图（Axial map）

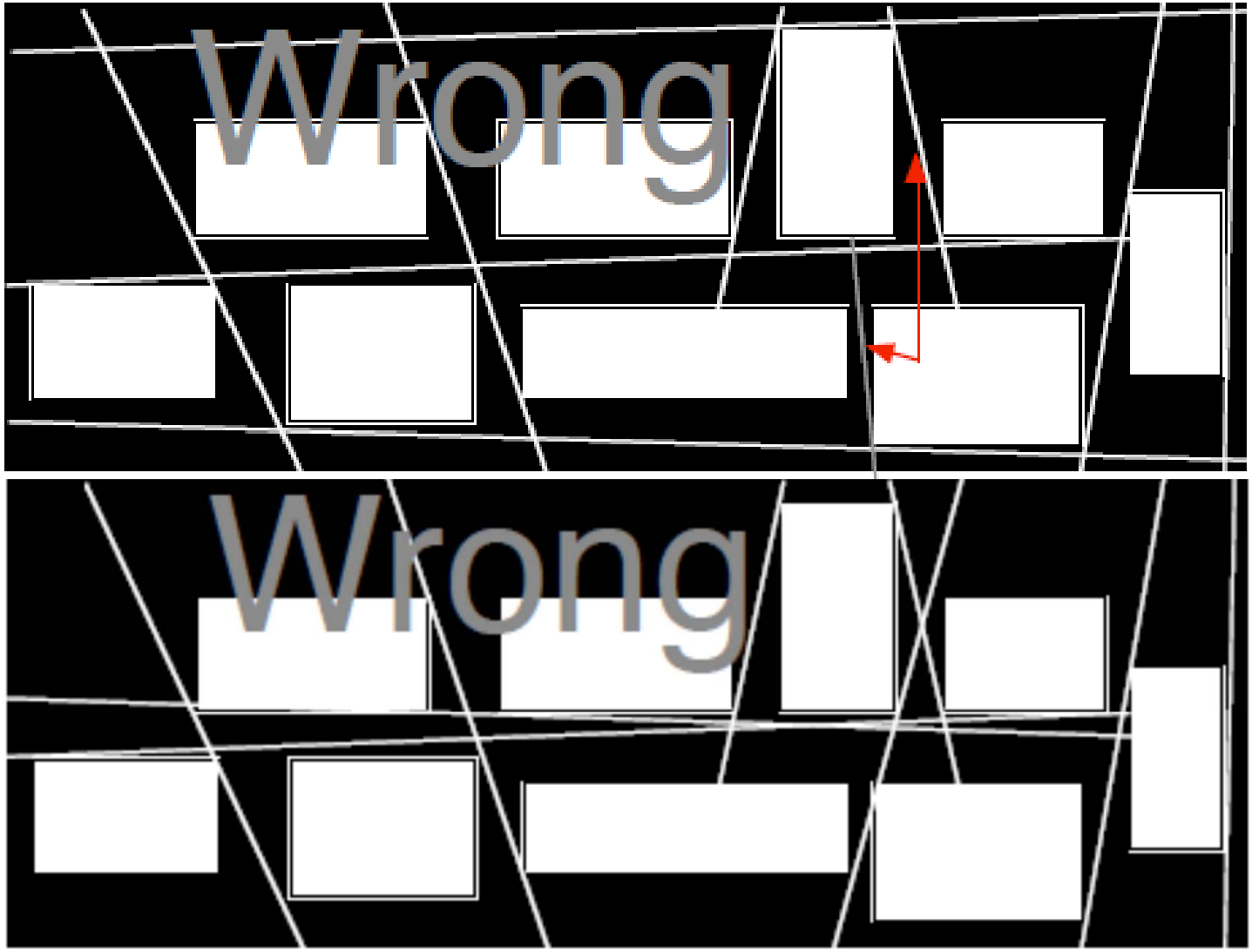
1，第一步先画所需分析空间中最长的线。
2，添加其他线时，确定每次均是在该空间中最长的线。如有对手中的地图有疑惑，可以采用现场核实的方式。





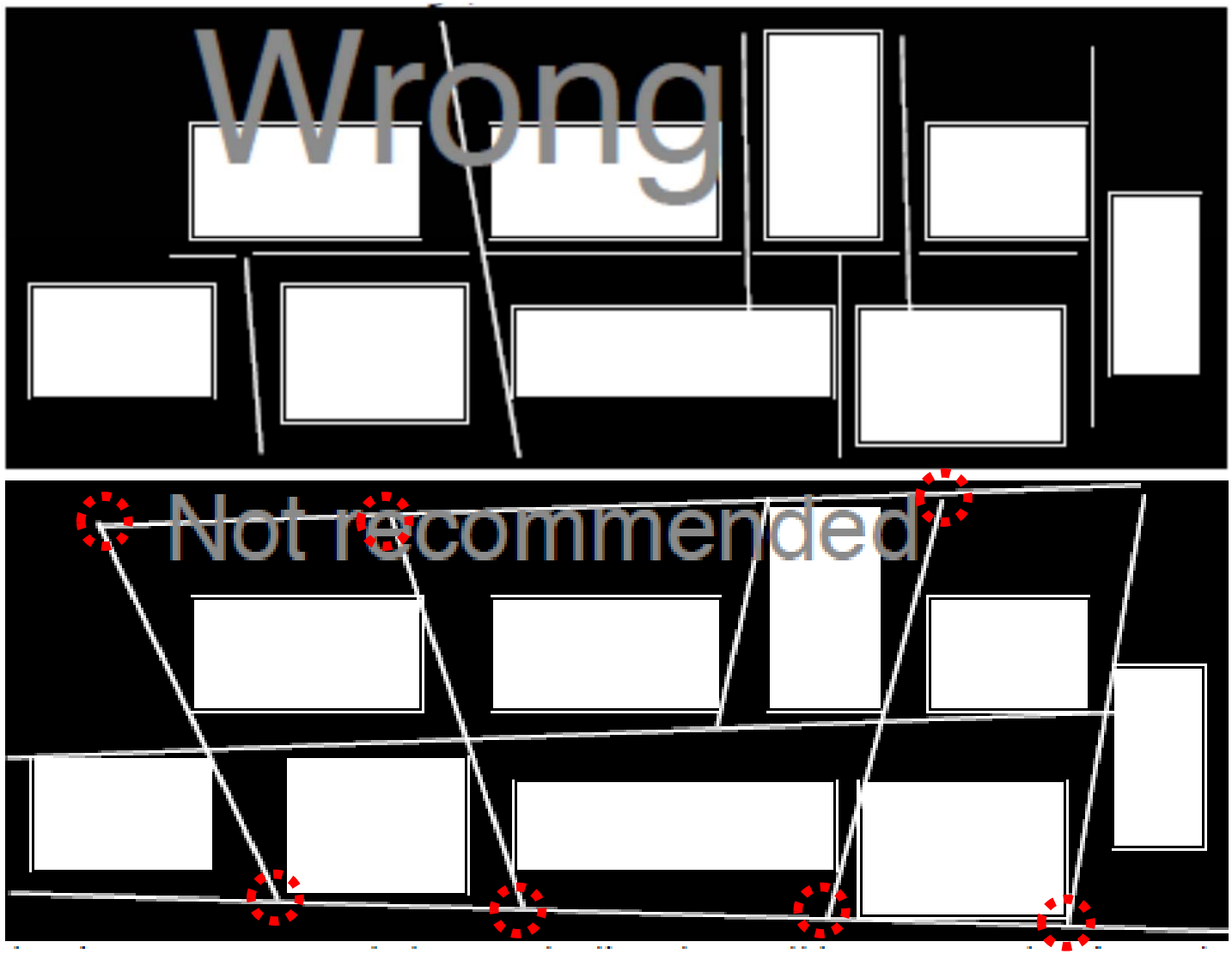
如何绘制轴线地图（Axial map）

违背最少线数量原则的例子……　力求平均深度最小化



如何绘制轴线地图（Axial map）

为确保线段之间的相交，建议在交点处画一点出头……

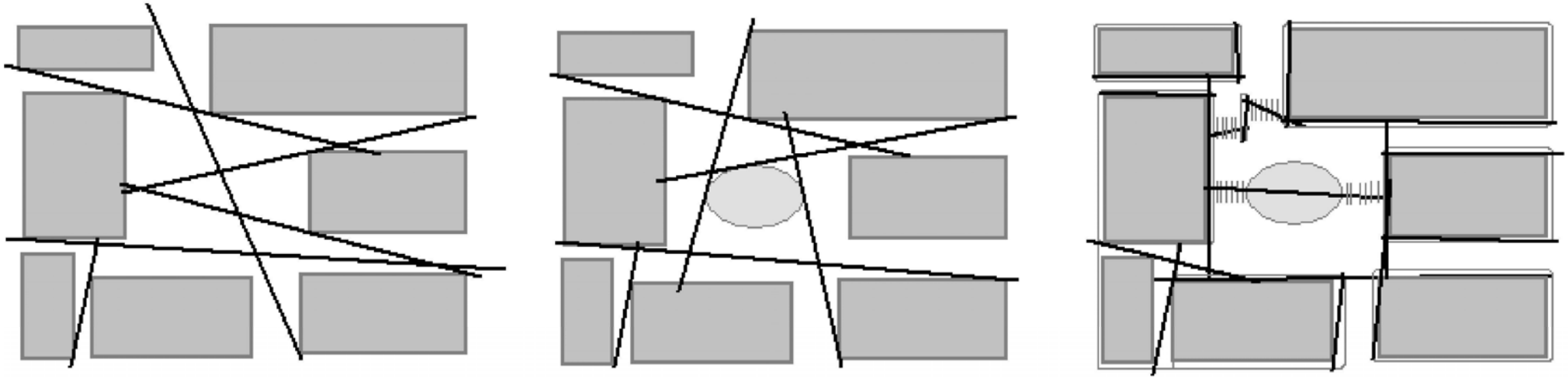


如何绘制轴线地图（Axial map）

如何画轴线地图取决于分析的目的!

轴线图并不总是基于视线来绘制，而是基于在地图上能够绘制的最长的直线。

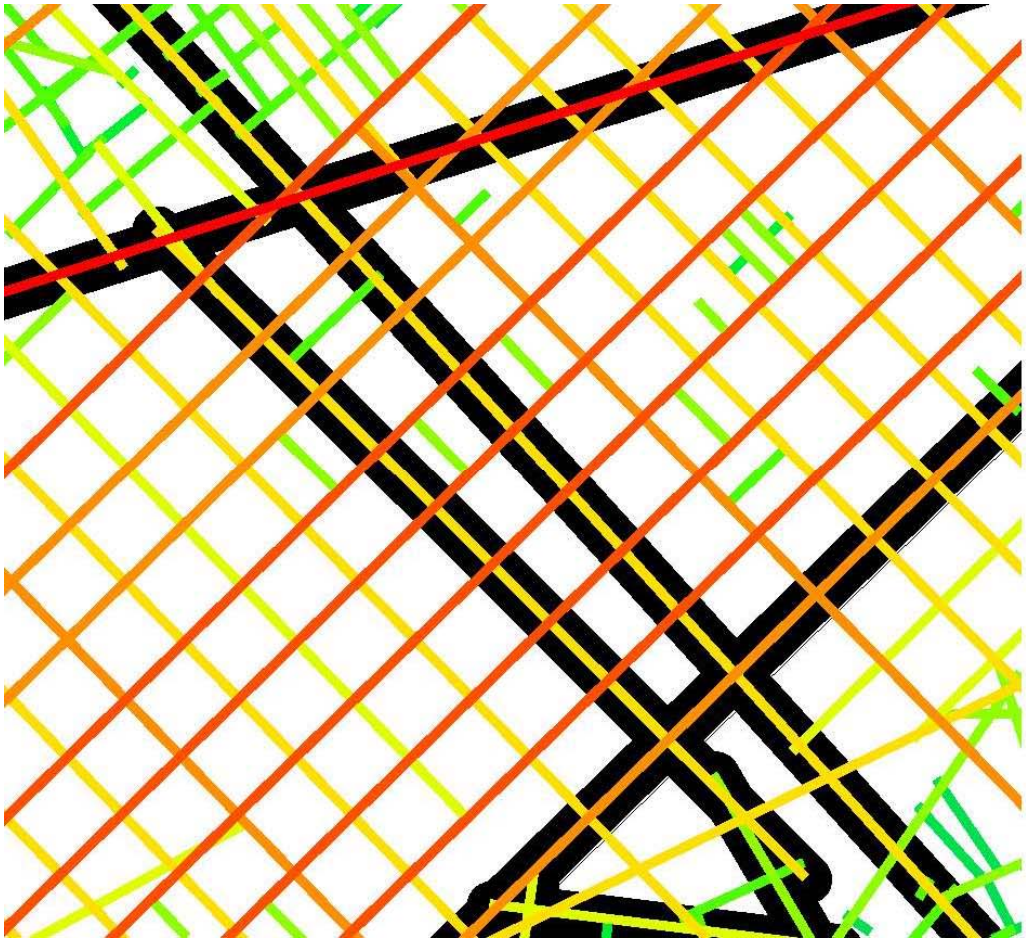
如果针对你分析的对象表面上连续的空间并不可达， 则不需要连接。

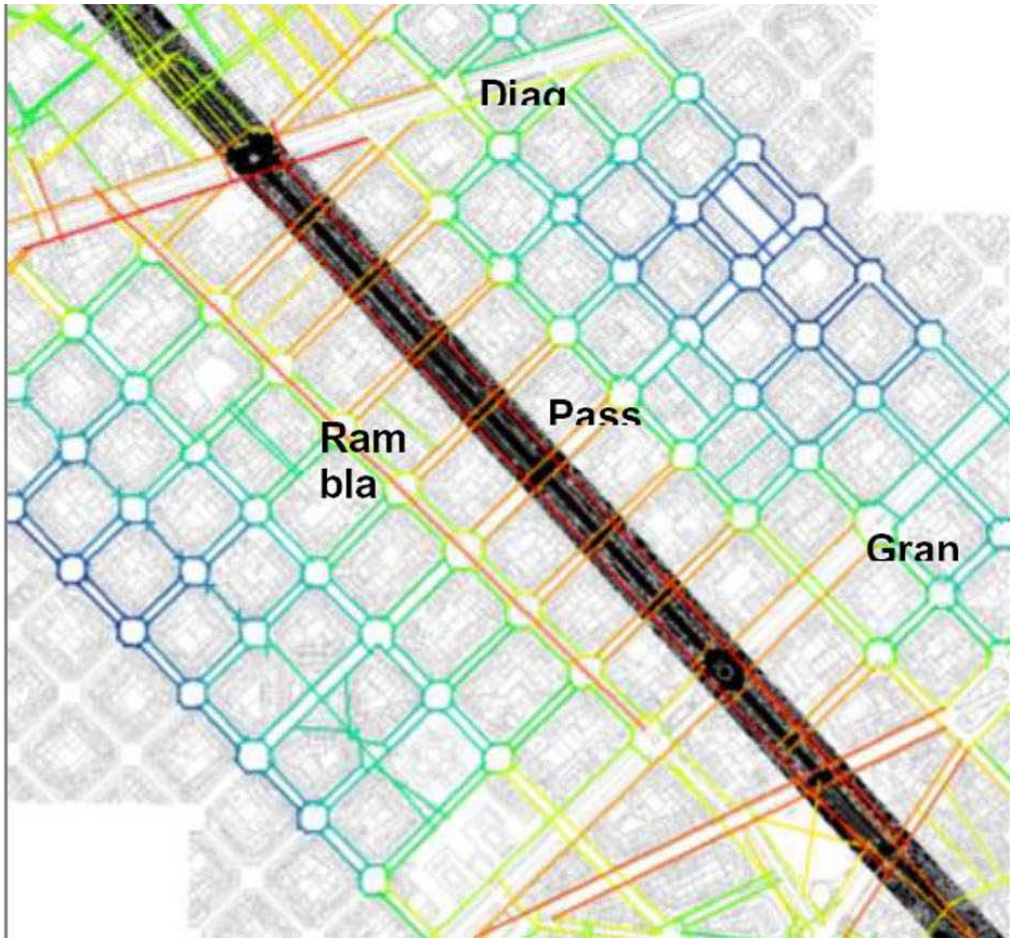


如何绘制轴线地图（Axial map）

如何画轴线地图取决于分析的目的!

通常我们也经常把分析车行空间和人行空间分别绘制成不同的轴线图。
巴塞罗纳市的两种轴线图分析

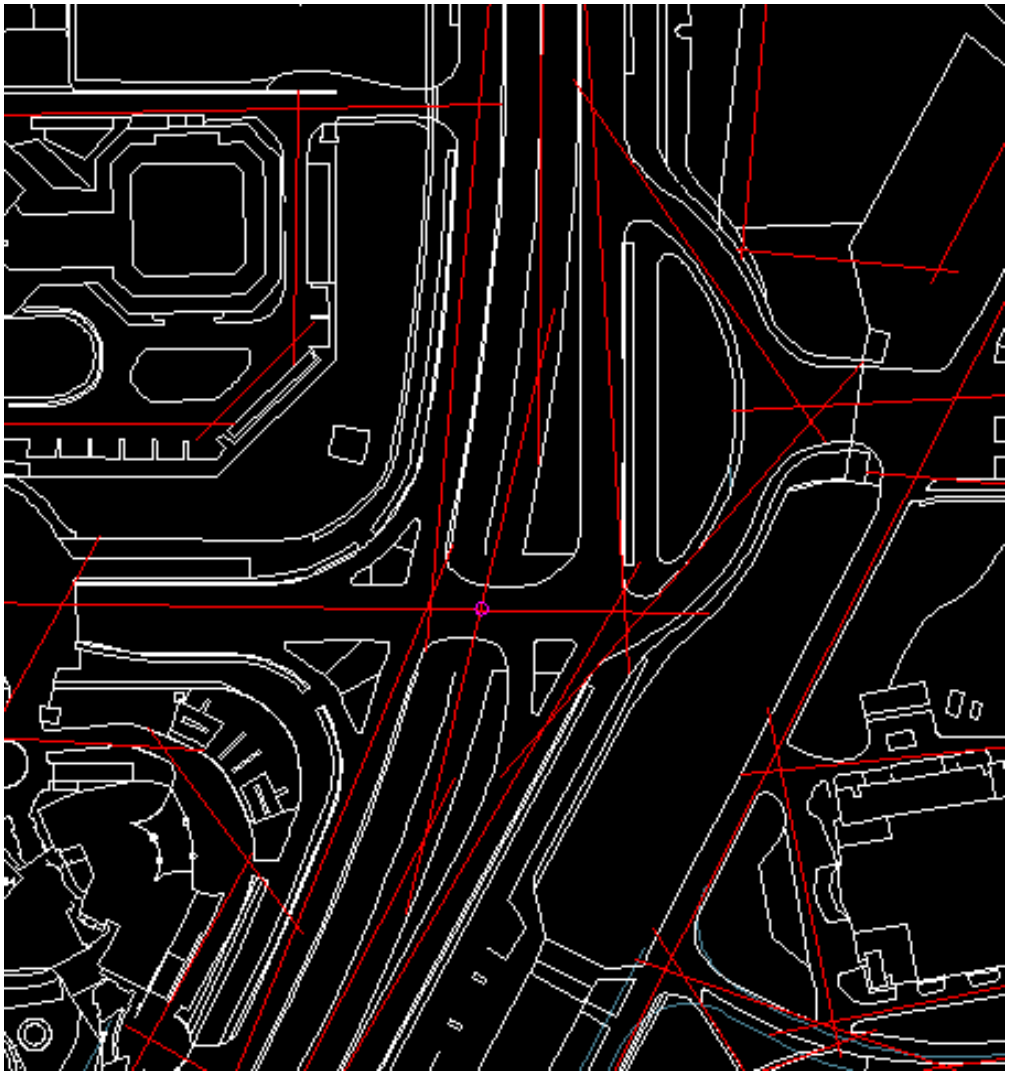




如何绘制轴线地图（Axial map）

当处理复杂的交通系统时：

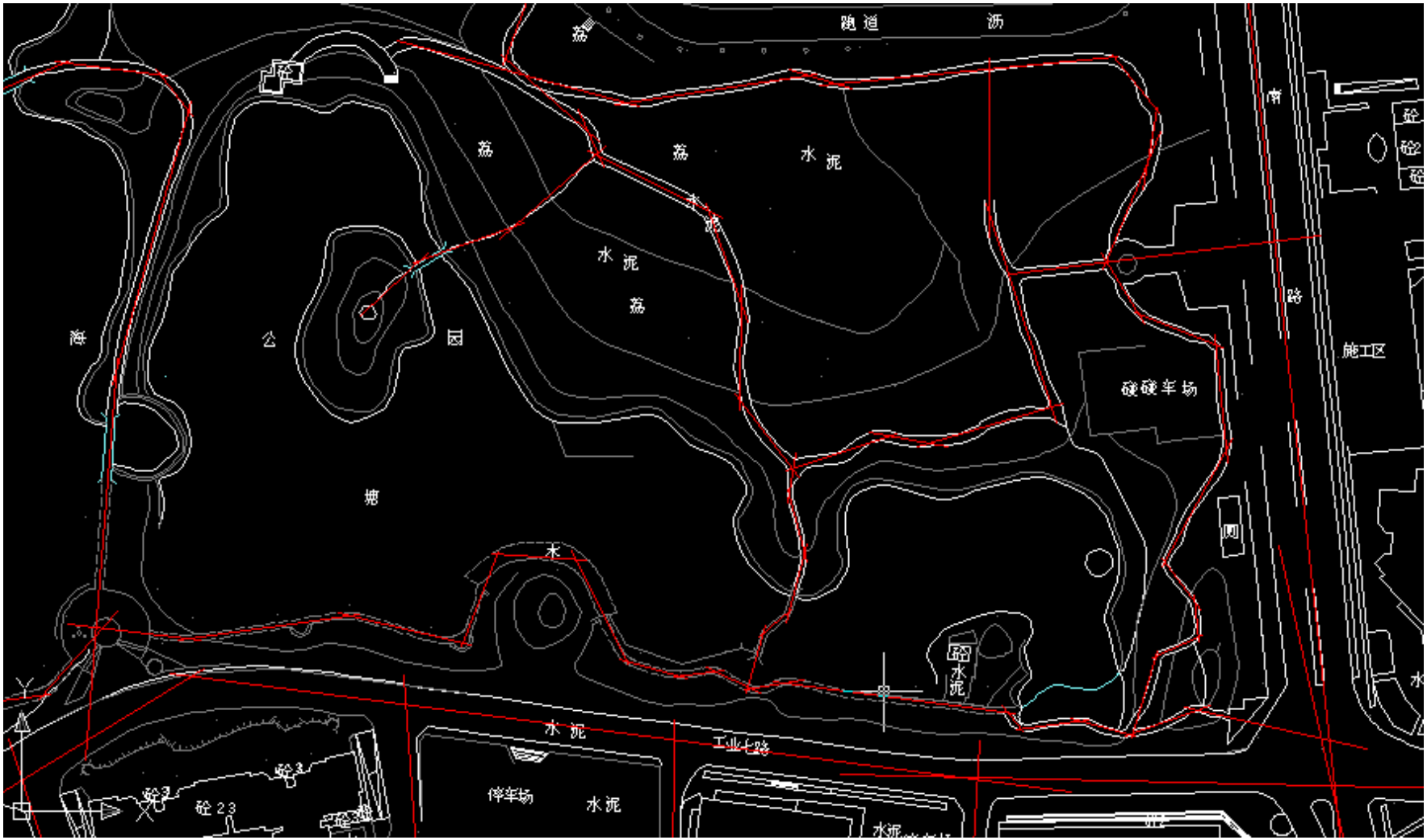
可以适当进行简化，但这种简化处理的方式在一张轴线地图中要统一。



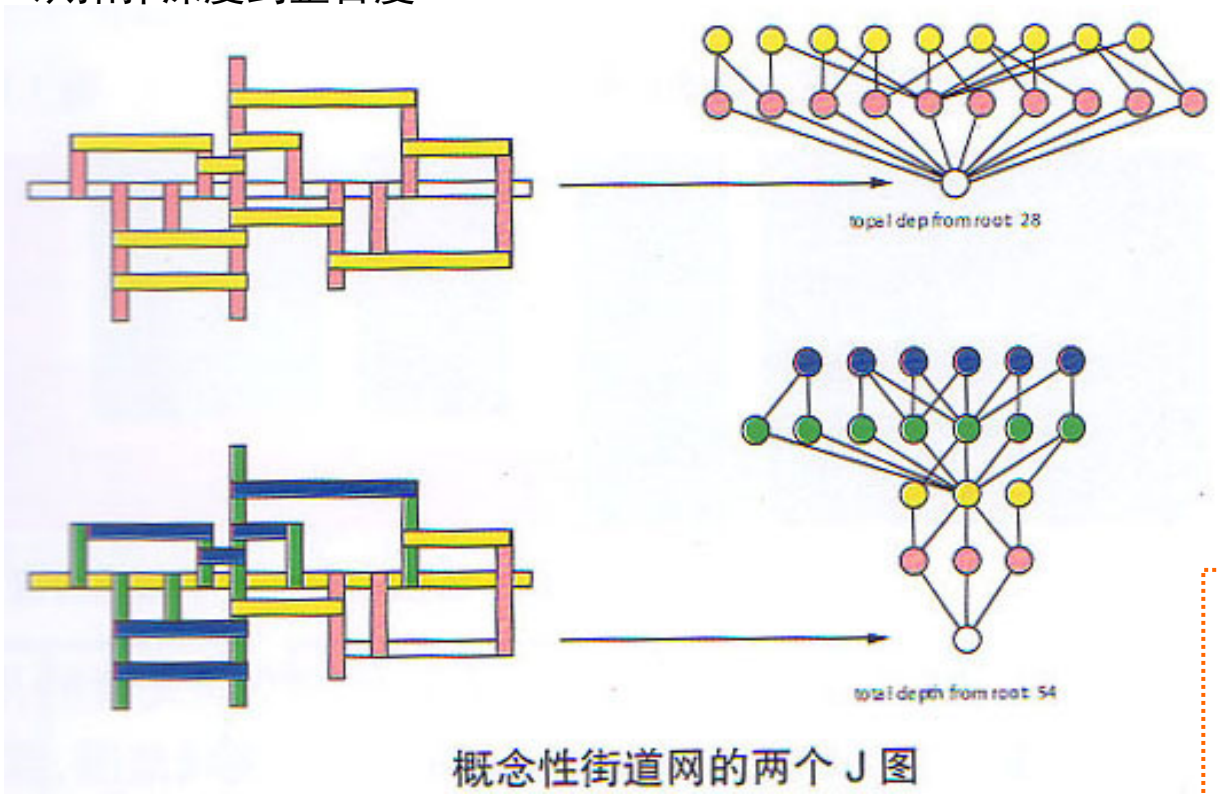
如何绘制轴线地图（Axial map）

当处理公园等开放系统时：

描绘铺装的道路或人群经常使用的小径，然后将入口与外部街道直接连接



从拓扑深度到整合度



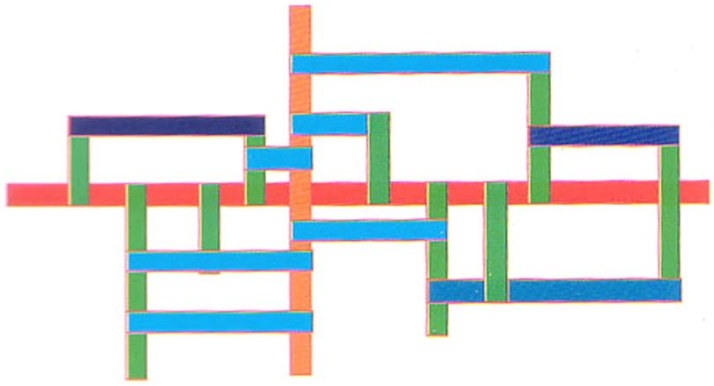
概念性街道网的两个J图

平均深度MD=(1X10+2X9)/(20-1)
=1.47
整合度Integration value=4.28

平均深度MD=(1X3+2X3+3X7+4X6)/(20-1)
=2.84
整合度Integration value=1.10

为了消除街道数量的影响，真实的把握形态

不对称值RA=2（MD－1）/（n－2）
相对不对称值RRA=RA/Dn
整合度=1/RRA

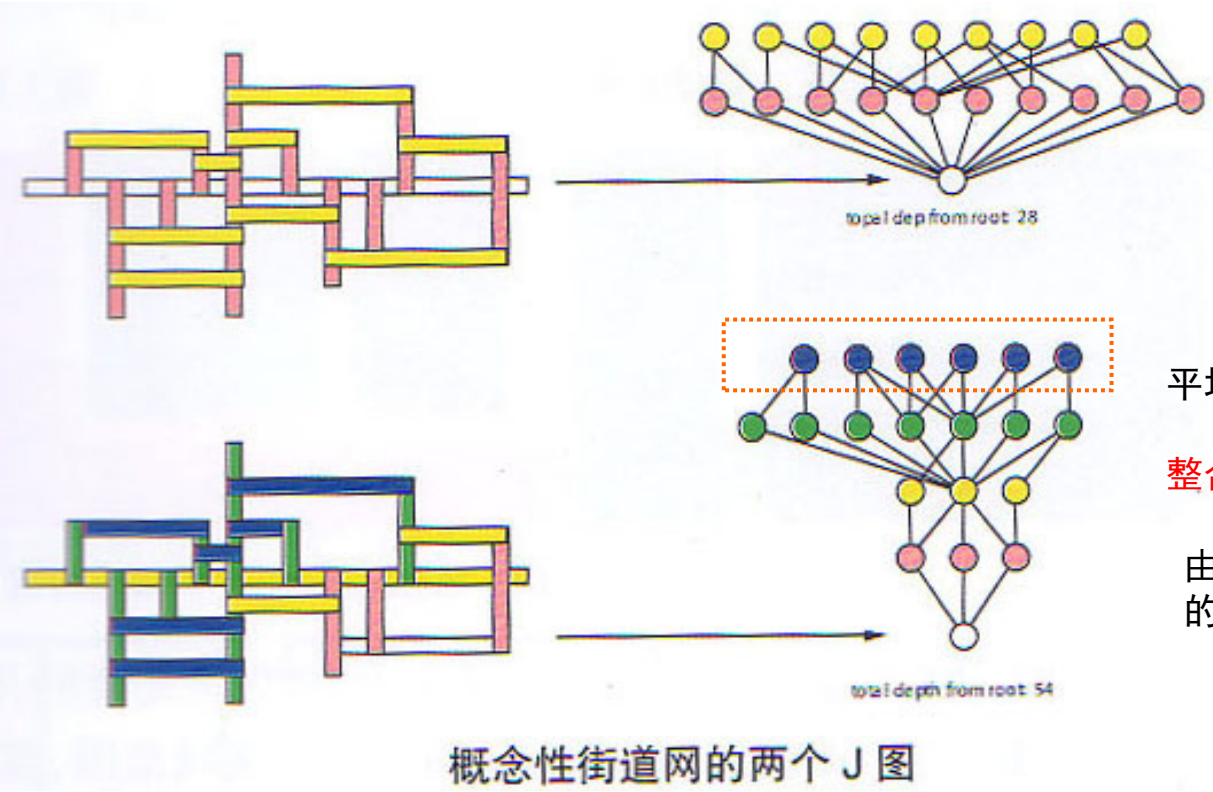


概念性街道网整合度上色图

上图中例举了分别从两条线为起点计算的整合度值，事实上，Depthmap会对**每条线**进行该计算，根据整合度数值的大小附以不同的颜色（红到蓝，见右侧图）。红色线整合度较高，平均深度较浅，在整个系统中的拓扑连接性较好。

全局整合度（半径为n)与局域整合度（以R=3为例)的区别

全局整合度与局域整合度的差别为：前者计算每条线到其他所有线的拓扑深度，而后者仅仅计算与每条线距离3个拓扑距离的线的平均深度。传统的空间句法研究认为，全局整合度可以反应出全城的商业中心；局域整合度可以避免边界作用的影响，可以反应出商业次中心。



概念性街道网的两个J图

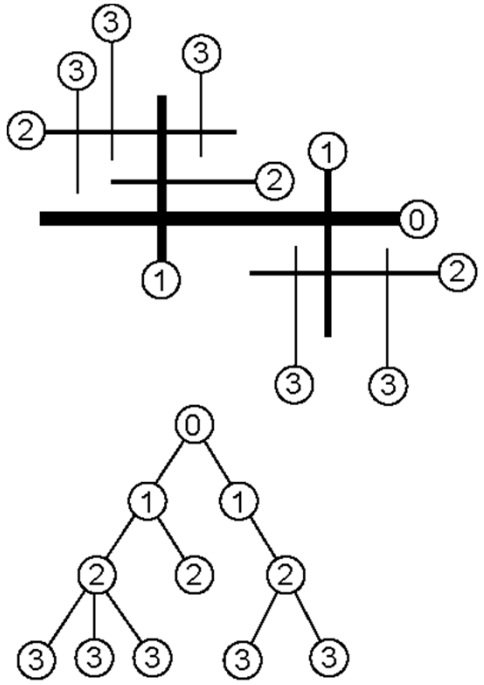
平均深度MD=(1X10+2X9)/(20-1)
=1.47
整合度Integration value=4.28

由于这条街与其他街连接均在3步以内，故其深度与全局整合度的计算方式无差别。

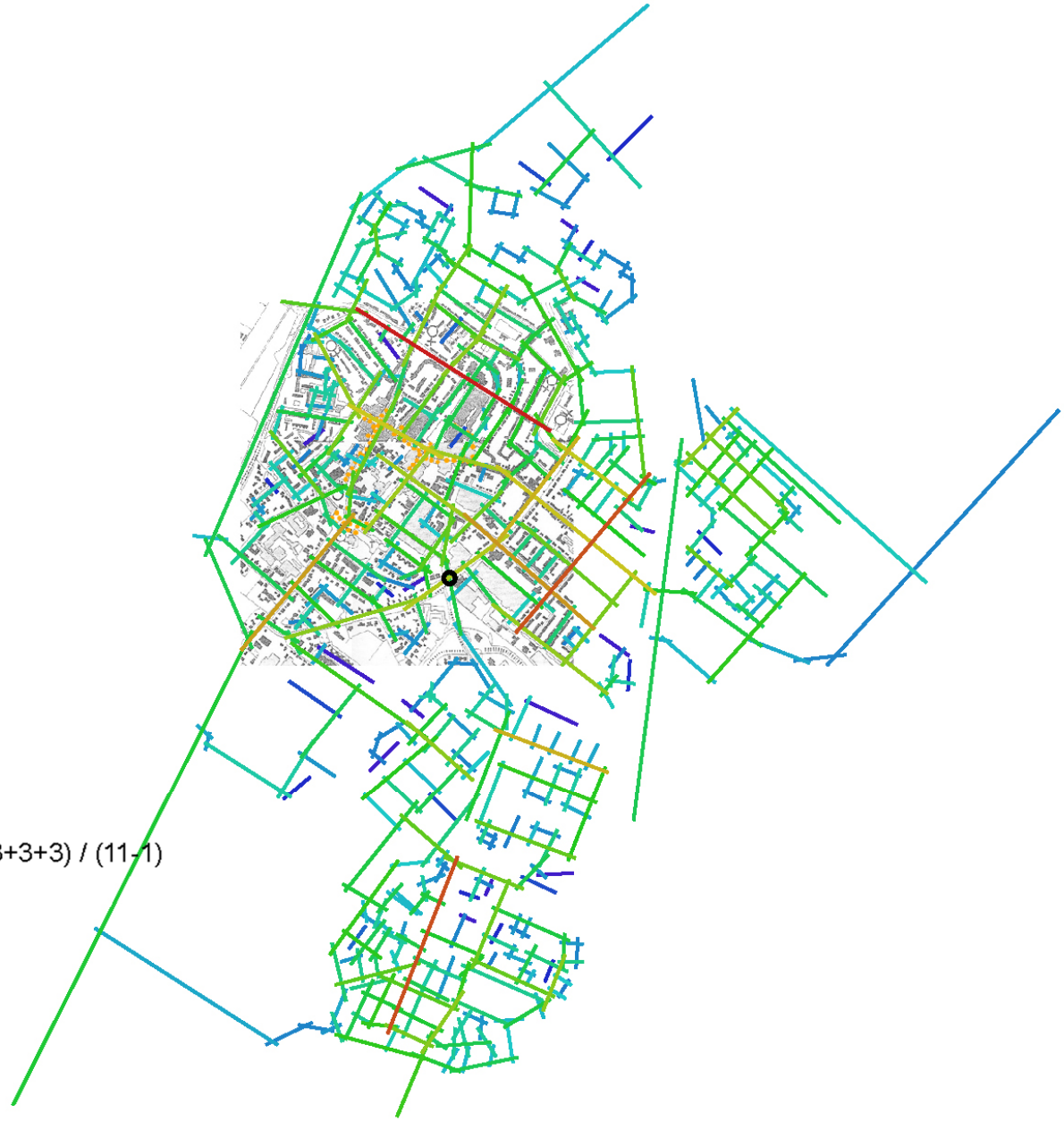
平均深度MD=(1X3+2X3+3X7)/(14-1)
=2.31
整合度Integration R3=1.22

由于这条街比较偏僻，如图所示，在3步以外的点被舍弃不算。

全局整合度与局域整合度

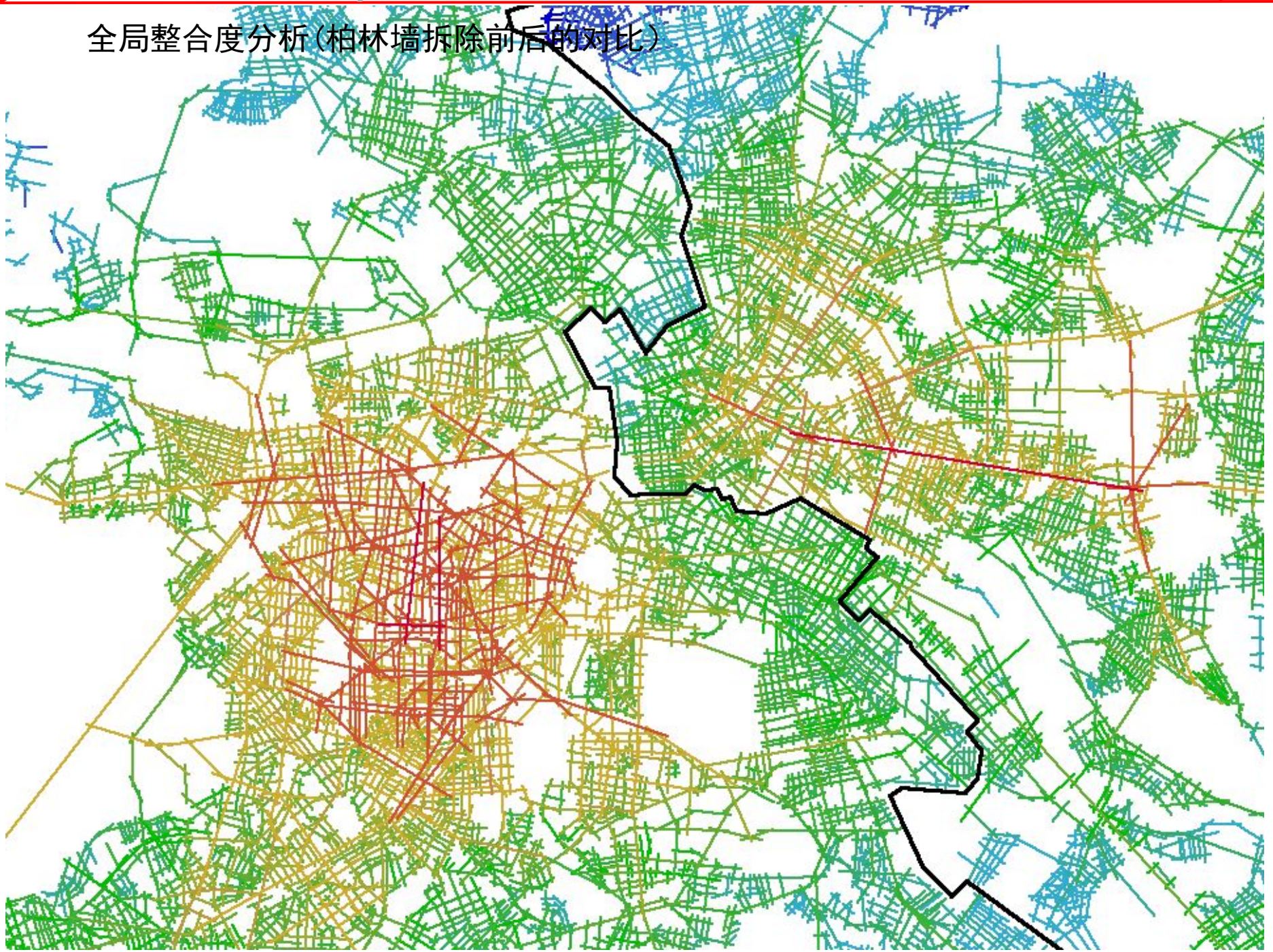


Average deepth = (0+1+1+2+2+2+3+3+3+3+3) / (11-1)
= 2.3

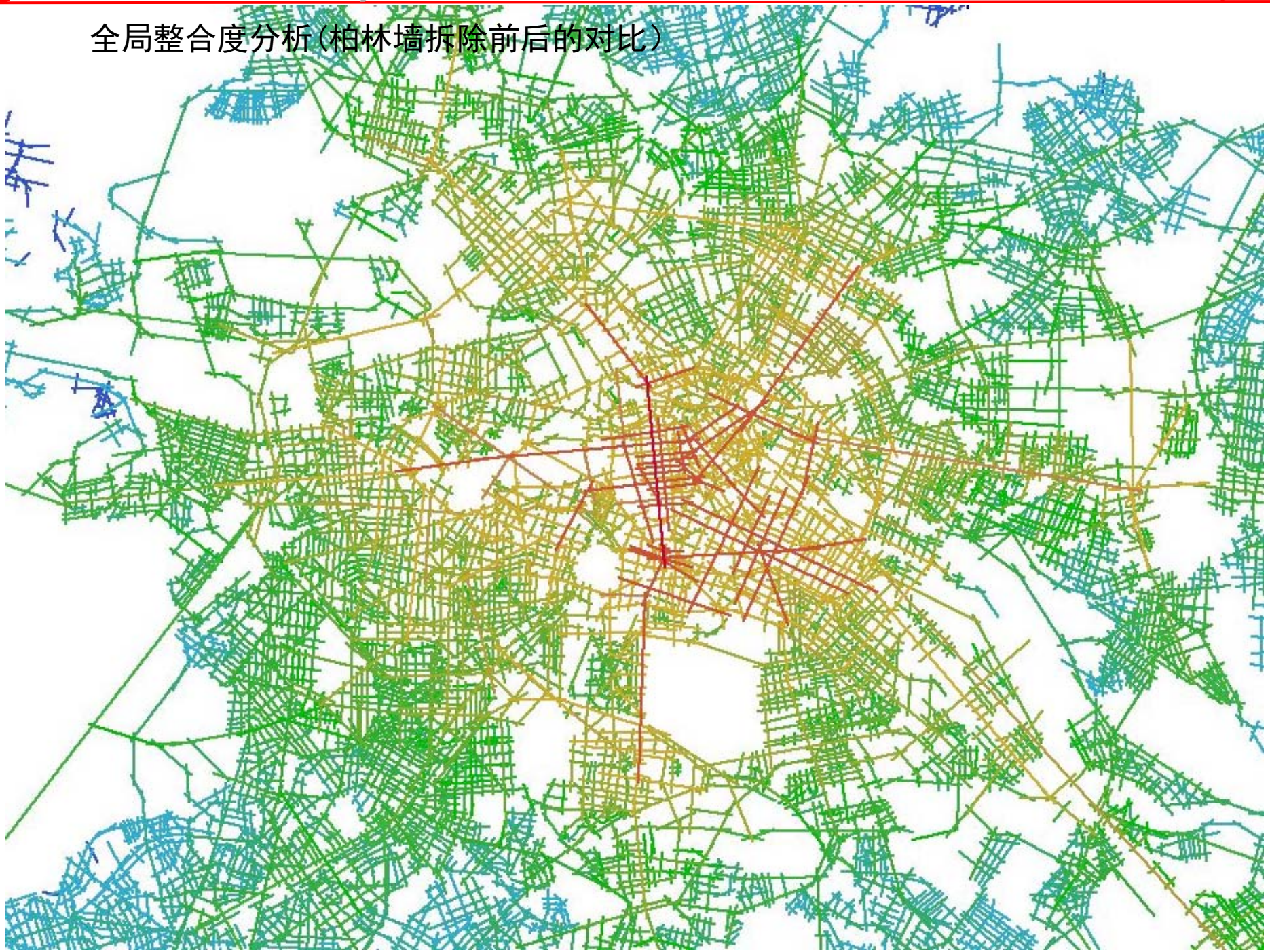


全局整合度分析(柏林墙拆除前后的对比)

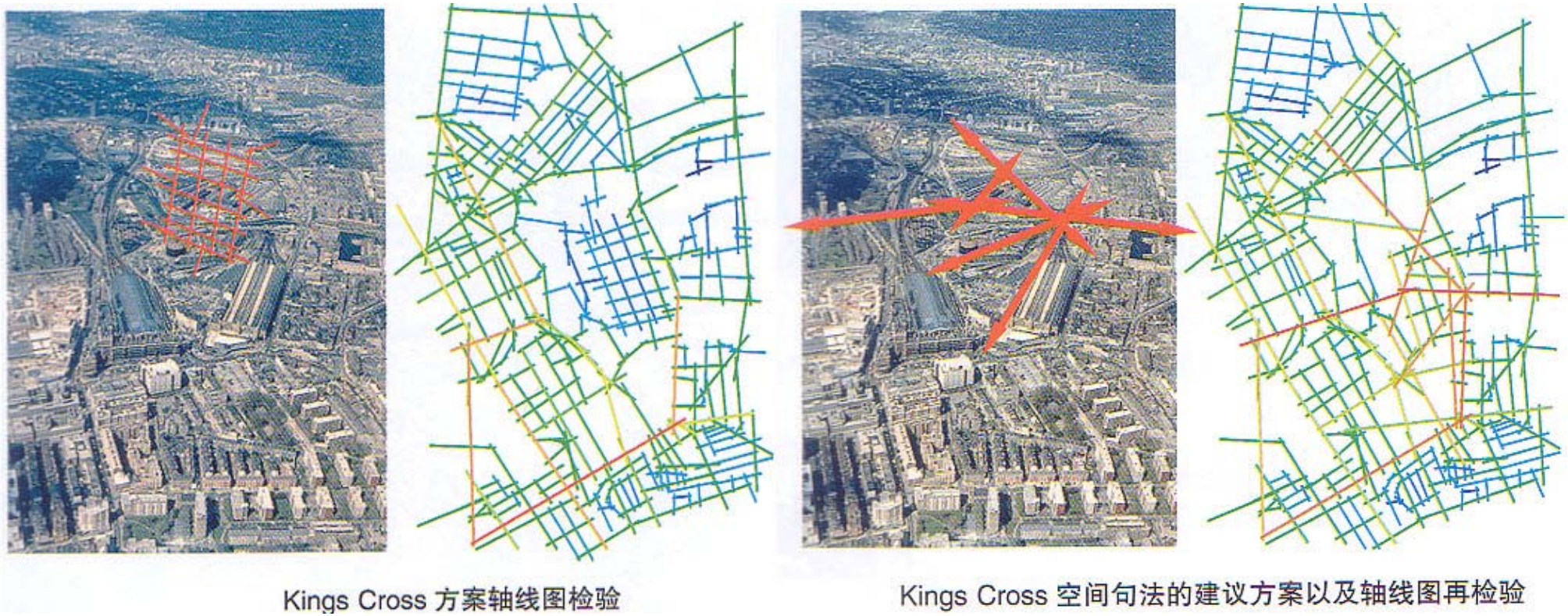
全局整合度分析（柏林墙拆除前后的对比）



全局整合度分析（柏林墙拆除前后的对比）



伦敦King Cross地区城市改造项目



Kings Cross 方案轴线图检验

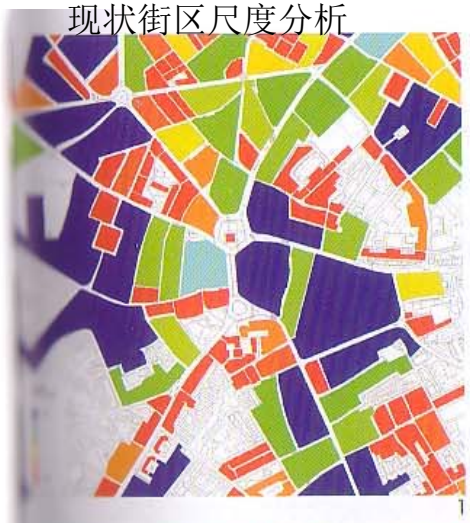
Kings Cross 空间句法的建议方案以及轴线图再检验

在对城市核心区的规划和设计中，建筑和规划师普遍存在着对网格体系的迷恋（或思维惰性）。客观上，网格形态也的确容易获得较高的拓扑整合度，但仍需要考虑具体城市周边道路环境的影响。

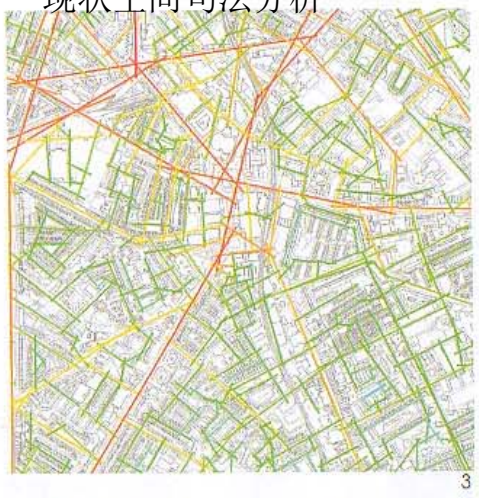
如果形式主义倾向不可避免，我们就把它纳为理性的一部分。

伦敦Elephant和Castle地区城市改造项目（2002，福斯特+空间句法公司）

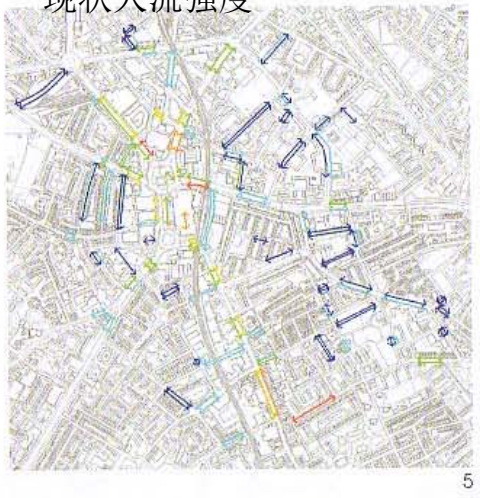
现状街区尺度分析



现状空间句法分析

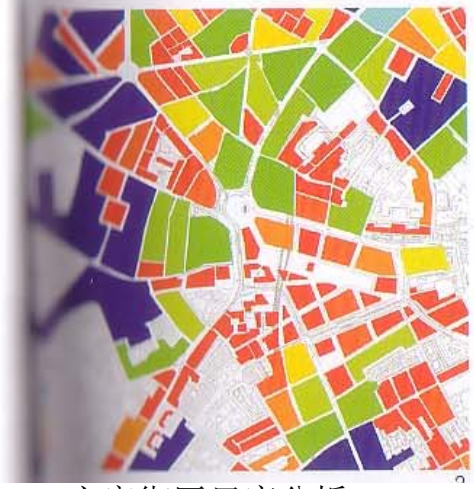


现状人流强度



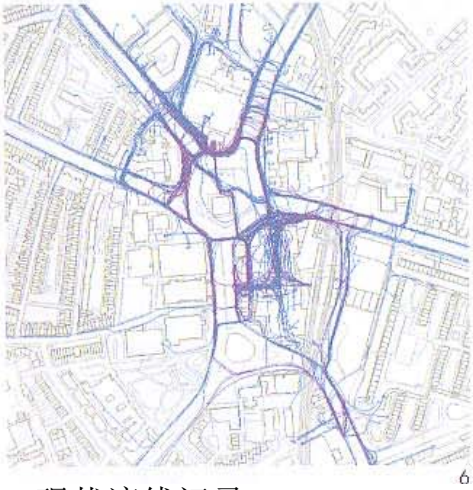
现状用地类型

方案街区尺度分析

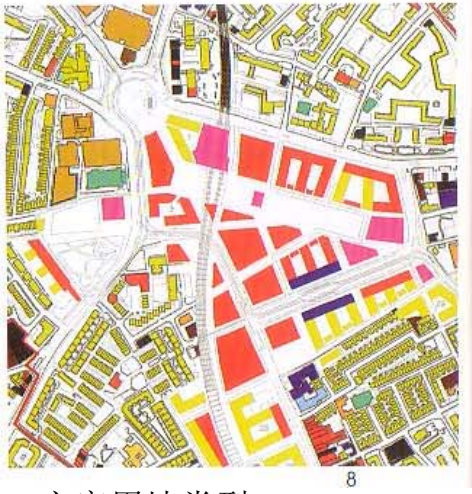


改造后句法分析

现状流线记录



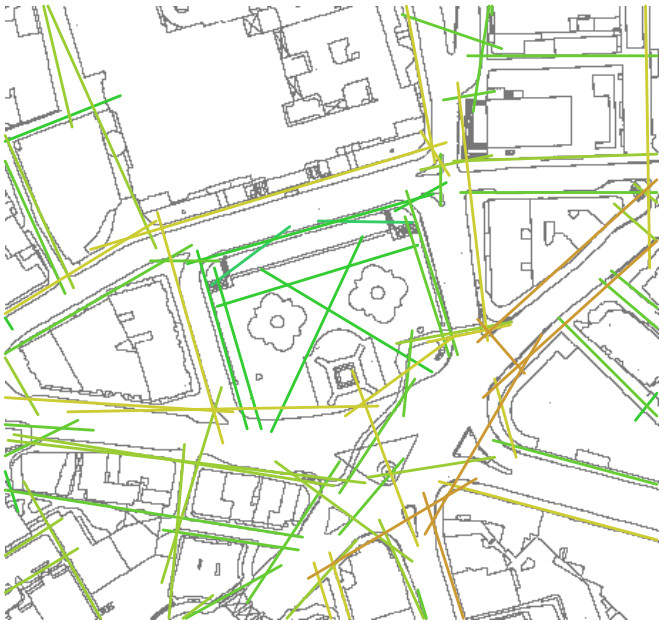
方案用地类型

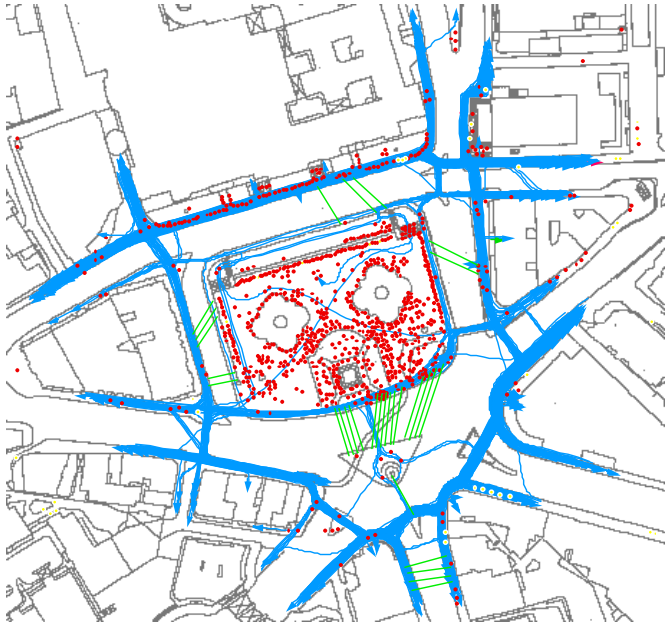


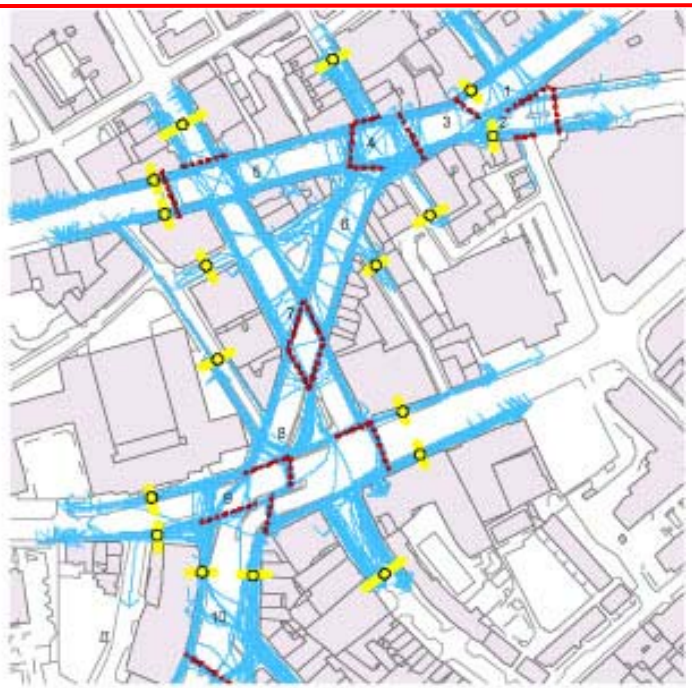
空间句法在城市设计上的应用最直接的就是通过调整路网结构（提高整合度的方式，小尺度网格，路网对接……），在更新和改造项目中对城市活力（商业和社会聚集活动）的存续和促进提供良好的空间基础。

伦敦特拉法加广场： Trafalgar Square, London

设计改变使用者行为



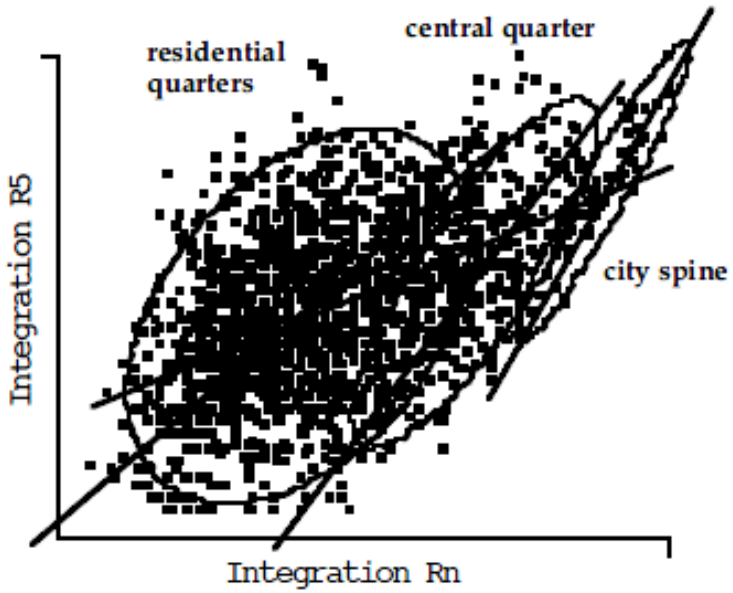


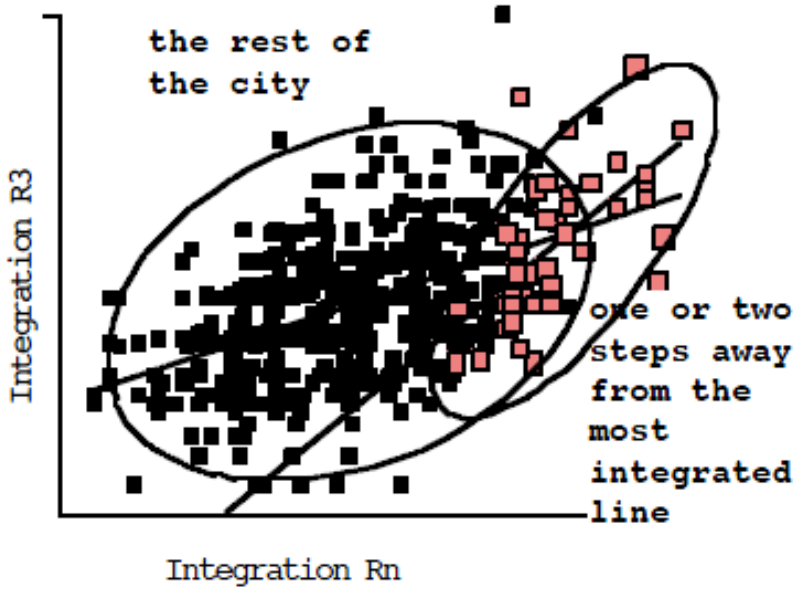



MOVEMENT POTENTIAL
high
low


MOVEMENT POTENTIAL
high
low

全局整合度与局域整合度





Jeddah Historic core 吉达 老城区

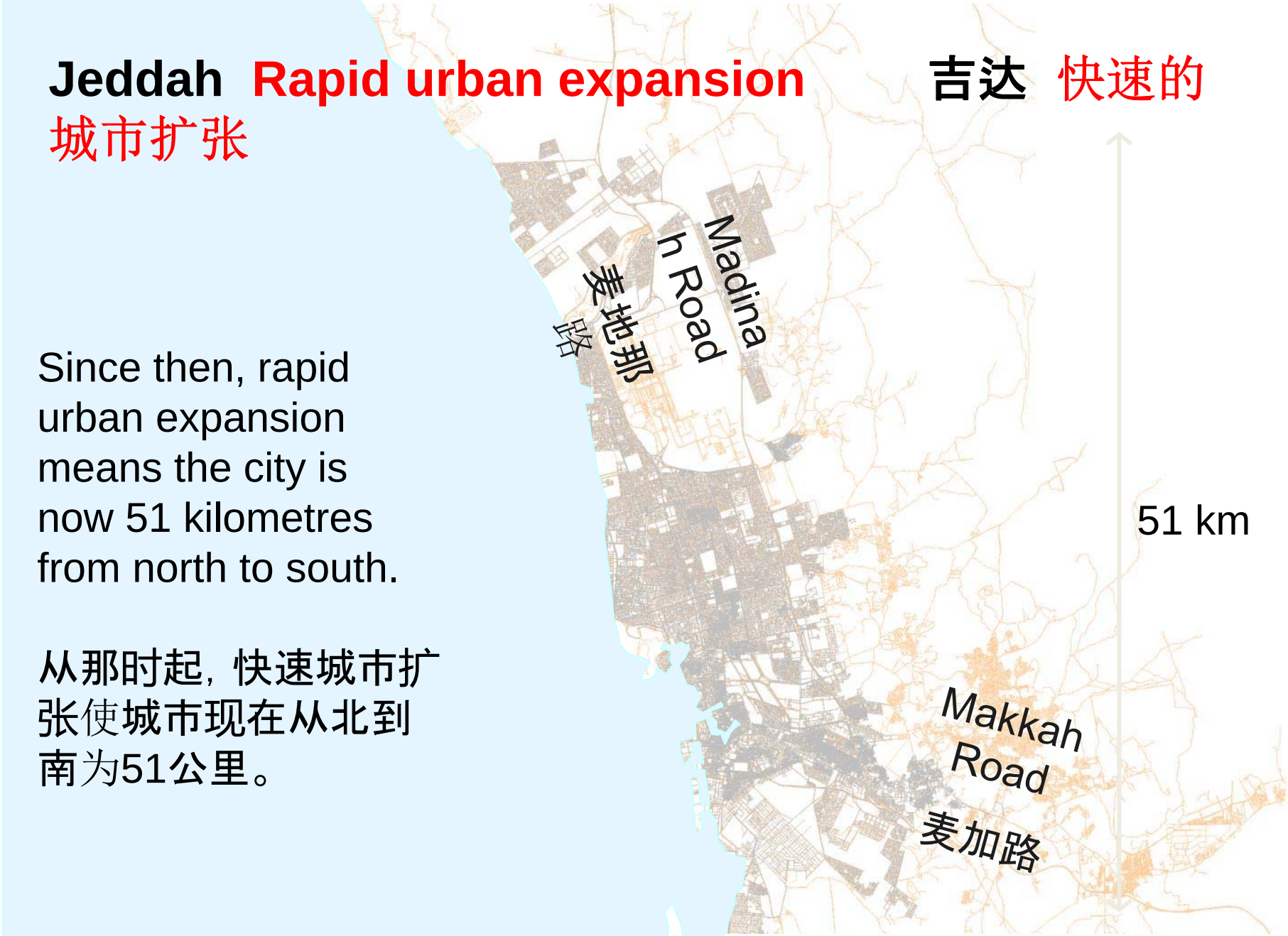
60 years ago the centre was one kilometre across

60年前的中心区直径为一公里

Jeddah Rapid urban expansion
吉达 快速的城市扩张

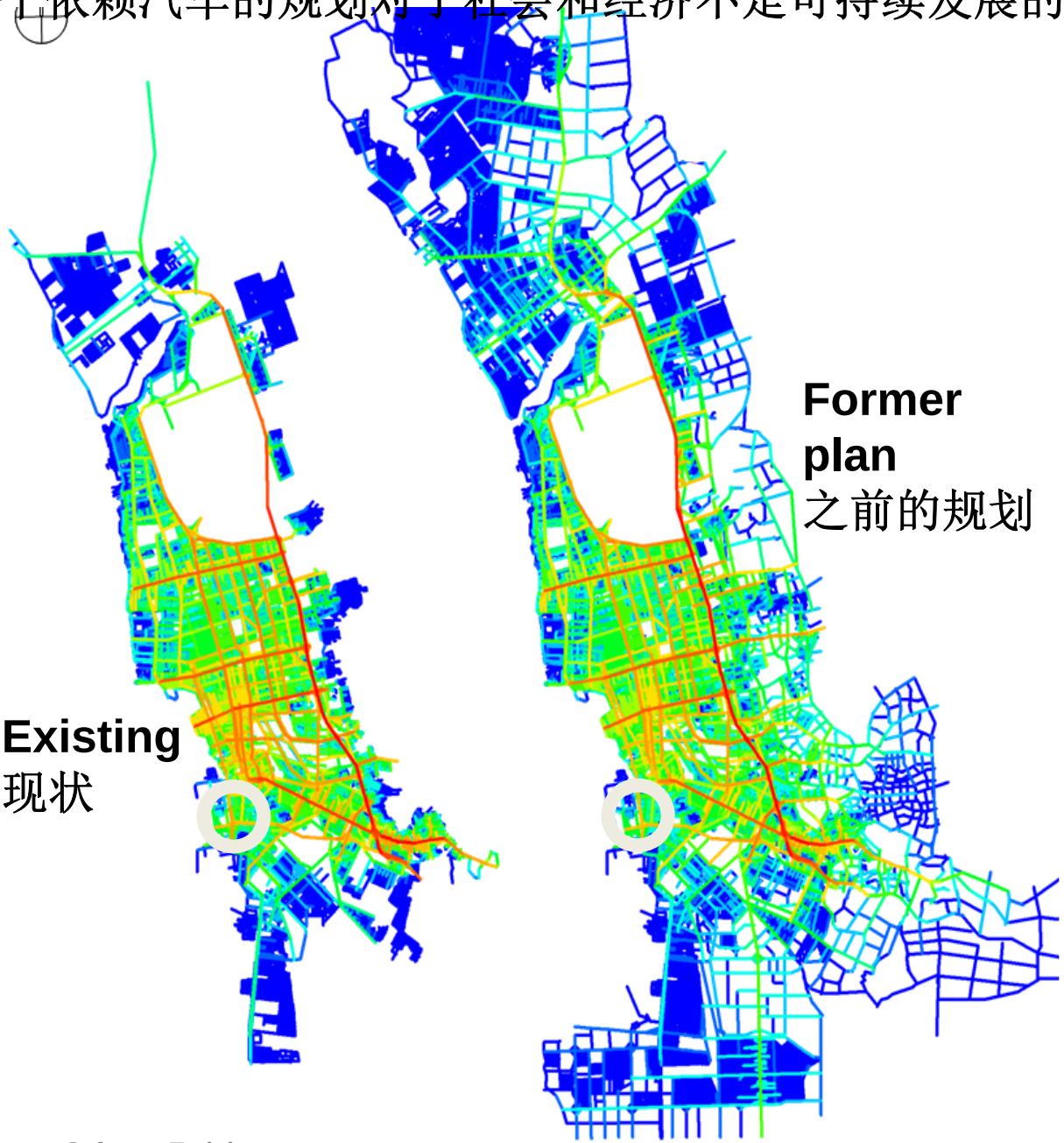
Since then, rapid urban expansion means the city is now 51 kilometres from north to south.

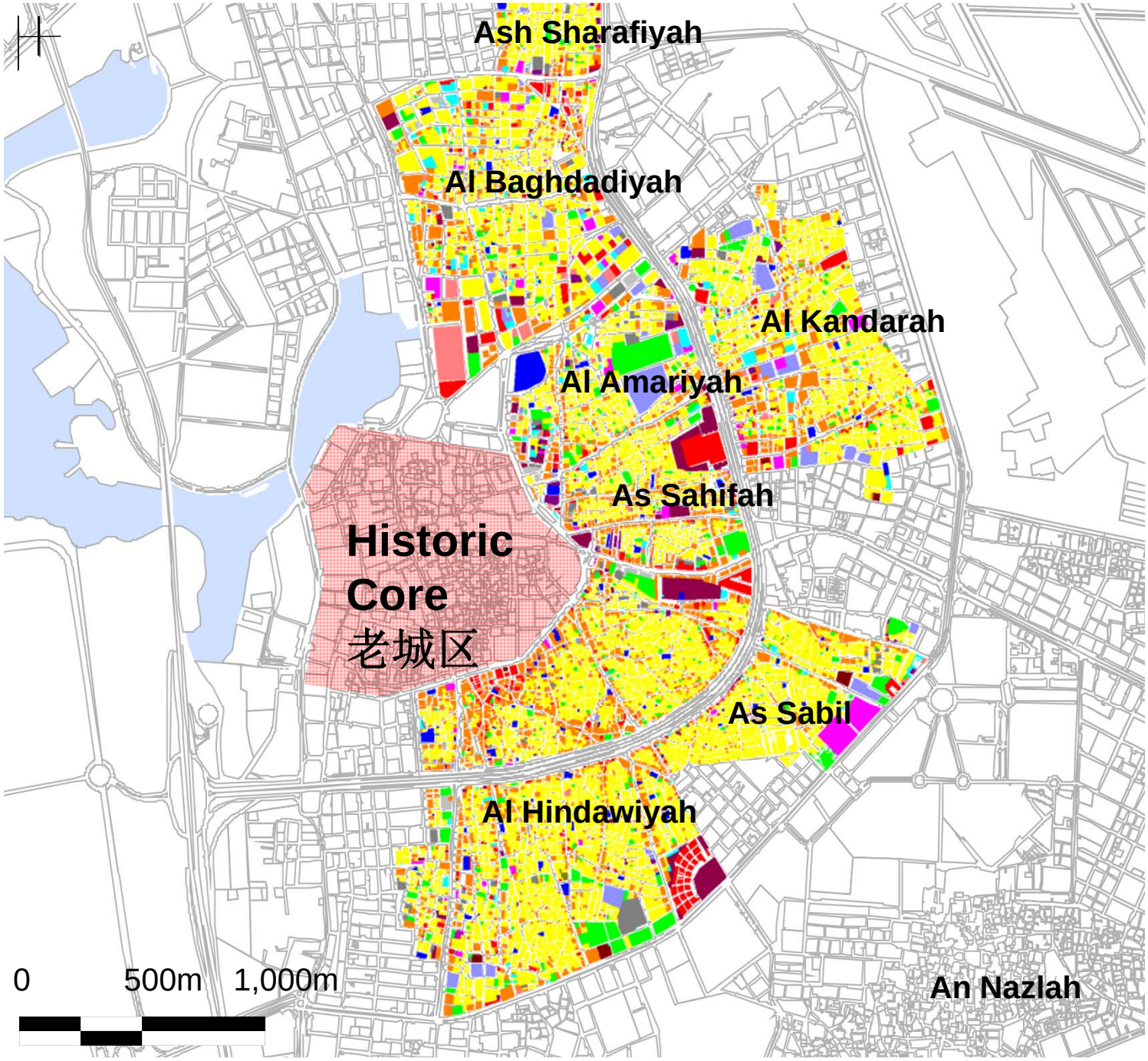
从那时起，快速城市扩张使城市现在从北到南为51公里。



A car-dependent plan is socially & economically unsustainable

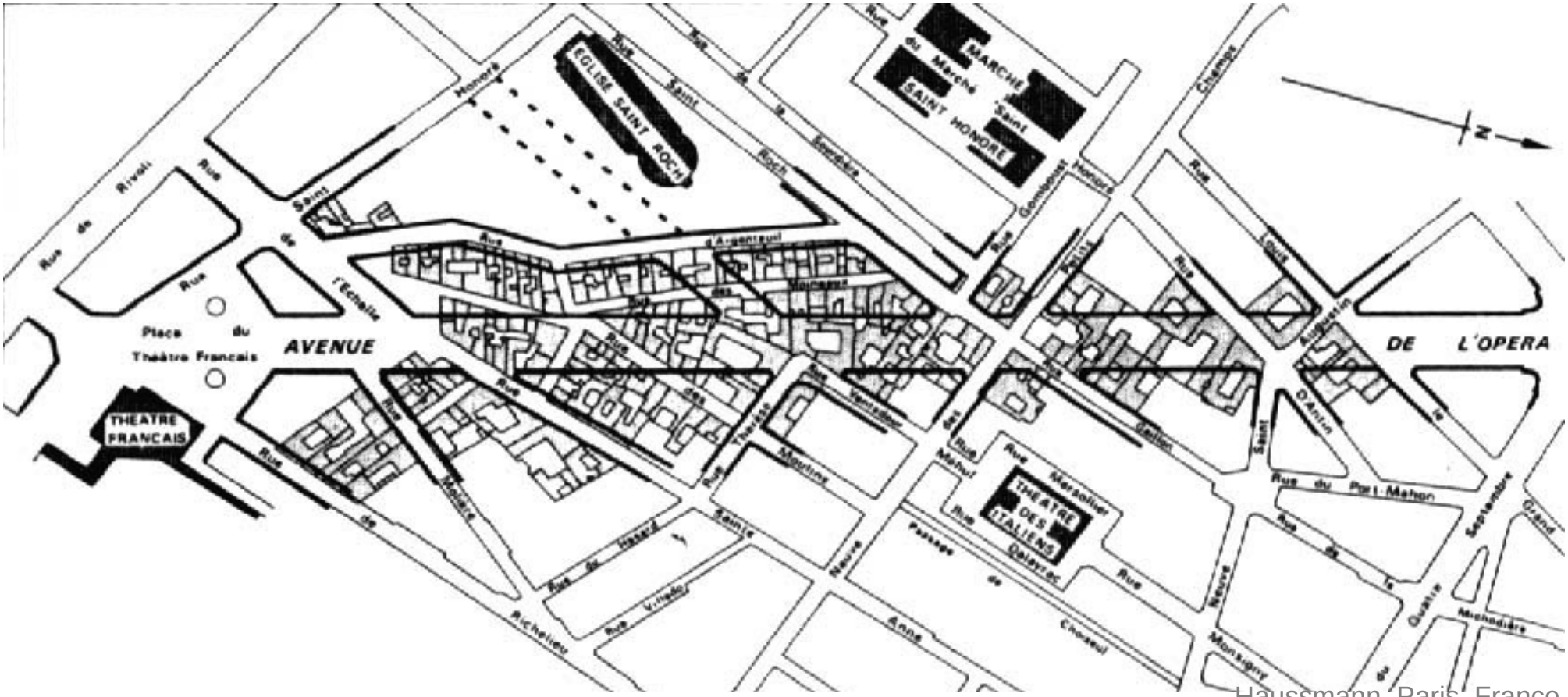
一个依赖汽车的规划对于社会和经济不是可持续发展的





老城区被无规划的住宅区“卡住”了

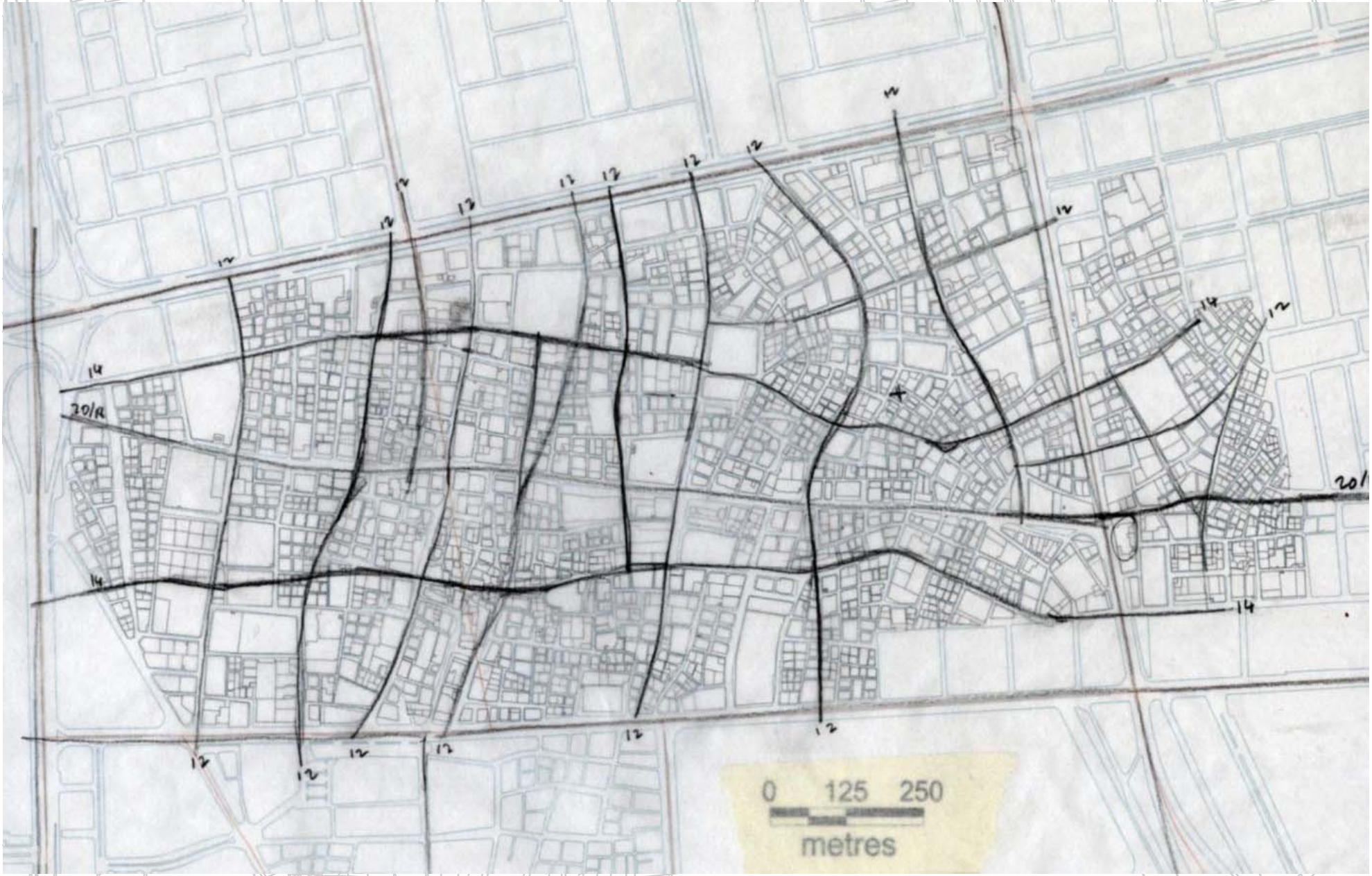
Spatial intervention in Paris Aggressive surgery
在巴黎的空间介入 积极的手段



Haussmann, Paris, France

Jeddah Planning strategy Context-driven layout
吉达的规划策略 城市环境影响的布局

Jeddah Planning strategy Context-driven layout
吉达的规划策略 城市环境影响的布局



Jeddah Spatial integration of contiguous settlements
吉达 空间介入之连续的居住区

Jeddah Space-based height/density coding
吉达 基于空间的高度/密度布置

Special project development guidelines
特殊项目的发展导向

Primary routes主干道

Land use mix土地混合使用

Commercial	商业	30%
Residential	住宅	65%
Social Infrastructure 社会基础设施		5%

FAR 4.5

Plot coverage (ground)
覆盖率（地下） 80 – 100%
Plot coverage (upper)
覆盖率（地上） 50 – 75%

Building height建筑高度 5 – 7

Secondary routes次干道

Land use mix土地混合使用

Commercial	商业	10%
Residential	住宅	75%
Social Infrastructure 社会基础设施		15%

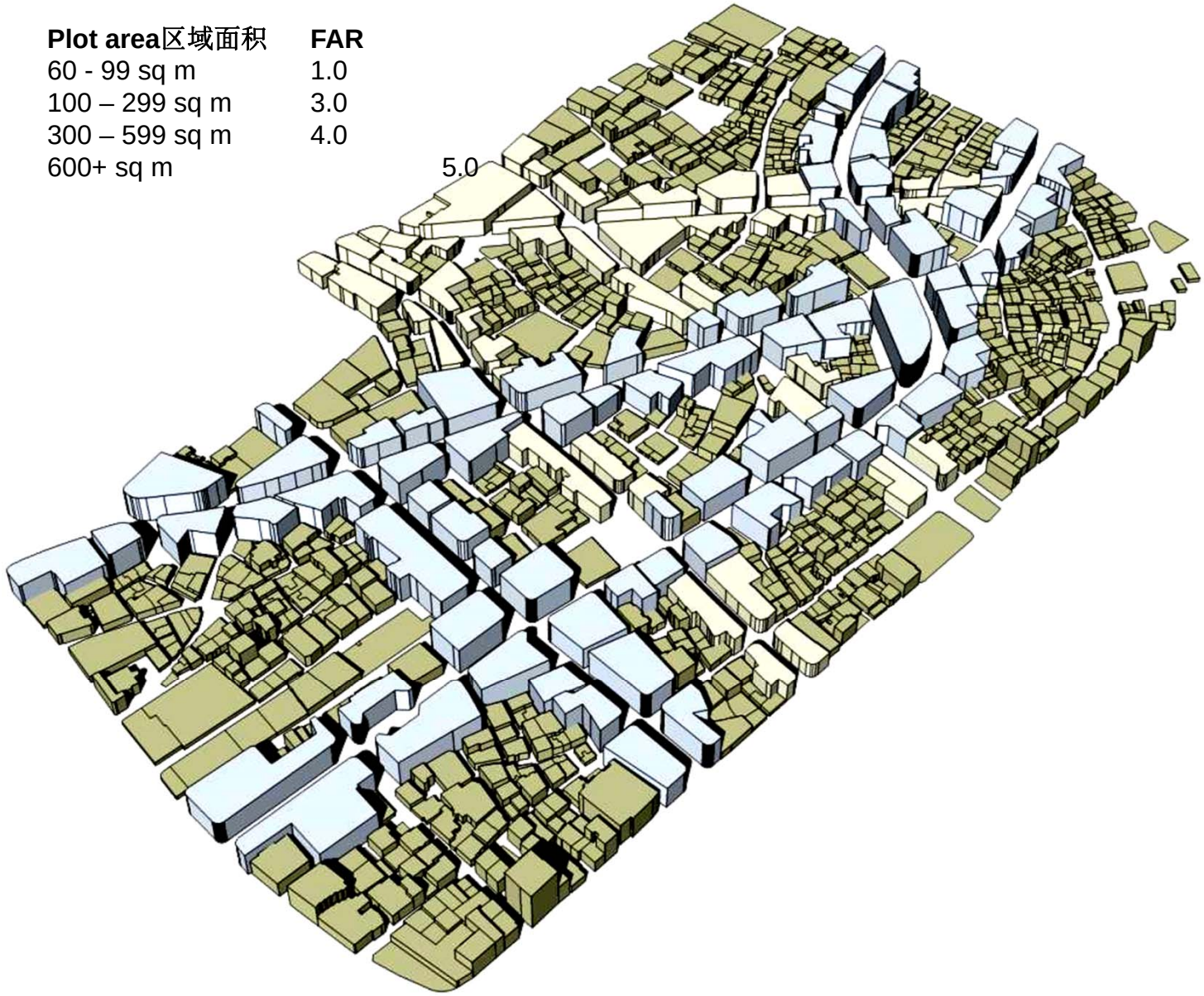
FAR 3.0

Plot coverage (ground)
覆盖率（地下） 70 – 80%
Plot coverage (upper)
覆盖率（地上） 50 – 60%

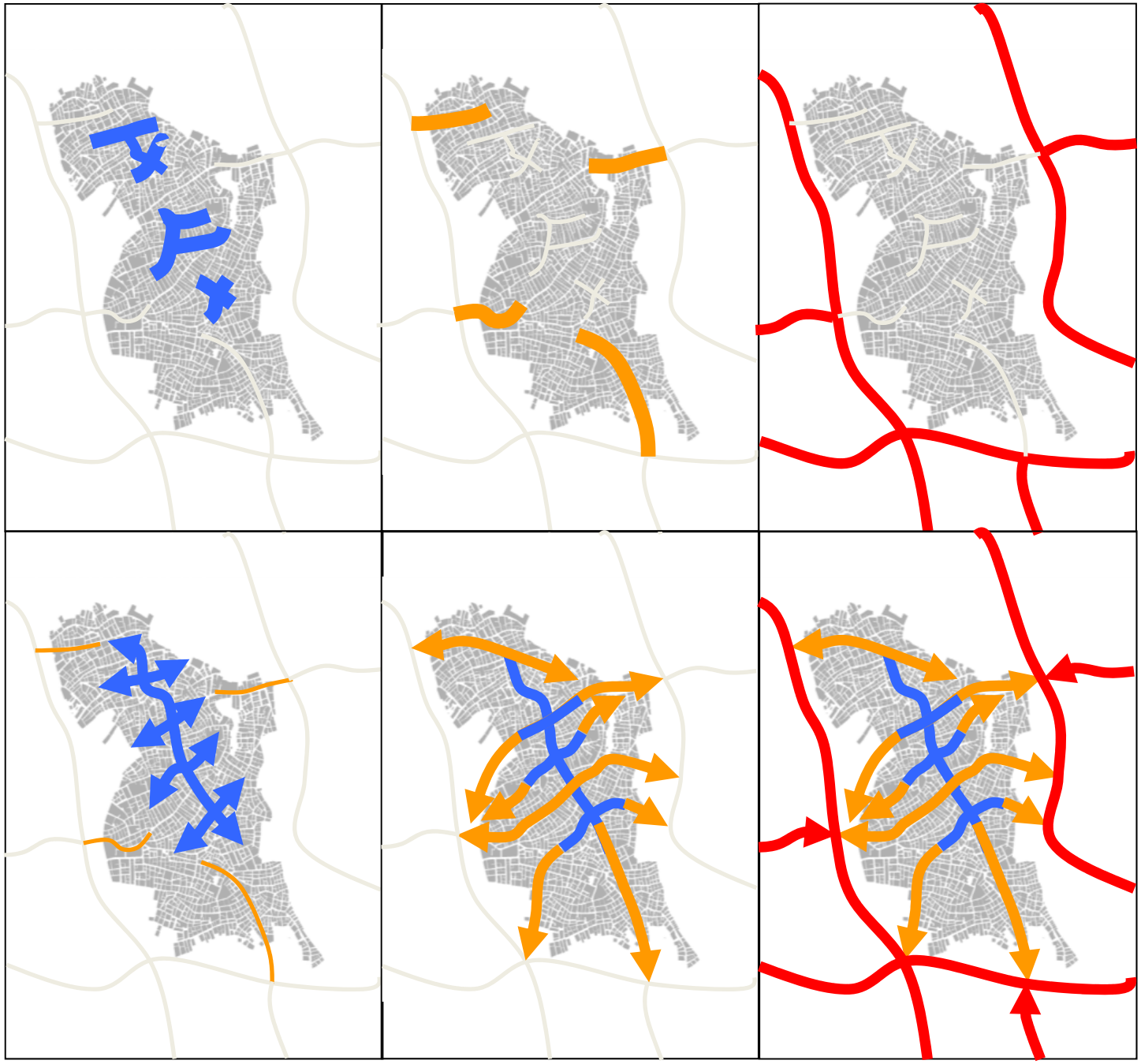
Building height建筑高度 4 - 5

Self organising development guidelines
自我组织的发展导向

Plot area区域面积	FAR
60 - 99 sq m	1.0
100 – 299 sq m	3.0
300 – 599 sq m	4.0
600+ sq m	5.0



Jeddah Space-based parametric design
吉达 基于空间的参数化设计



吉达 整合不同尺度被隔断的活动

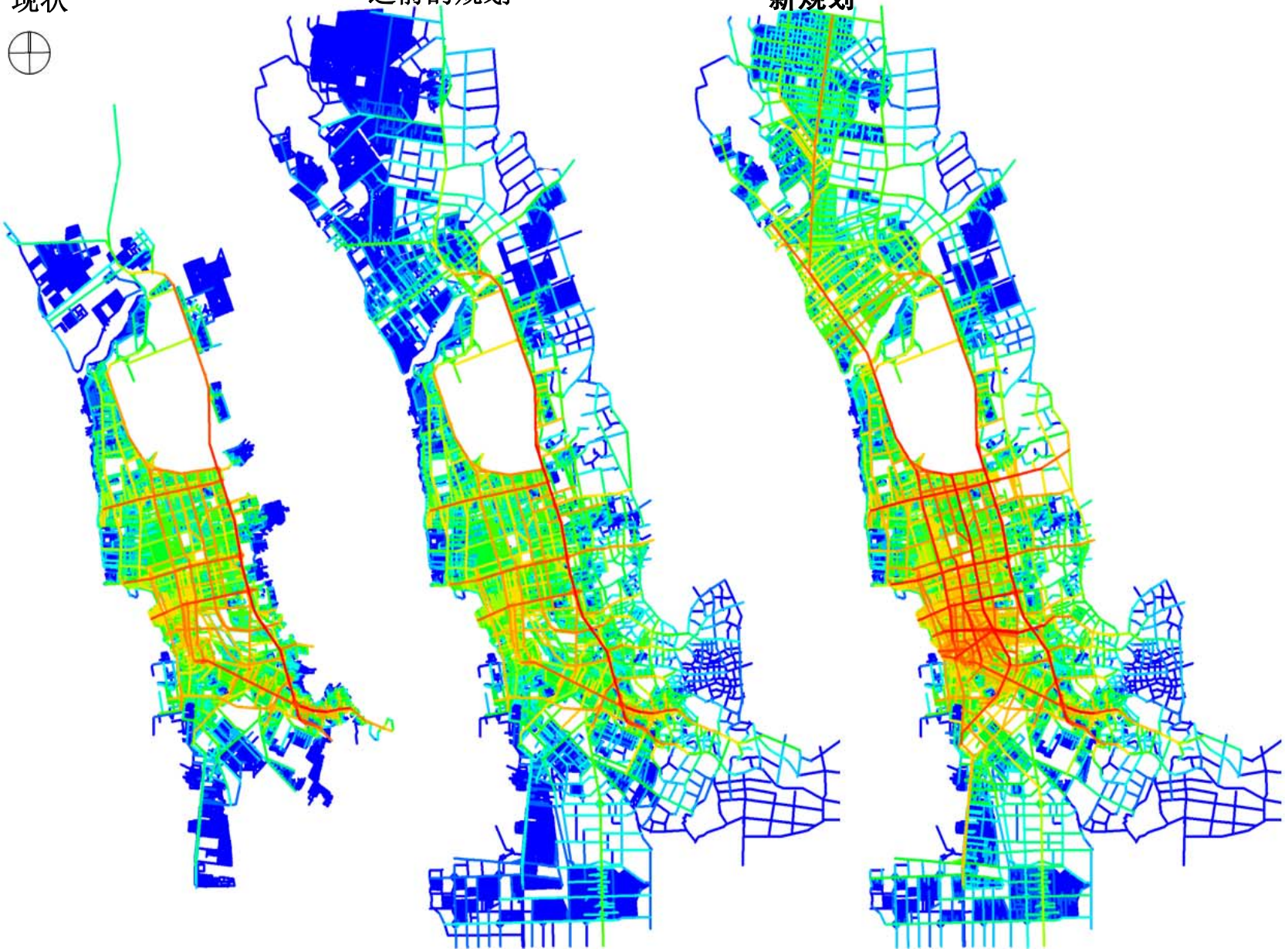
- **Local important routes** 局部尺度重要道路
- **Intermediate important routes** 中级尺度重要道路
- **Global important routes** 全局尺度重要道路

Jeddah City Plan 吉达城市规划

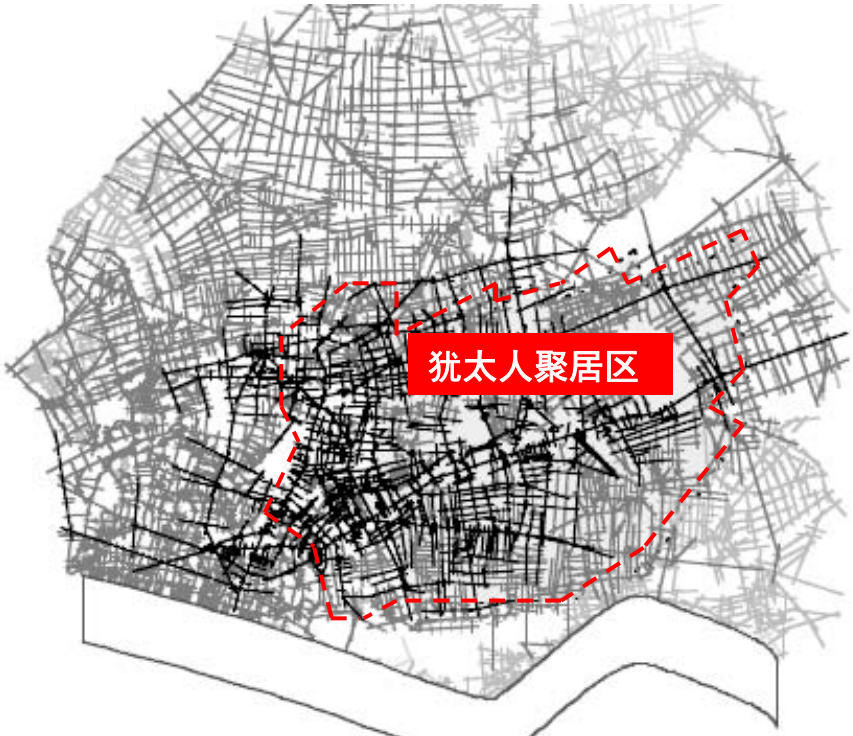
Existing
现状

Former plan
之前的规划

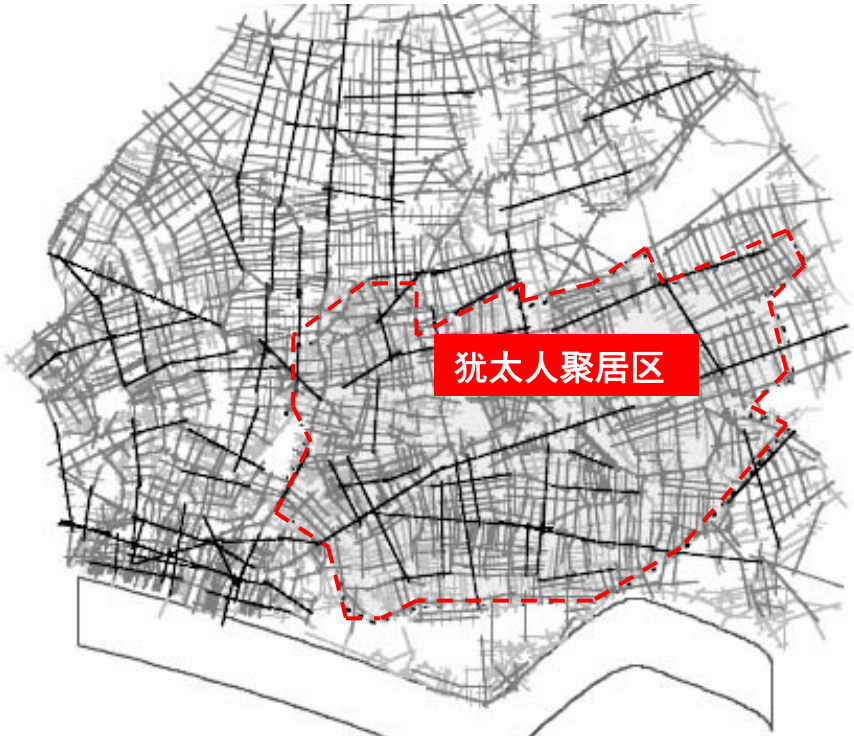
New plan by Space Syntax
新规划



19世纪英国少数民族分布空间研究



19世纪伦敦的全局整合度 (R n)



19世纪伦敦的局域整合度 (R 3)

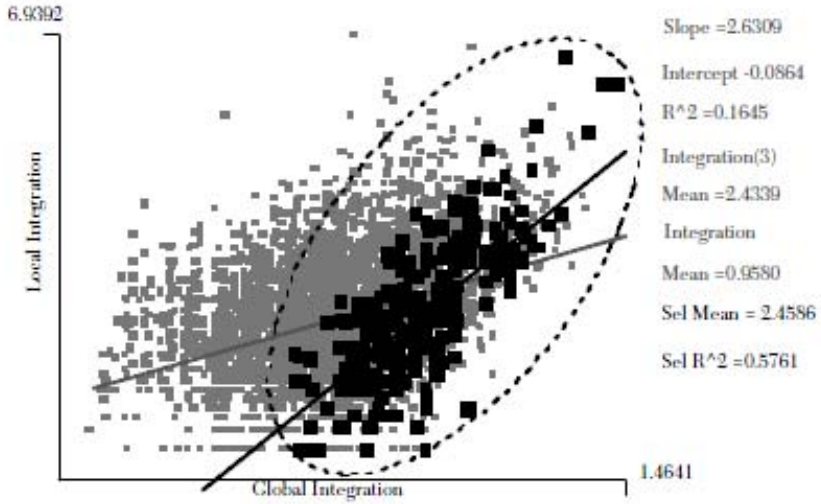


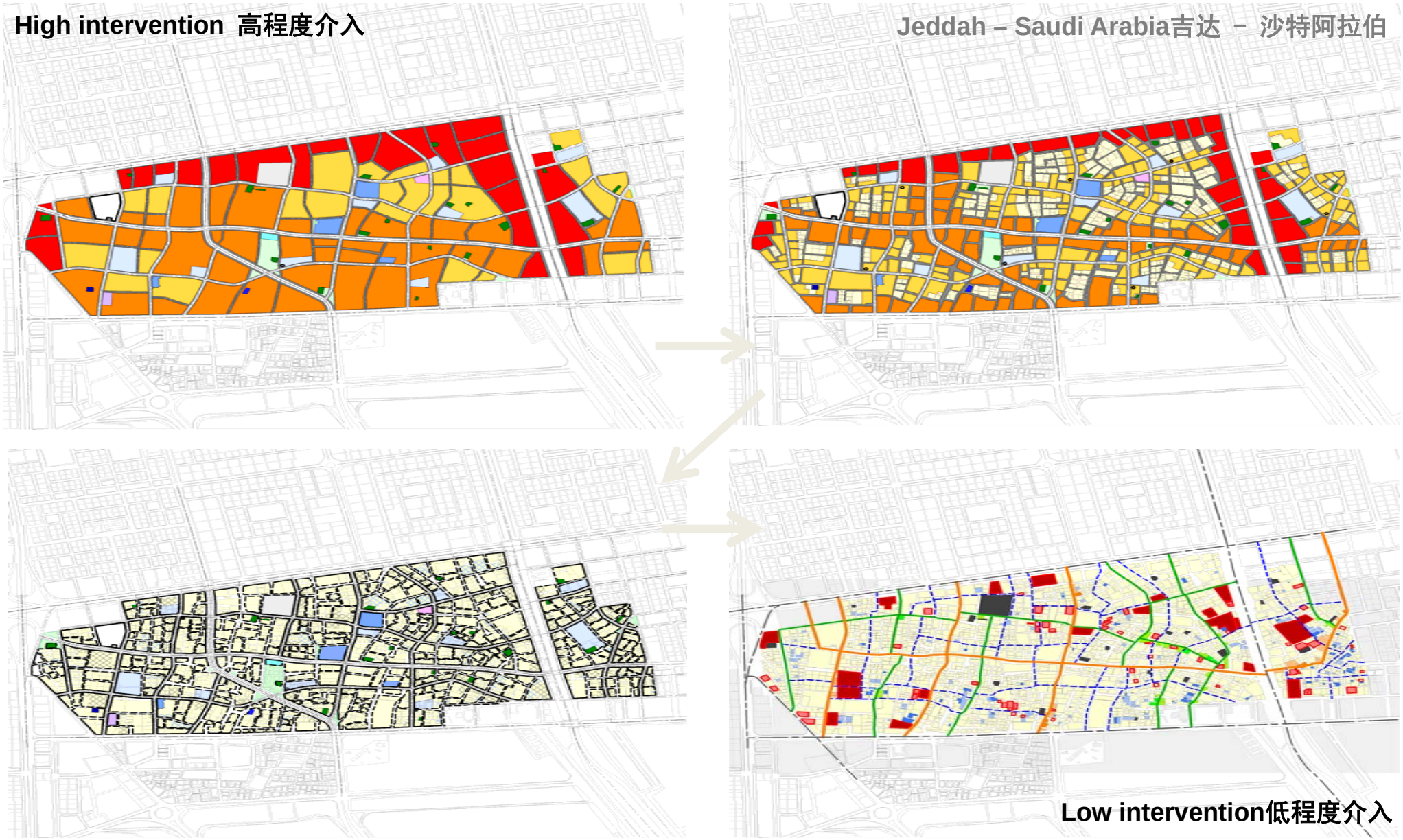
Figure 1. Global Integration - London 19th Century.

Figure 2. Local Integration - London 19th Century.

Figure 3. Intelligibility - Streets with 50% or More Jews Highlighted

High intervention 高程度介入

Jeddah – Saudi Arabia吉达 – 沙特阿拉伯



Low intervention低程度介入

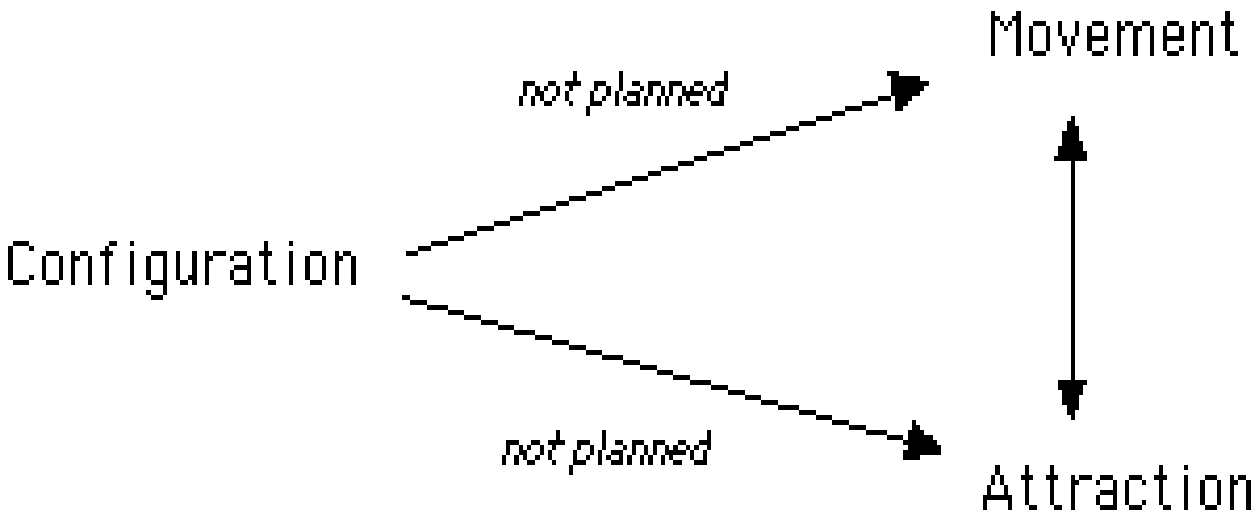
研究成果向实践转化 以实证为基础，提供兼顾社会经济利益，且有适应力的城市更新和可持续发展策略。

自然运动（Natural Movement）

空间句法理论认为“运动”或“流”是影响城市功能分布的基础，而城市空间的拓扑网络形式则对“流”的分布起到决定性的作用。

这种纯粹由城市空间构型决定的，而非其他具体的吸引点影响的“流”的分布状态，在空间句法理论被成为“自然运动”而与城市中真实的交通分布相区别。

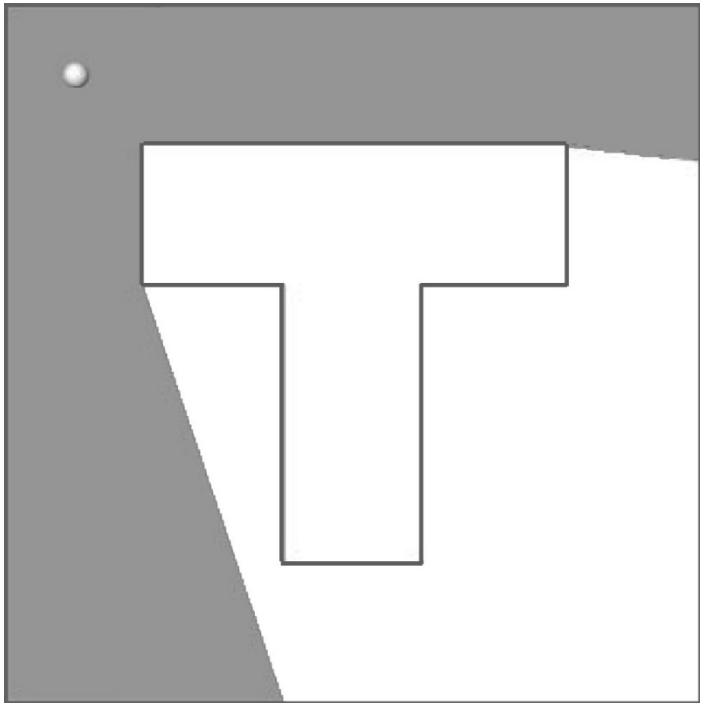
对于自然生长的城市（或经历足够长的时间来消化随机因素的影响，或分析的区域不至于过小），自然运动与真实运动间应有较大的相关性，也可以用来解释真实城市运动网络的生长和中心性的形成。



视域分析

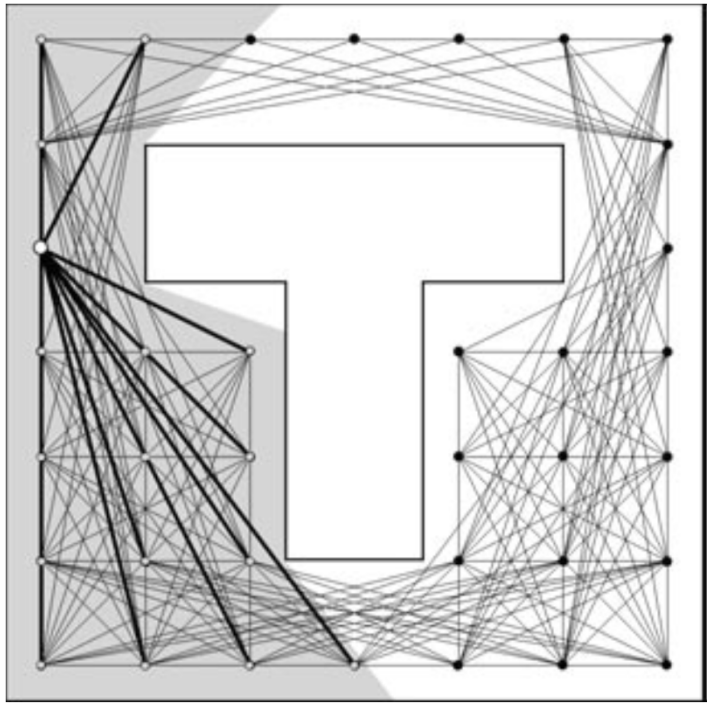
视域分析算法介绍及实例
人流模拟模型介绍及实例

空间分析—等视域和可视图分析（Isovists and VGA）



A 等视域（ Isovist）

面积（Area）
周长（Perimeter）
轴长（Radial）
紧密度（Compactness）



B 可视图 （Visibility graph）

连接度（Connectivity）
控制度（Control）
整合度（Integration）
熵值（Entropy）

视觉整合度分析（Visibility Graph Analysis)

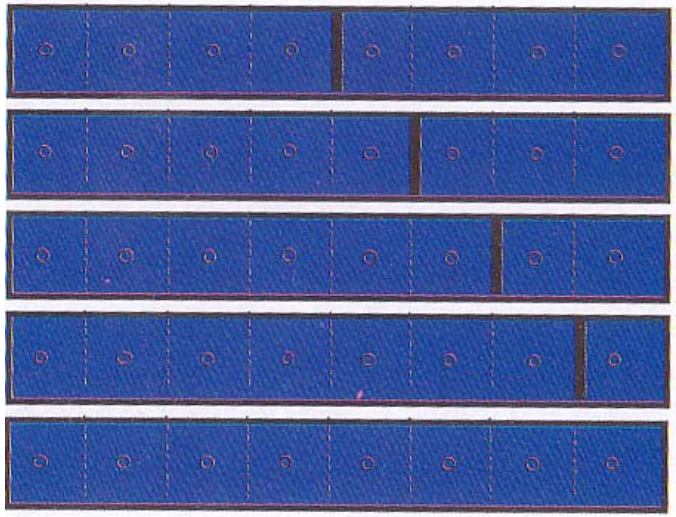


图 1.28　对长方形空间的分割与相互可见性

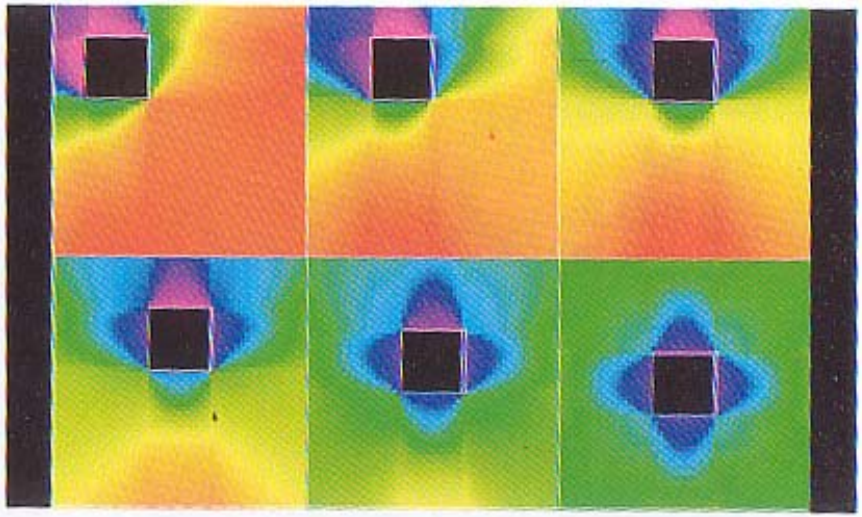


图 1.29　视觉整合度分析(把同一个障碍物从边缘向中心移动,相互可见性会减退)

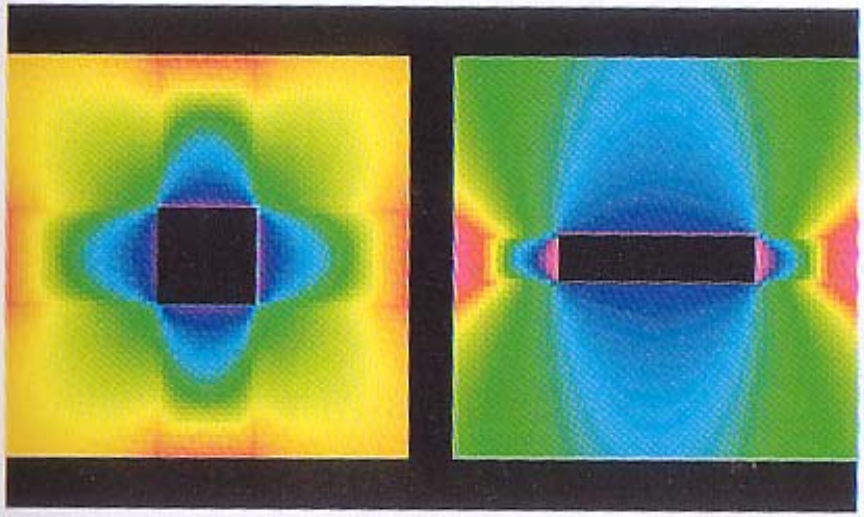


图 1.30　视觉整合度分析(同样面积的一个长方形和正方形相比较,前者相互可见性要强)

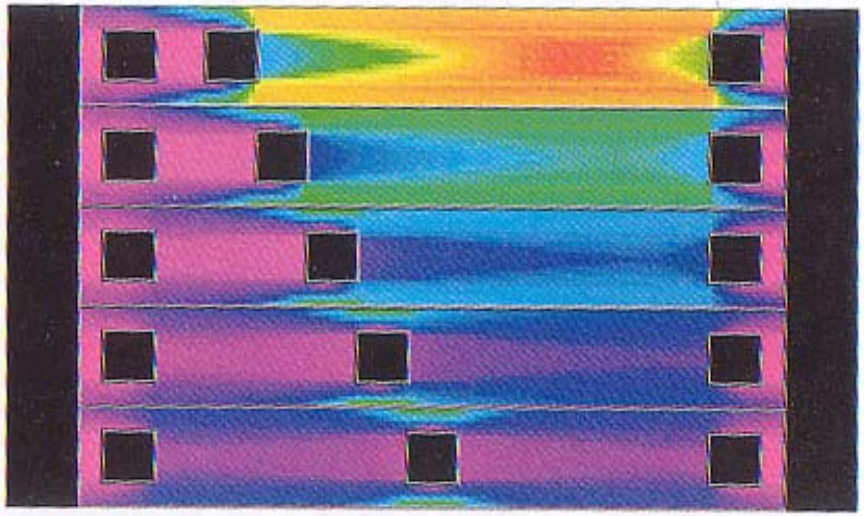
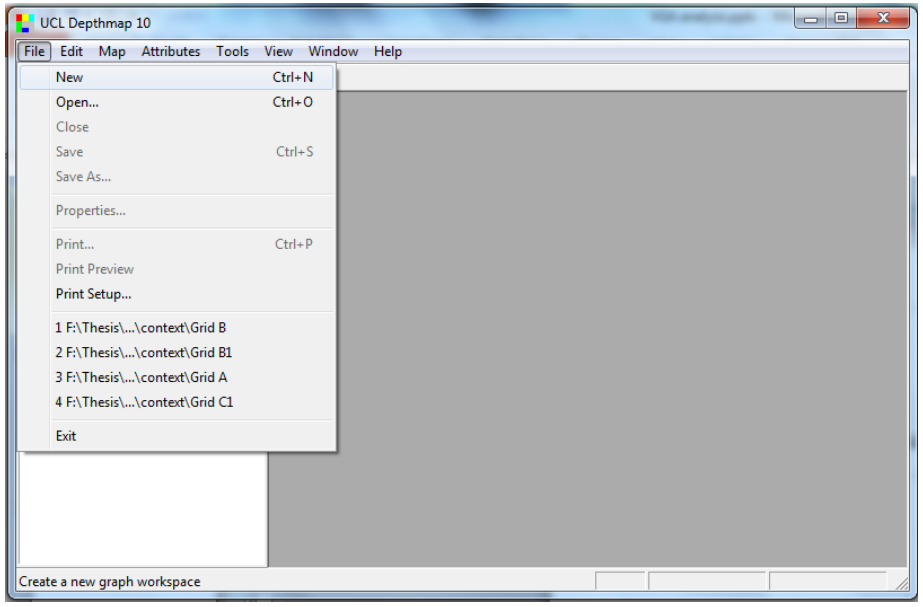
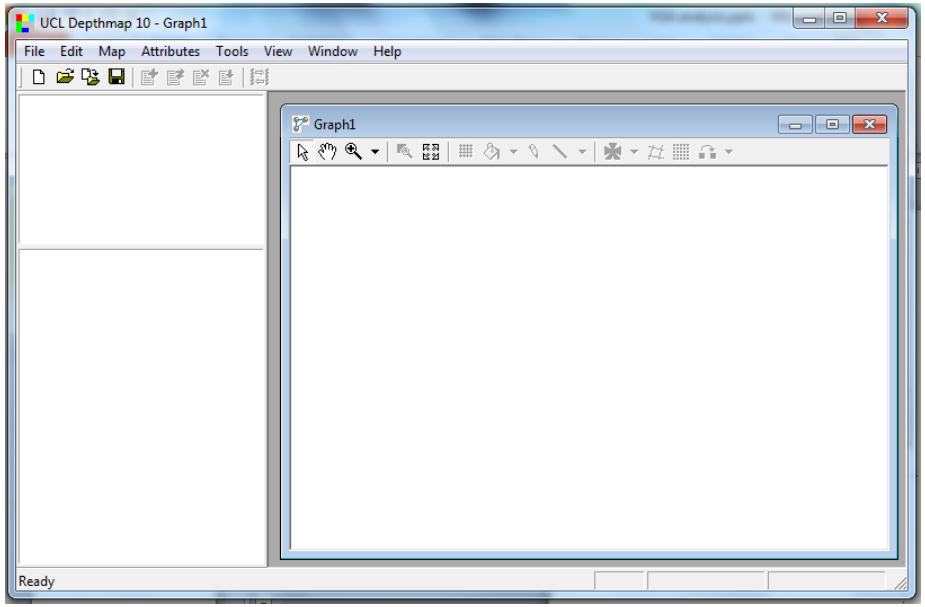


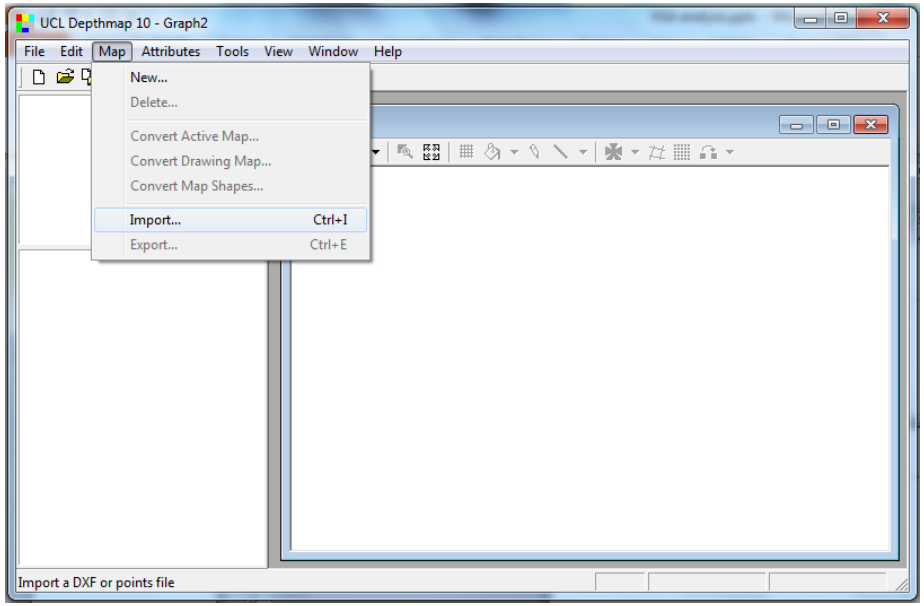
图 1.31　线性空间的视觉整合度分析

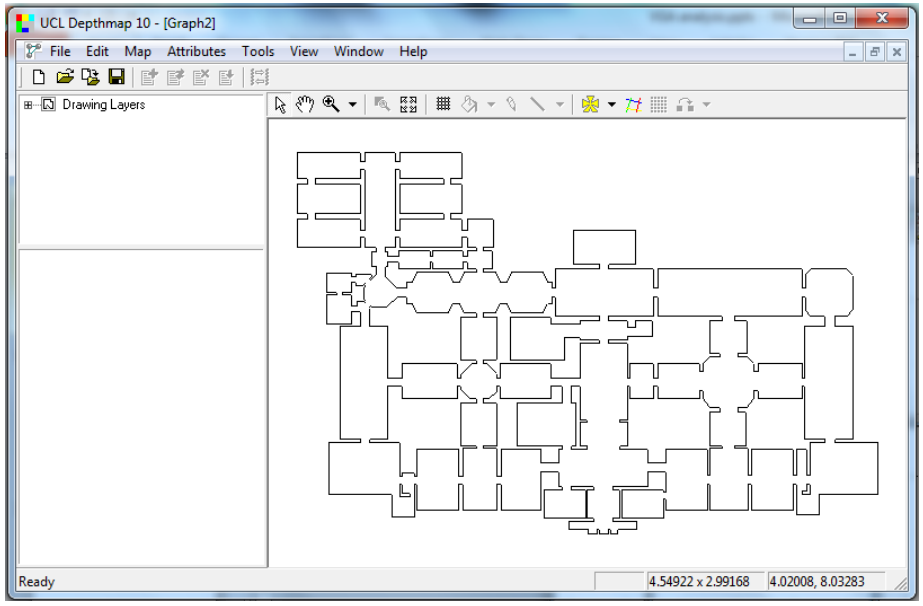
图片来源：《空间研究3——空间句法与城市规划》。

操作简介：输入文件

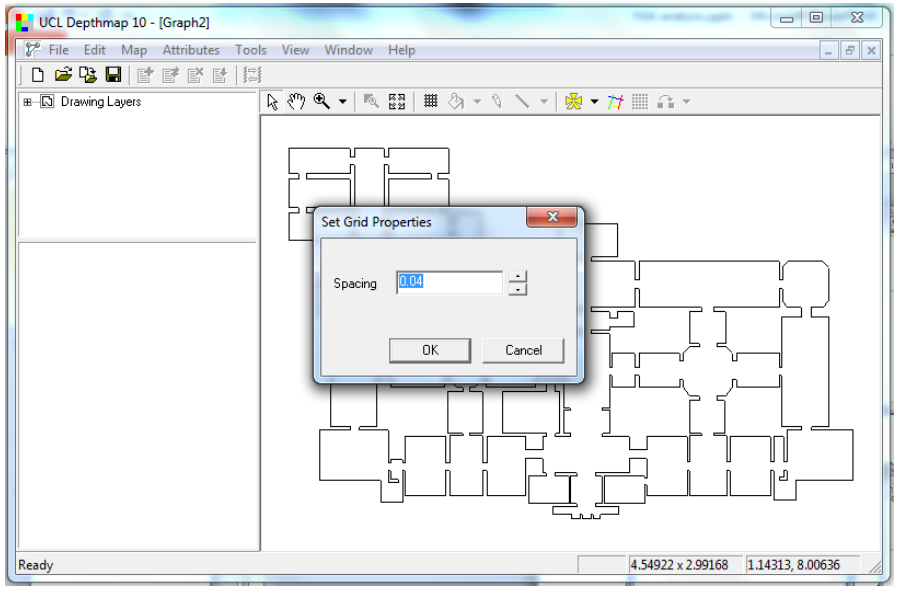

UCL Depthmap 10
File Edit Map Attributes Tools View Window Help
New Ctrl+N
Open... Ctrl+O
Close
Save Ctrl+S
Save As...
Properties...
Print... Ctrl+P
Print Preview
Print Setup...
1 F:\Thesis\...\context\Grid B
2 F:\Thesis\...\context\Grid B1
3 F:\Thesis\...\context\Grid A
4 F:\Thesis\...\context\Grid C1
Exit
Create a new graph workspace

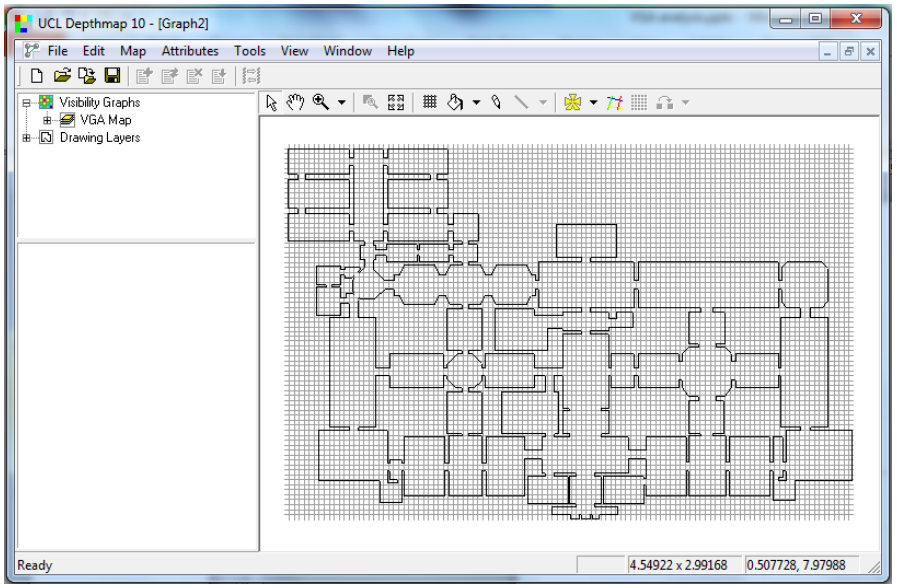

UCL Depthmap 10 - Graph1
File Edit Map Attributes Tools View Window Help
Graph1
Ready

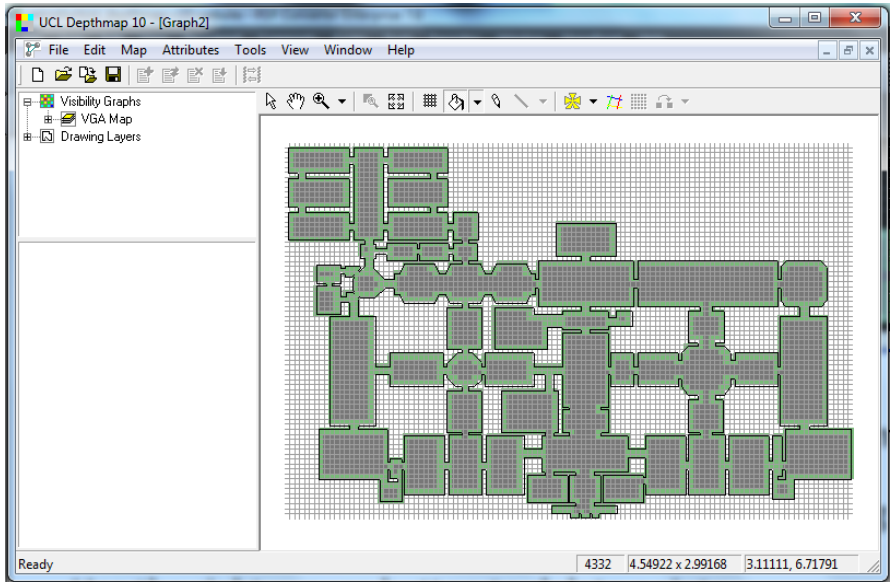

UCL Depthmap 10 - Graph2
File Edit Map Attributes Tools View Window Help
New...
Delete...
Convert Active Map...
Convert Drawing Map...
Convert Map Shapes...
Import... Ctrl+I
Export... Ctrl+E
Import a DXF or points file

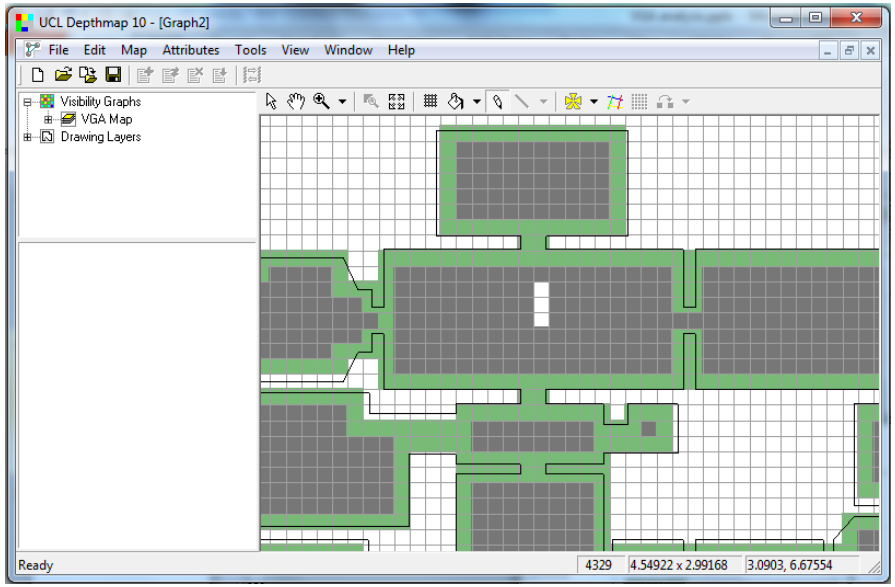

UCL Depthmap 10 - [Graph2]
File Edit Map Attributes Tools View Window Help
Drawing Layers
Ready
4.54922 x 2.99168
4.02008, 8.03283

操作简介：设置栅格并填充分析区域

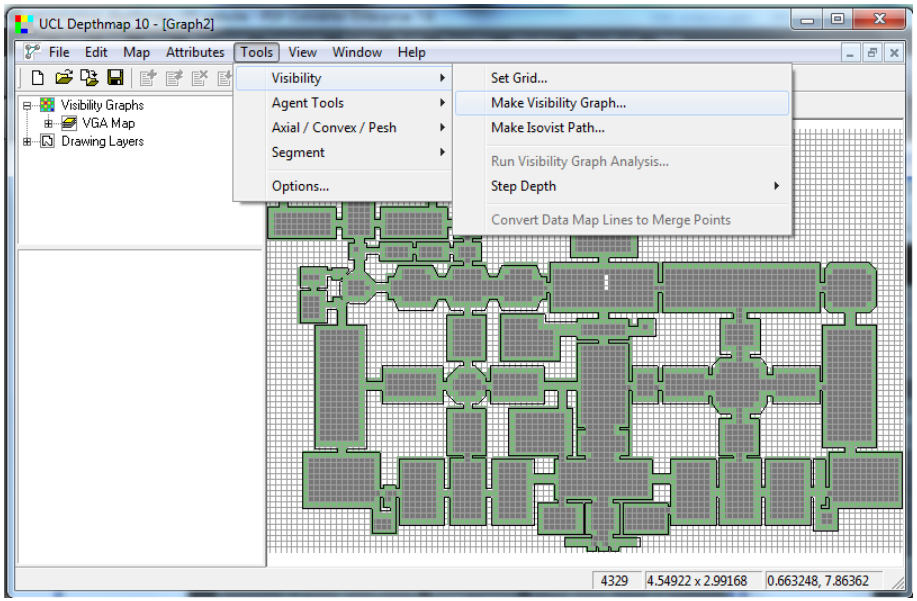


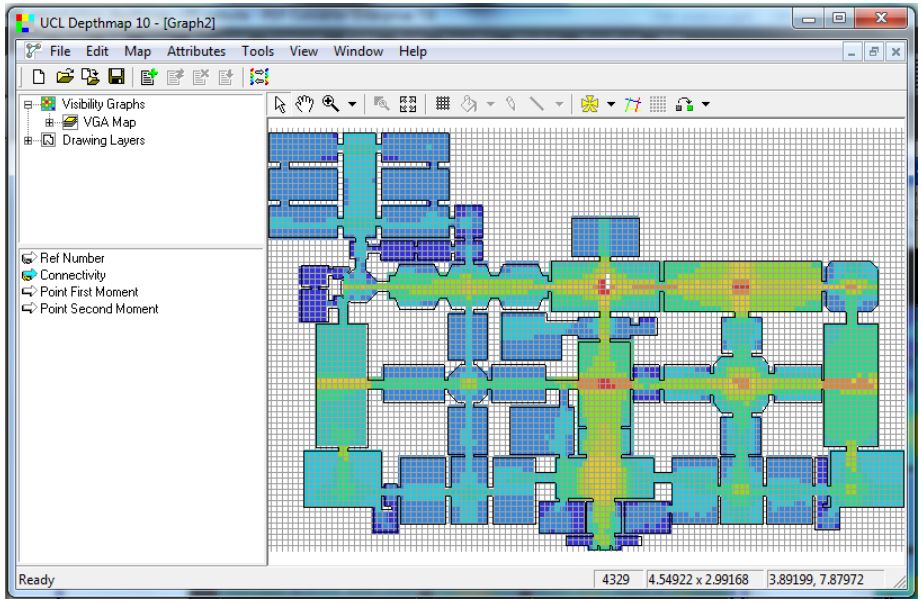


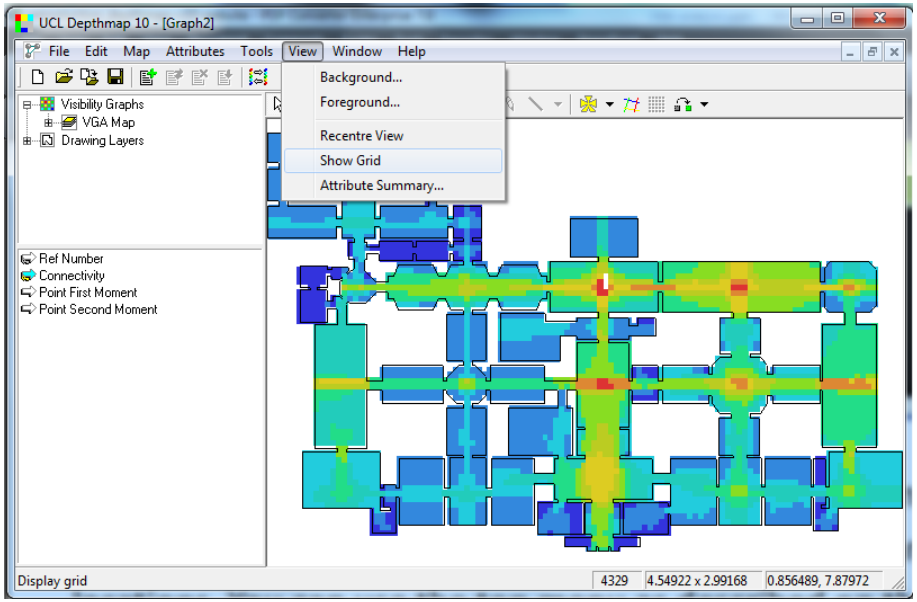


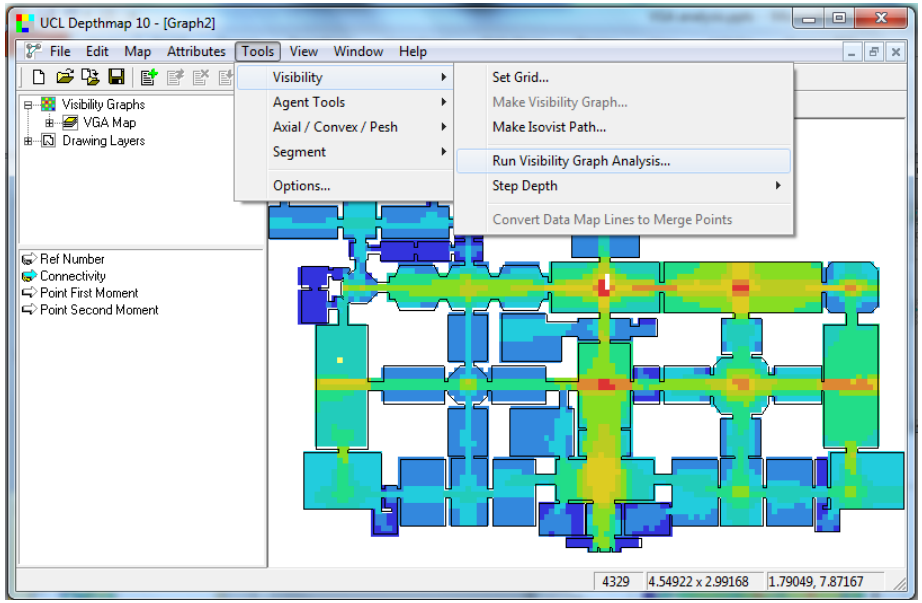


操作简介：进行初步分析

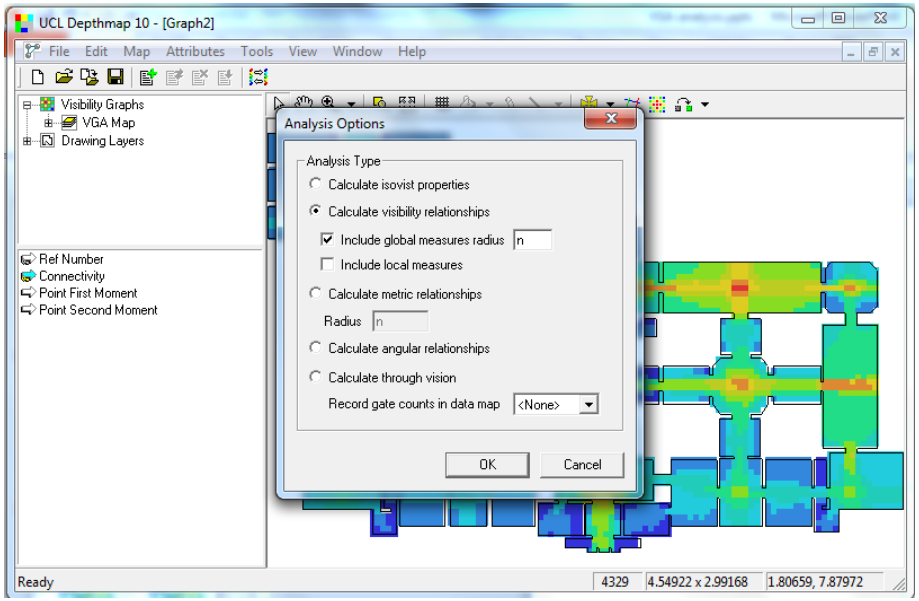

UCL Depthmap 10 - [Graph2]
File Edit Map Attributes Tools View Window Help
Visibility
Agent Tools
Axial / Convex / Pesh
Segment
Options...
Set Grid...
Make Visibility Graph...
Make Isovist Path...
Run Visibility Graph Analysis...
Step Depth
Convert Data Map Lines to Merge Points
Visibility Graphs
VGA Map
Drawing Layers
4329
4.54922 x 2.99168
0.663248, 7.86362

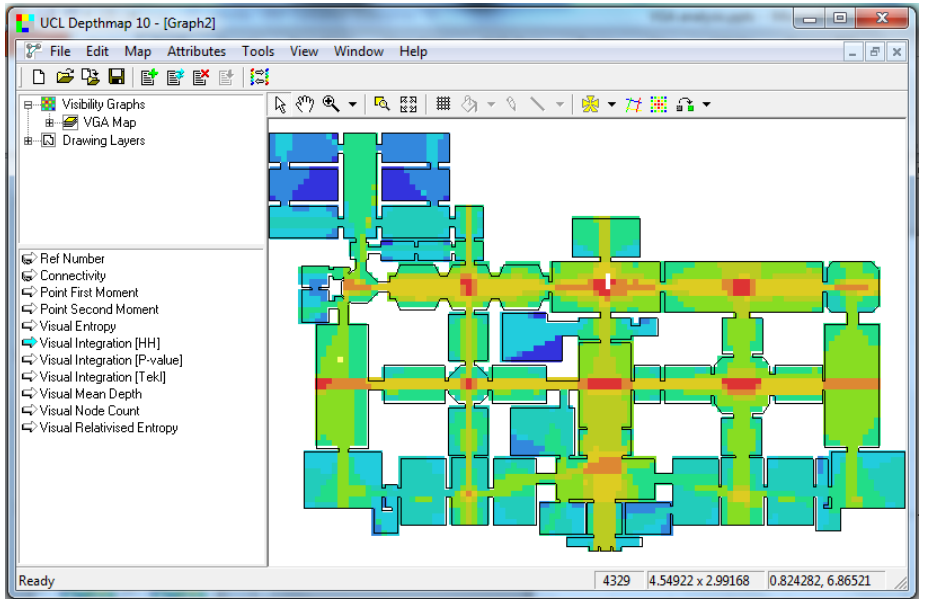

UCL Depthmap 10 - [Graph2]
File Edit Map Attributes Tools View Window Help
Visibility Graphs
VGA Map
Drawing Layers
Ref Number
Connectivity
Point First Moment
Point Second Moment
Ready
4329
4.54922 x 2.99168
3.89199, 7.87972


UCL Depthmap 10 - [Graph2]
File Edit Map Attributes Tools View Window Help
Background...
Foreground...
Recentre View
Show Grid
Attribute Summary...
Visibility Graphs
VGA Map
Drawing Layers
Ref Number
Connectivity
Point First Moment
Point Second Moment
Display grid
4329
4.54922 x 2.99168
0.856489, 7.87972

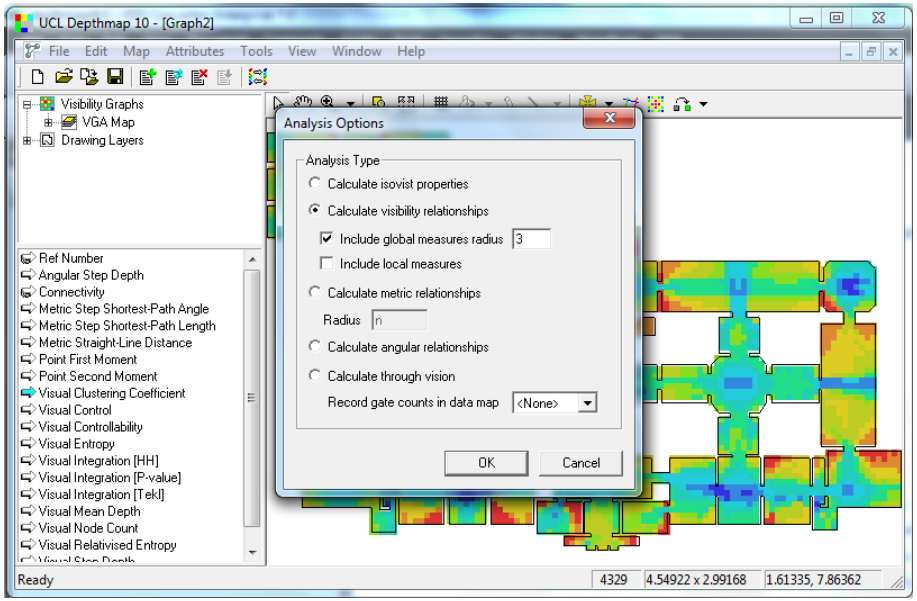

UCL Depthmap 10 - [Graph2]
File Edit Map Attributes Tools View Window Help
Visibility
Agent Tools
Axial / Convex / Pesh
Segment
Options...
Set Grid...
Make Visibility Graph...
Make Isovist Path...
Run Visibility Graph Analysis...
Step Depth
Convert Data Map Lines to Merge Points
Visibility Graphs
VGA Map
Drawing Layers
Ref Number
Connectivity
Point First Moment
Point Second Moment
4329
4.54922 x 2.99168
1.79049, 7.87167

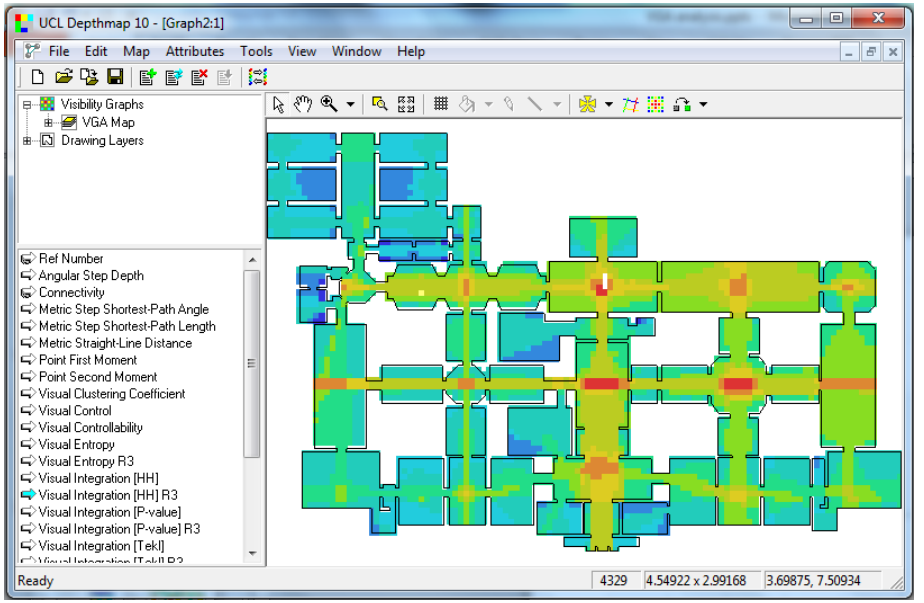
操作简介：整体视域整合度分析



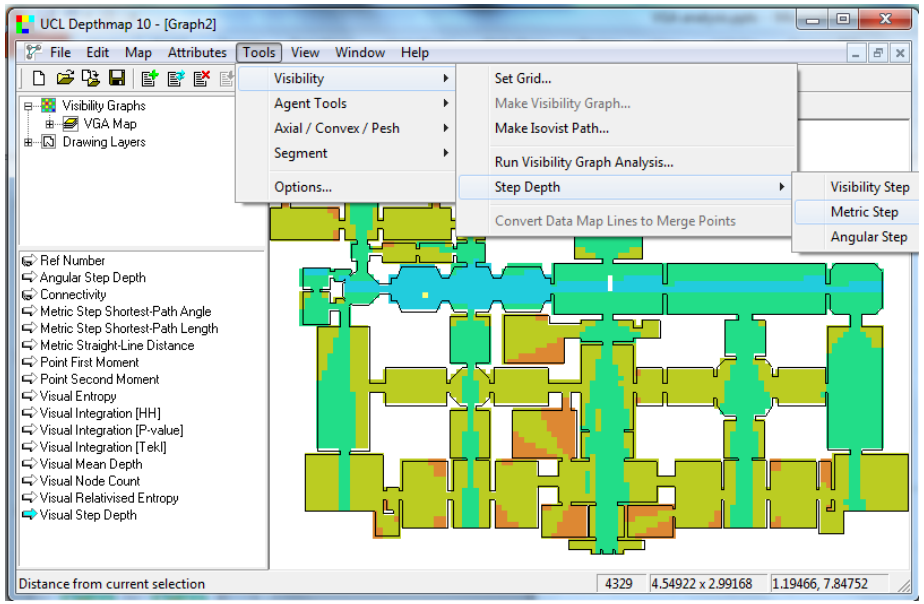


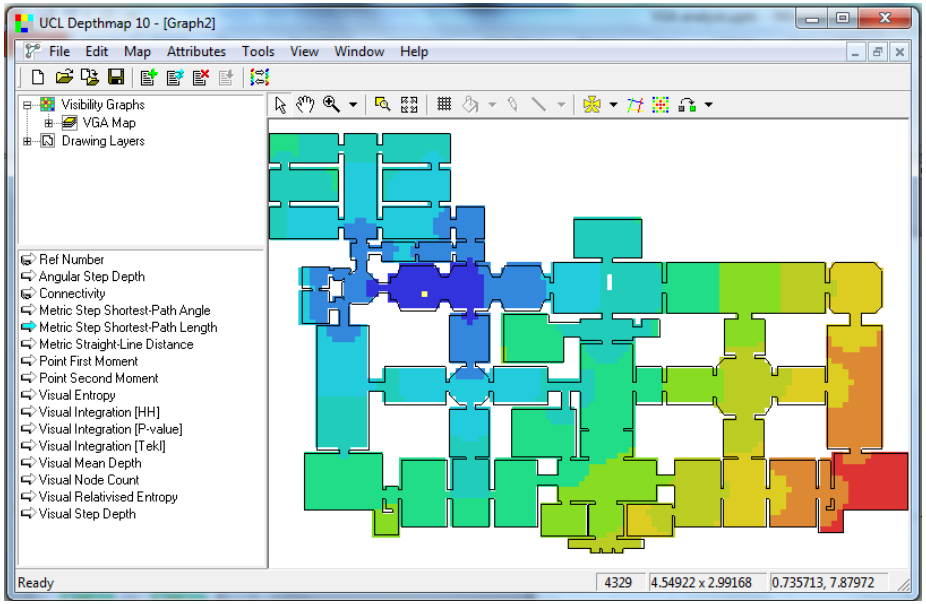
操作简介：局部视域整合度分析



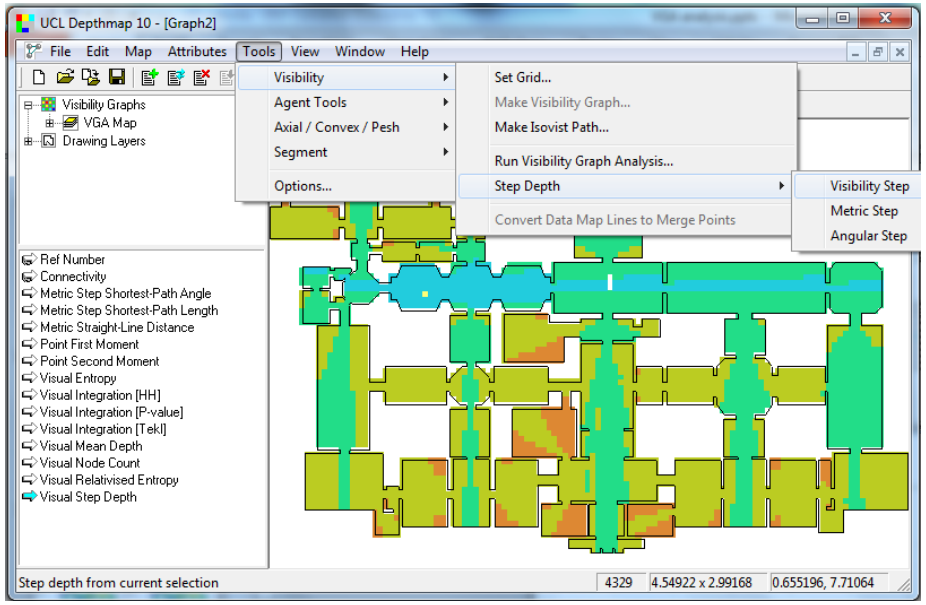


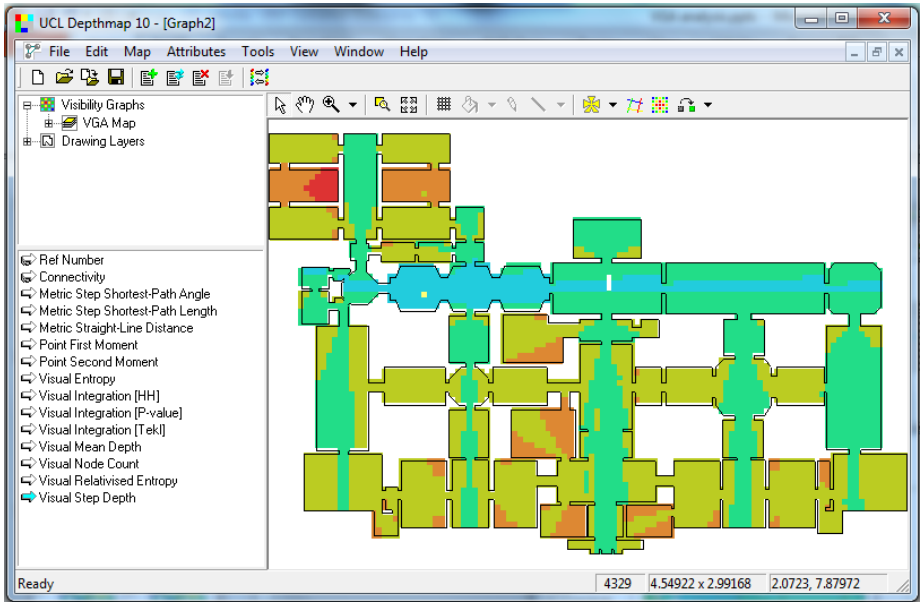
操作简介：某个点的实际距离分析

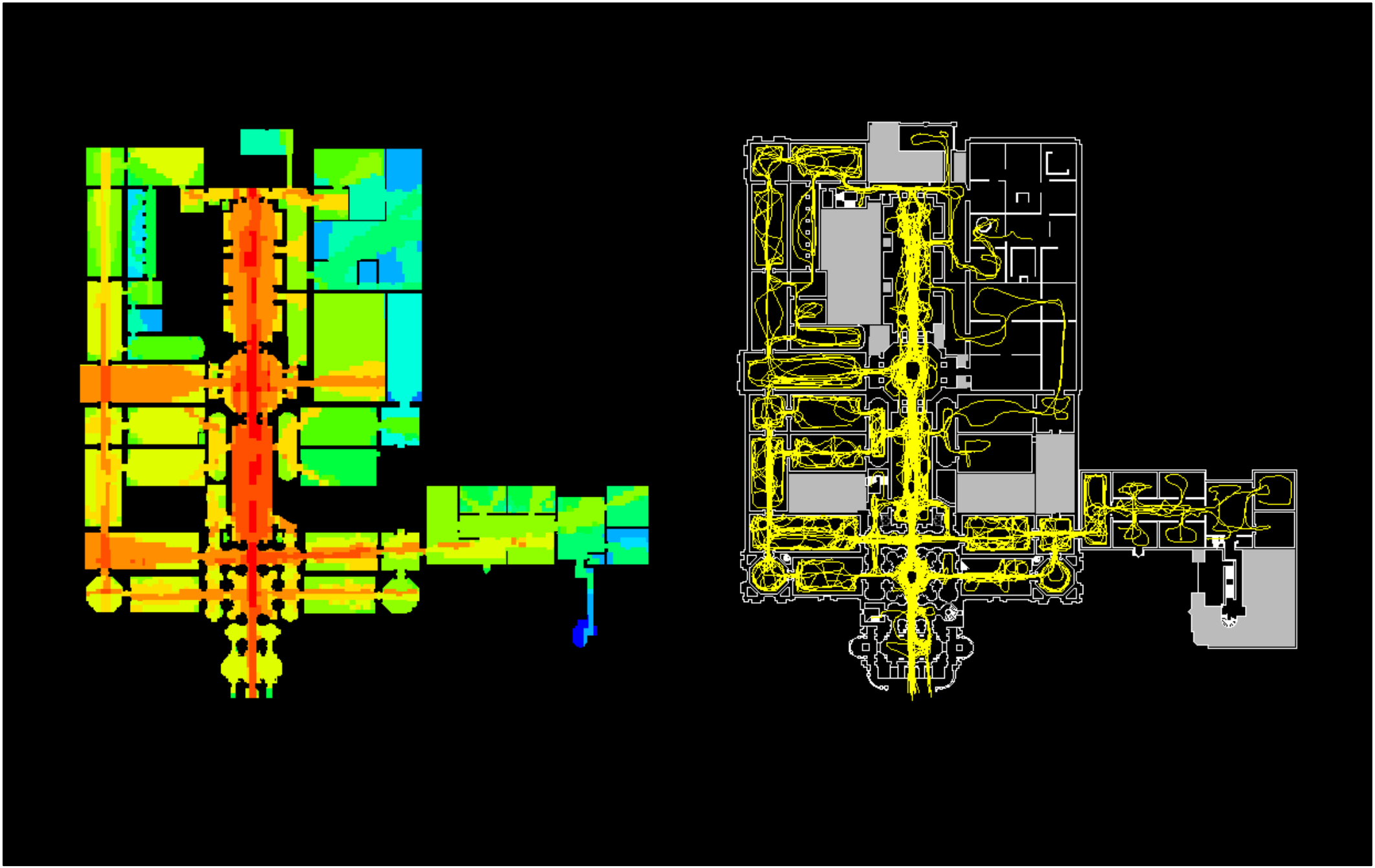


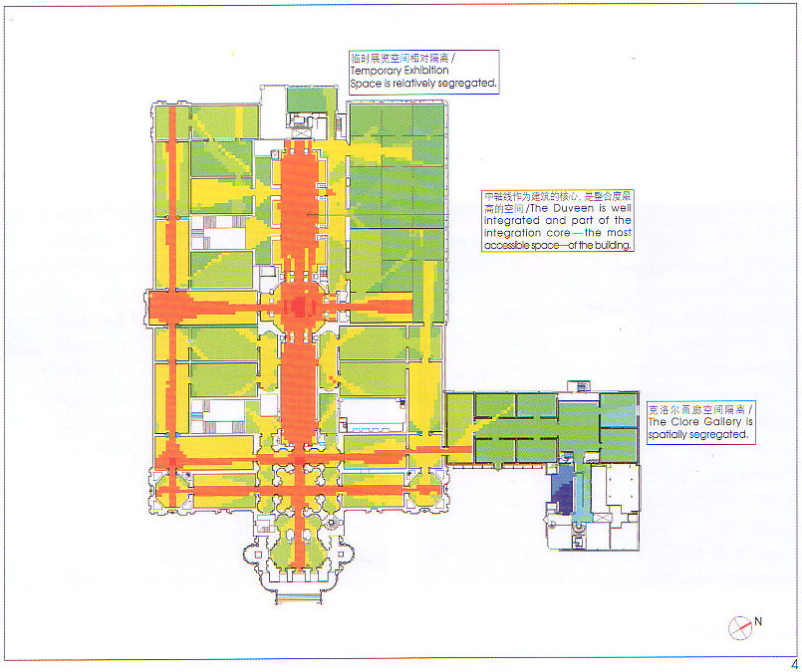


操作简介：某个点的视域距离分析

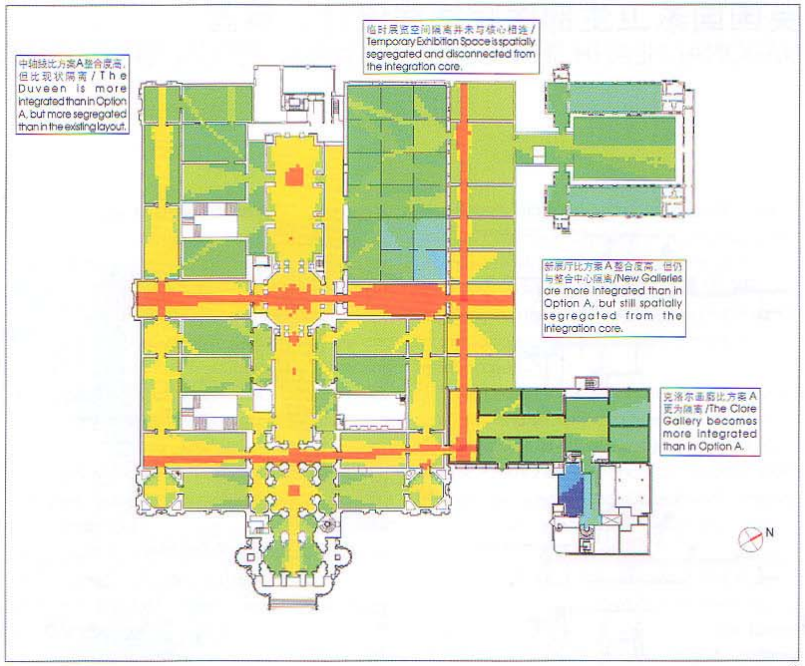




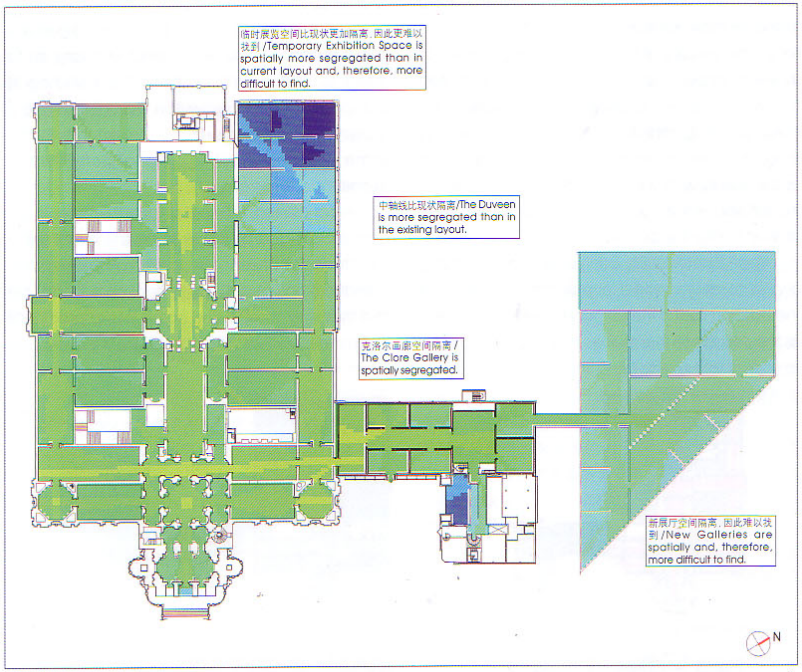



临时展览空间相对隔离 / Temporary Exhibition Space is relatively segregated.
中轴线作为建筑的核心，是整合度最高的空间 /The Duveen is well integrated and part of the integration core — the most accessible space — of the building.
克洛尔画廊空间隔离 / The Clore Gallery is spatially segregated.
N

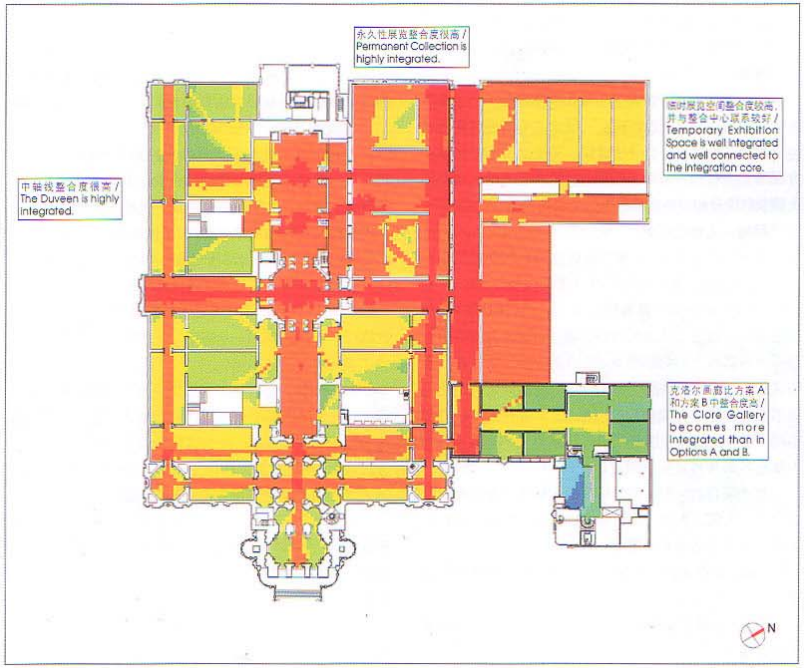
4


临时展览空间隔离并未与核心相连 / Temporary Exhibition Space is spatially segregated and disconnected from the integration core.
中轴线比方案A整合度高，但比现状隔离 / The Duveen is more integrated than in Option A, but more segregated than in the existing layout.
新展厅比方案A整合度高，但仍与整合中心隔离/New Galleries are more integrated than in Option A, but still spatially segregated from the integration core.
克洛尔画廊比方案A更为隔离 /The Clore Gallery becomes more integrated than in Option A.
N

6

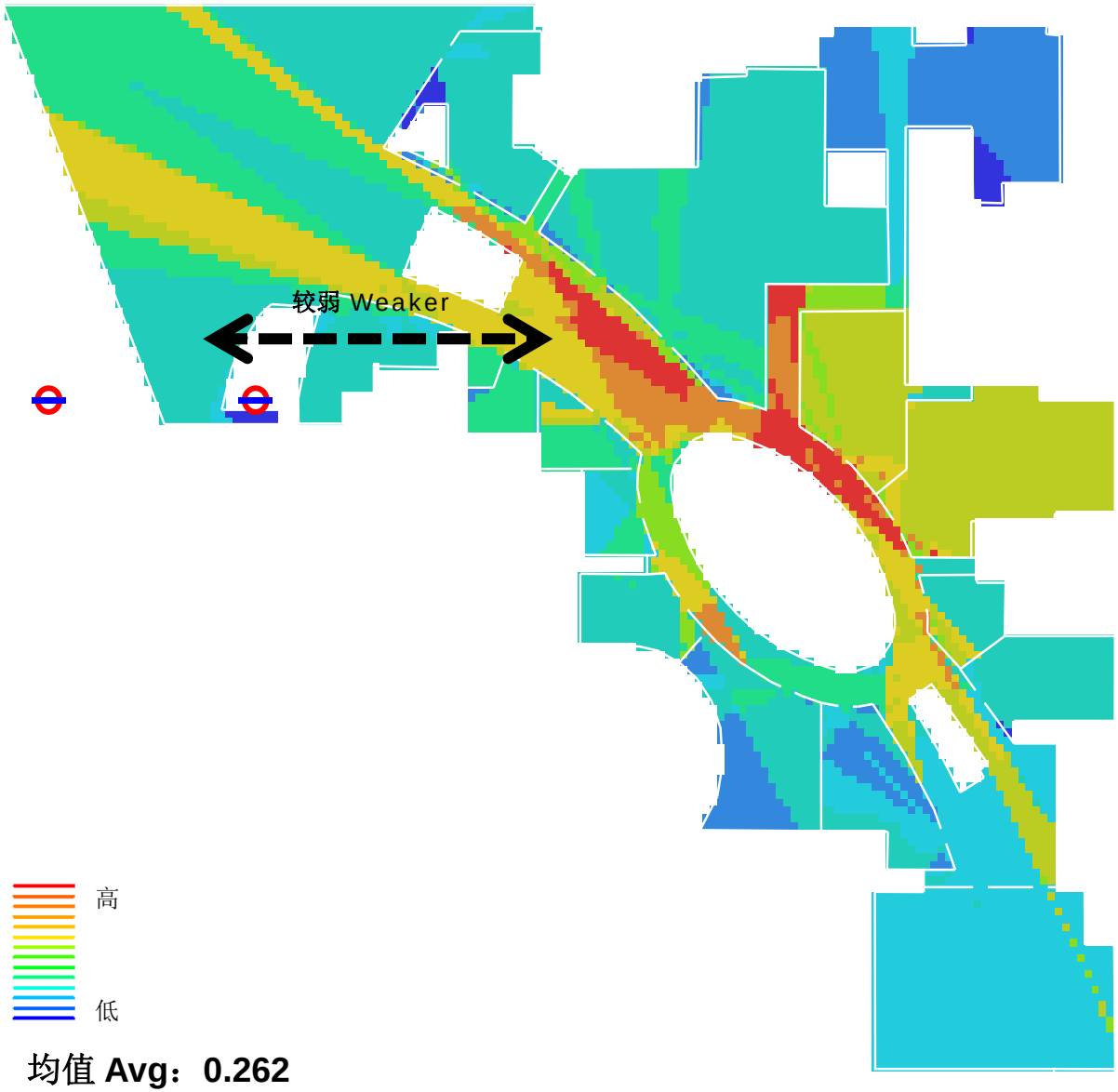

临时展览空间比现状更加隔离，因此更难以找到 /Temporary Exhibition Space is spatially more segregated than in current layout and, therefore, more difficult to find.
中轴线比现状隔离/The Duveen is more segregated than in the existing layout.
克洛尔画廊空间隔离 / The Clore Gallery is spatially segregated.
新展厅空间隔离，因此难以找到 /New Galleries are spatially and, therefore, more difficult to find.
N

5


永久性展览整合度很高 / Permanent Collection is highly integrated.
临时展览空间整合度较高，并与整合中心联系较好 / Temporary Exhibition Space is well integrated and well connected to the integration core.
中轴线整合度很高 / The Duveen is highly integrated.
克洛尔画廊比方案A和方案B中整合度高 / The Clore Gallery becomes more integrated than in Options A and B.
N

7

原有方案的高精度视线分析 The VGA Analysis for Old Scheme



均值 **Avg：0.262**

视线分析
VGA (a higher resolution analysis)

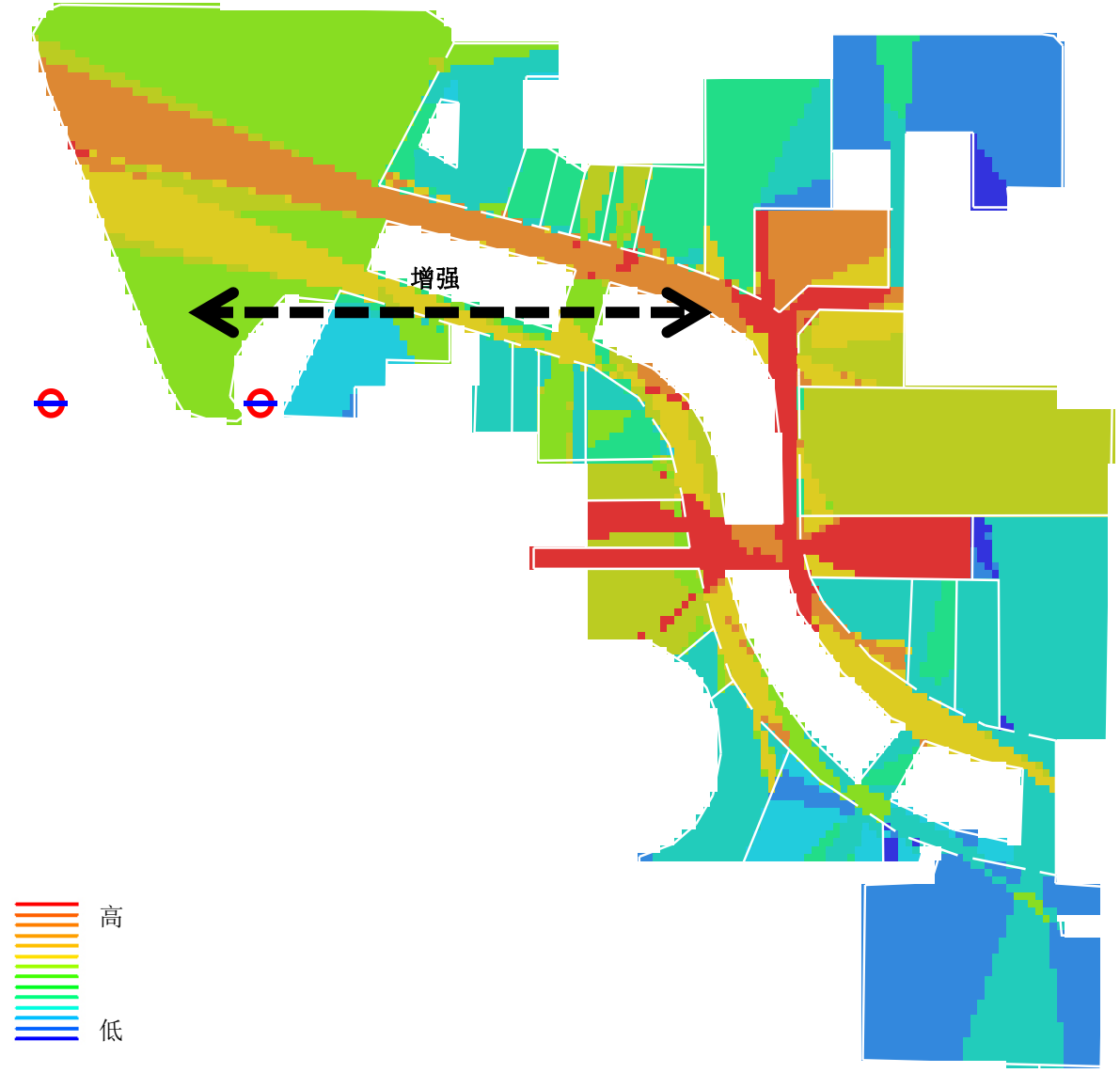
椭圆上空北侧是该建筑内的视觉中心(红色部分)，因此它有可能成为建筑中具有活力的中心场所。

The north part of the elliptical void is a visual focus (denoted by red) of this building, and so perhaps it would become an active place.

然而，该视觉中心与入口大厅（包括地铁口）的联系较弱。

However, the relationship between the visual focus and the main entrance hall （with the entrance of tube station) is weak.

新方案的高精度视线分析 The VGA Analysis for New Scheme



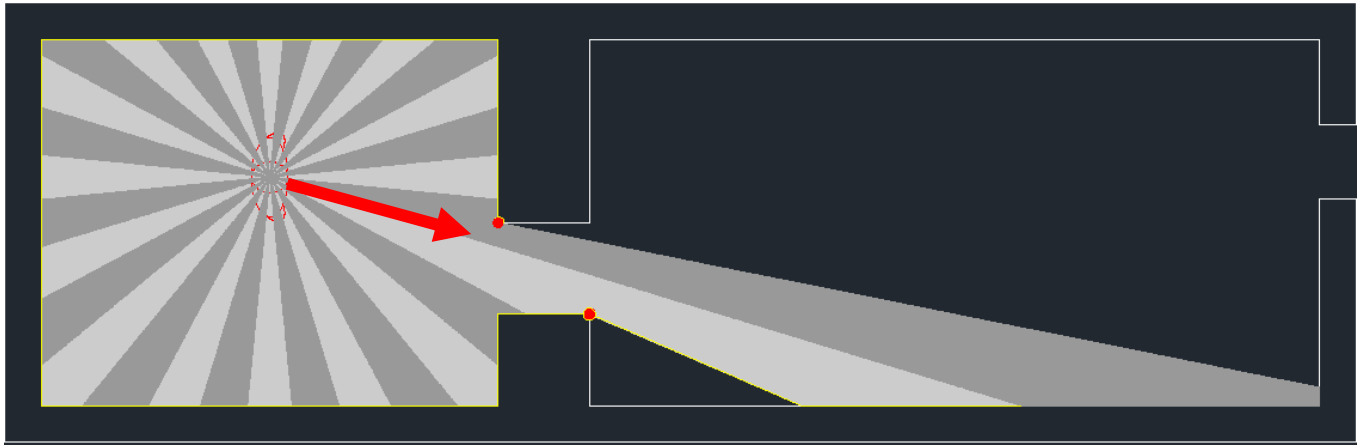
均值 **Avg：0.325；增加率 increment ratio: 24%**

视觉中心（红色部分）仍然位于主轴的中间部分，并向水平和垂直方向扩展，联系周边的小店铺和楼梯等。这儿有可能成为活跃的中心区。

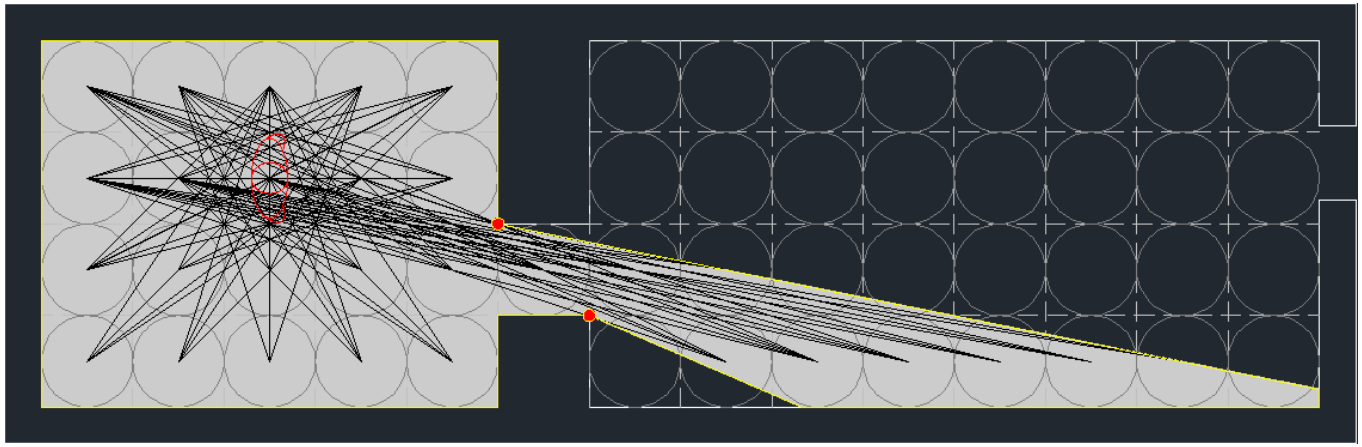
The visual focus (denoted by red) still remains in the middle of the spine, and extending in both vertical and horizontal directions along which small shops and stairs are placed. This would become an active central place.

与原有方案比较，该活跃中心区与主入口门庭的联系较强 （还有进一步改善的空间），这将吸引更多来自地铁的人流。

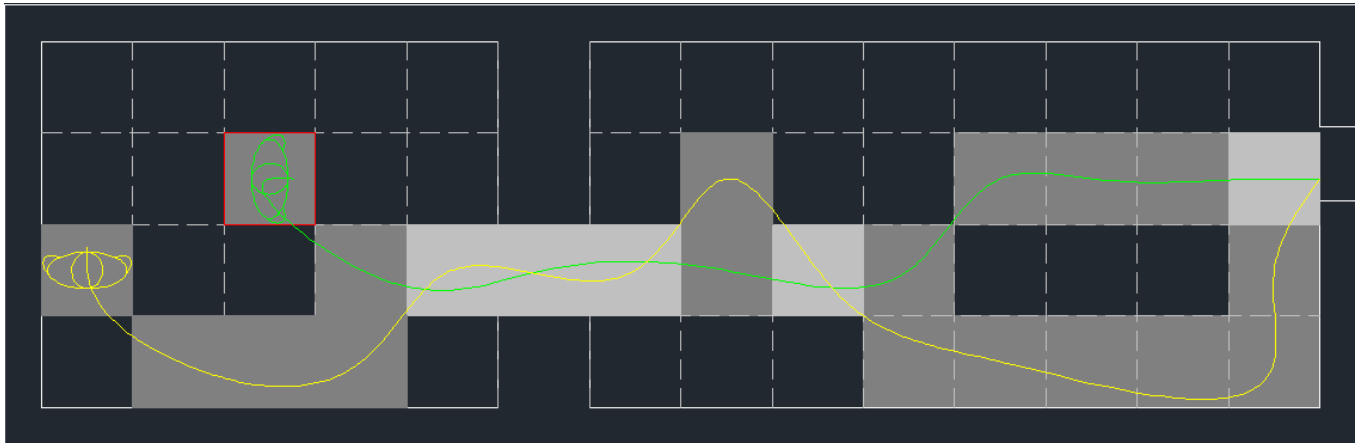
Compared to the old scheme, the active central place is more closely connected to the main entrance hall that also becomes relatively shallow, though their relationship can be further improved. And this would attract more customers coming from the tube station.



从可视图到智能体（Agnets）

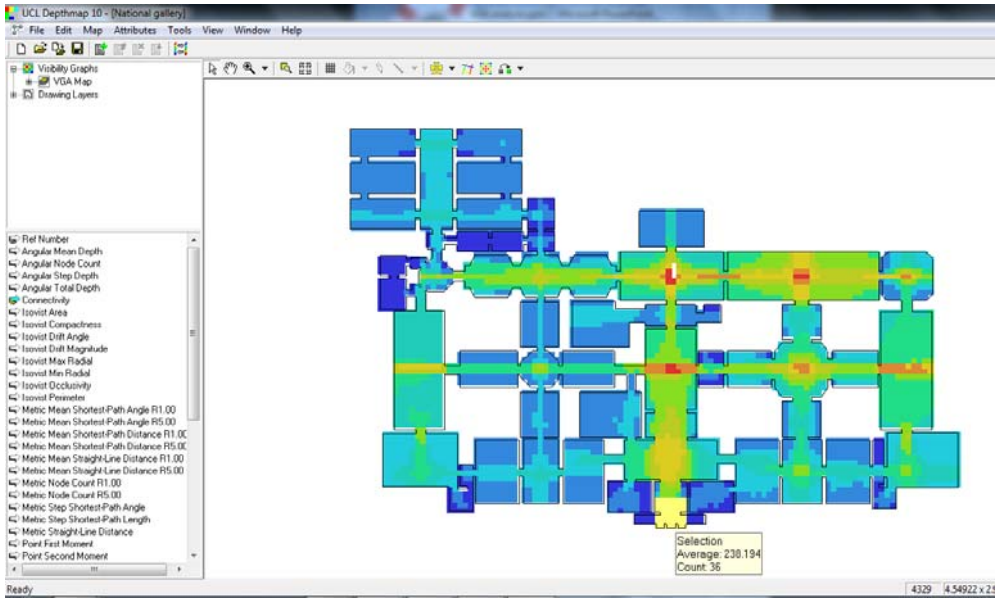


寻路逻辑：
随机选取任意目的地
向那个目的地走去

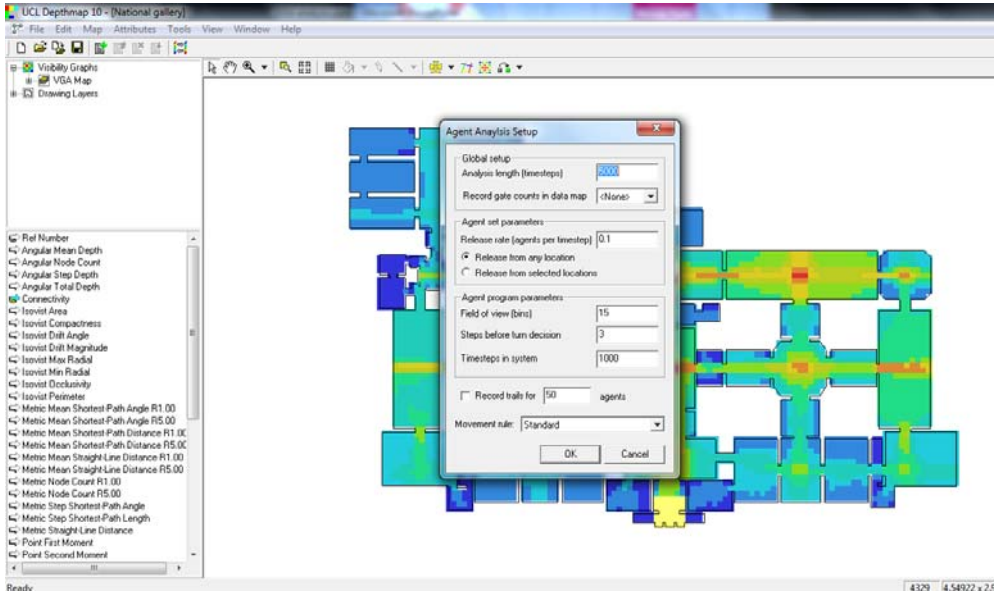


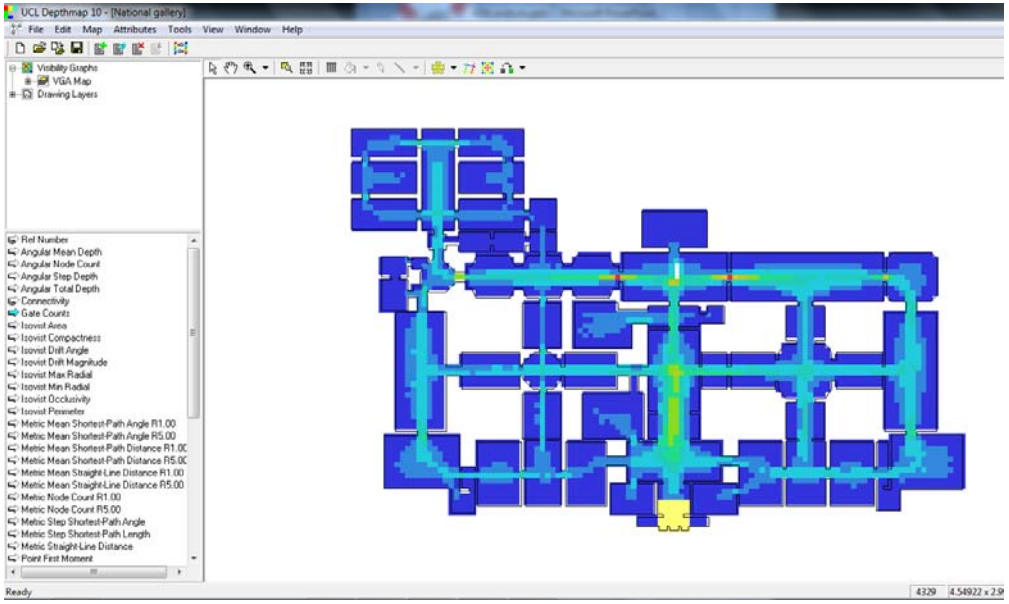
智能体的行走基于迁移概率（ transition probability）

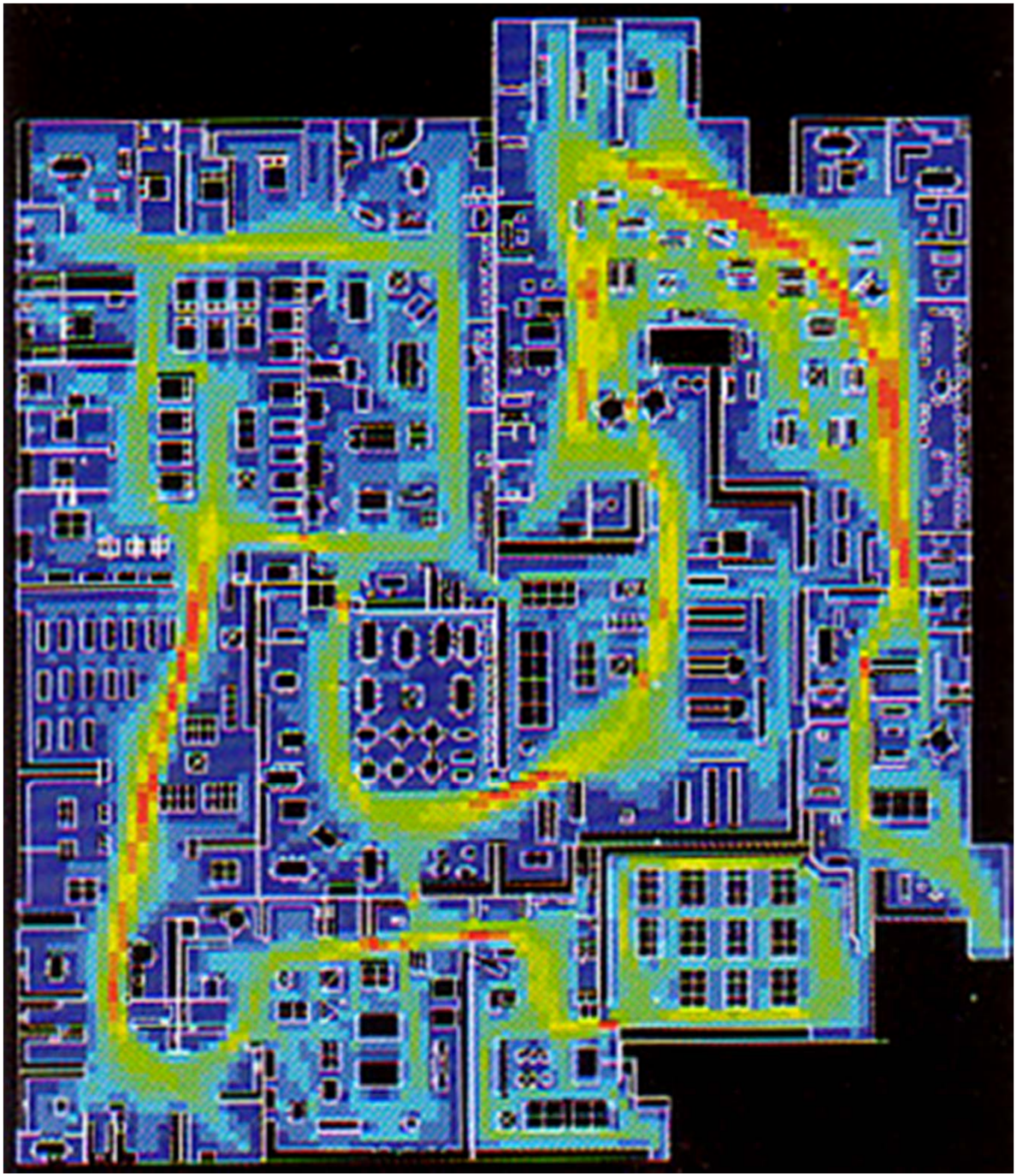
操作简介：选择智能体出发地



操作简介：选择计算的参数

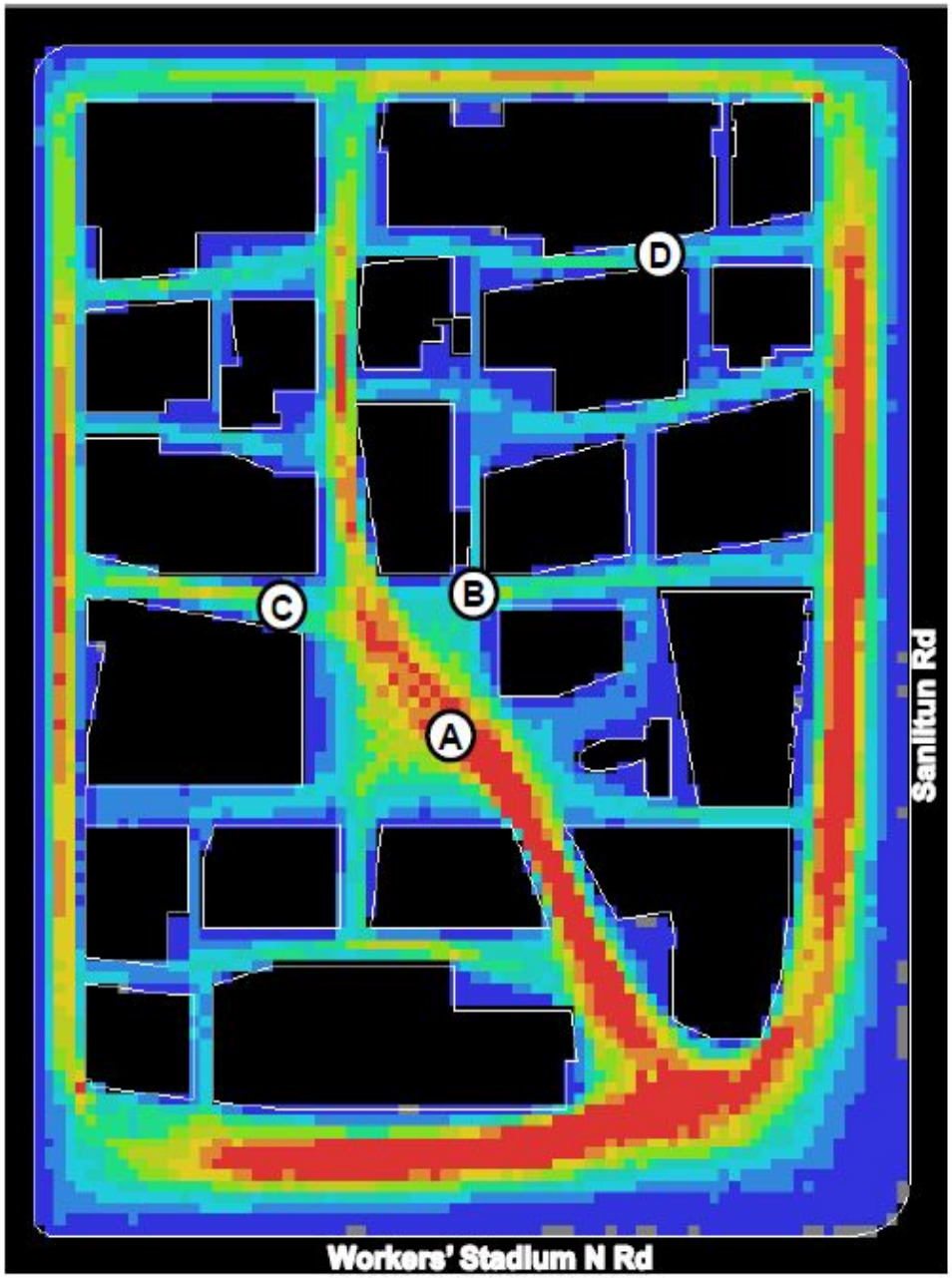






Agent Based Model对宜家室内的运动模拟。

北京三里屯Village模拟结果与实地活动比较




A.


B.


C.


D.

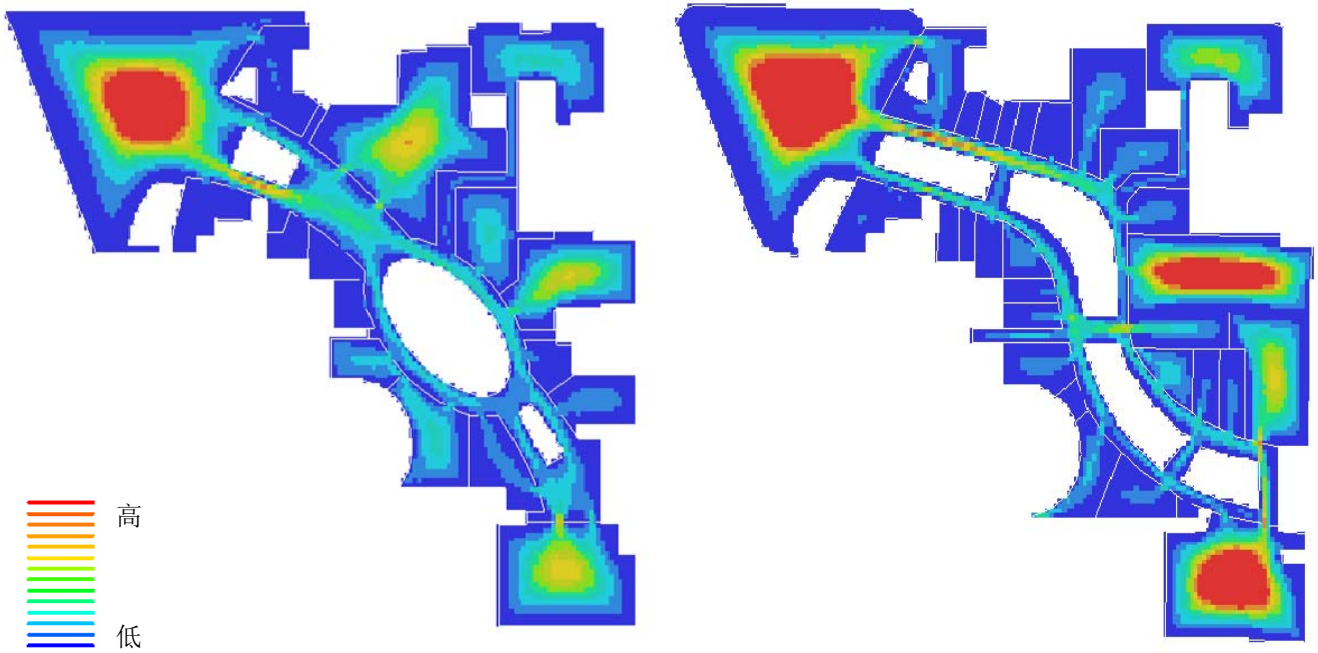
The image shows an agent based simulation of Sanlitun Village. Red indicates higher movement potential and blue indicates lower movement potential.

- The simulation corresponds closely to the movement potential of reality shown by the photos on the left.
- Higher movement potential along the edge of the development and the central spine.
- The scheme encourages visibility into the heart of development from the junction.

软件生成的智能体较少到达的地区实际商业功能也非常萧条。

Agent counts

两个方案的初步流线模拟 A Preliminary Agent Analysis of the Two Schemes



原有方案
Old Scheme

新方案
Proposed Scheme

虚拟流线分析 （未考虑室外情况）

Agent Analysis

新方案的最大顾客流量也将增加**15.96%**。因此租金将会显著提高。

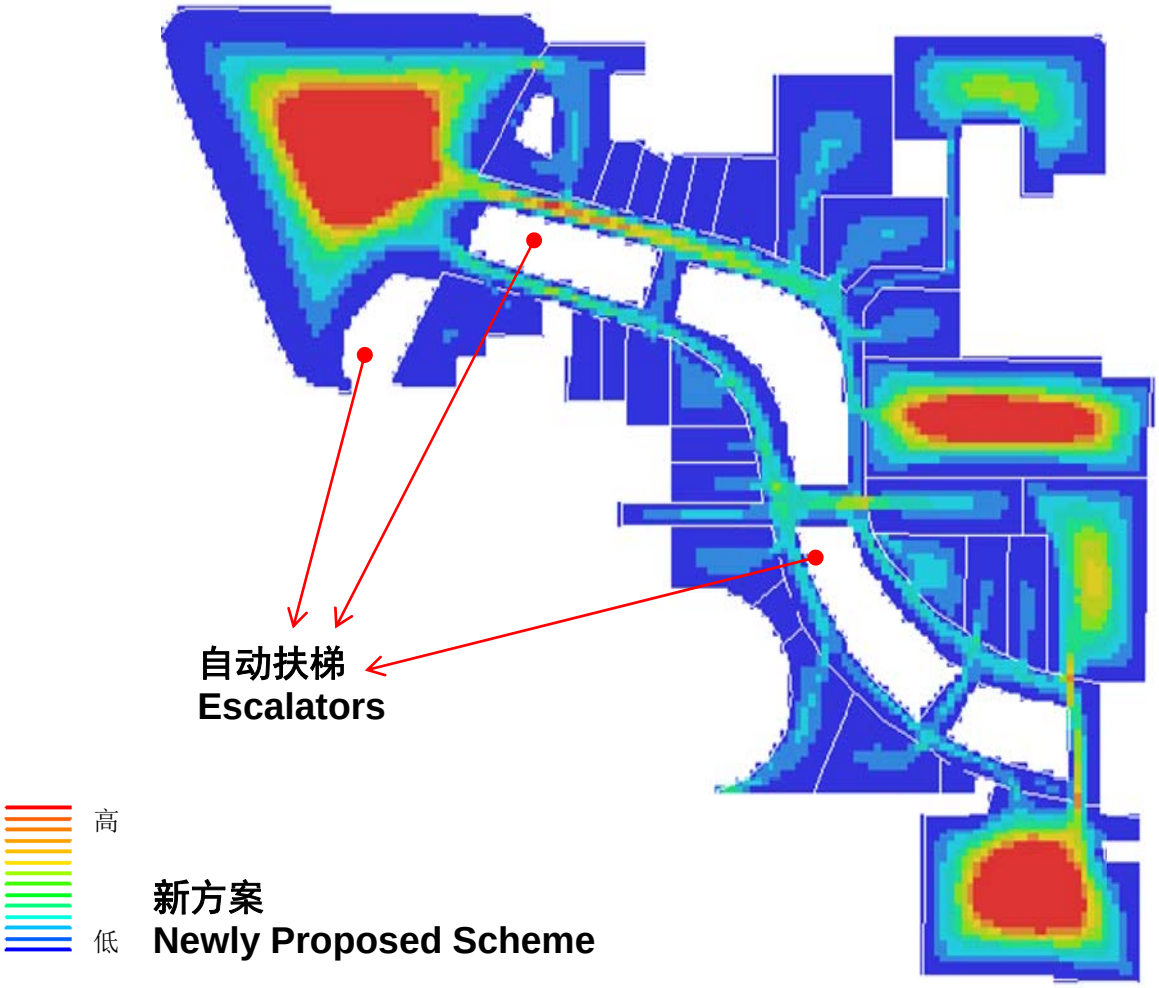
the new scheme would create 15.96% more agents at max. Therefore, the rental values will increase significantly.

新方案中两个次主力店（红色标示）有更多虚拟的顾客。中轴线走道也更加热闹，这与它沿途更多的小店铺有一定关系。

In the new scheme，two department stores (denoted by red) seem to be occupied by more agents and the corridors are busier in the new scheme, partly due to more small shops opening to it.

	老方案 Old Scheme	新方案 New Scheme	增加值 Ratio(%)
顾客流量极值 Max Counted Agents	14621	16955	15.96

对自动扶梯布局的建议 A Caveat Concerning The Location of Escalators



进一步分析

Further Analysis

然而，新方案中的自动扶梯应根据人流分布和主要入口来进一步调整。

In the new scheme, the location of the escalators however needs to be adjusted according to the distribution of movements as well as main entrances.

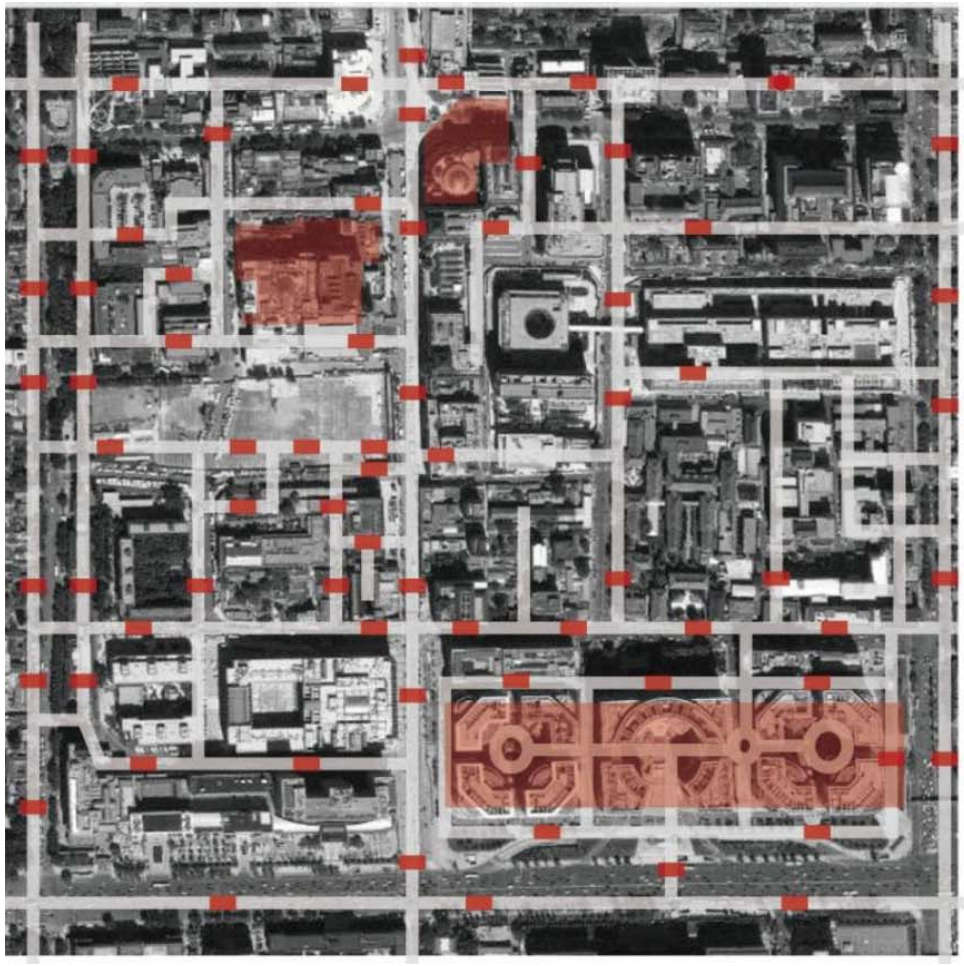
下一步将模拟垂直交通和其他楼层，进行评估分析。

The vertical circulation as well as other levels will be modeled and evaluated in the next step.

流量与空间 王府井国际品牌中心研究案例

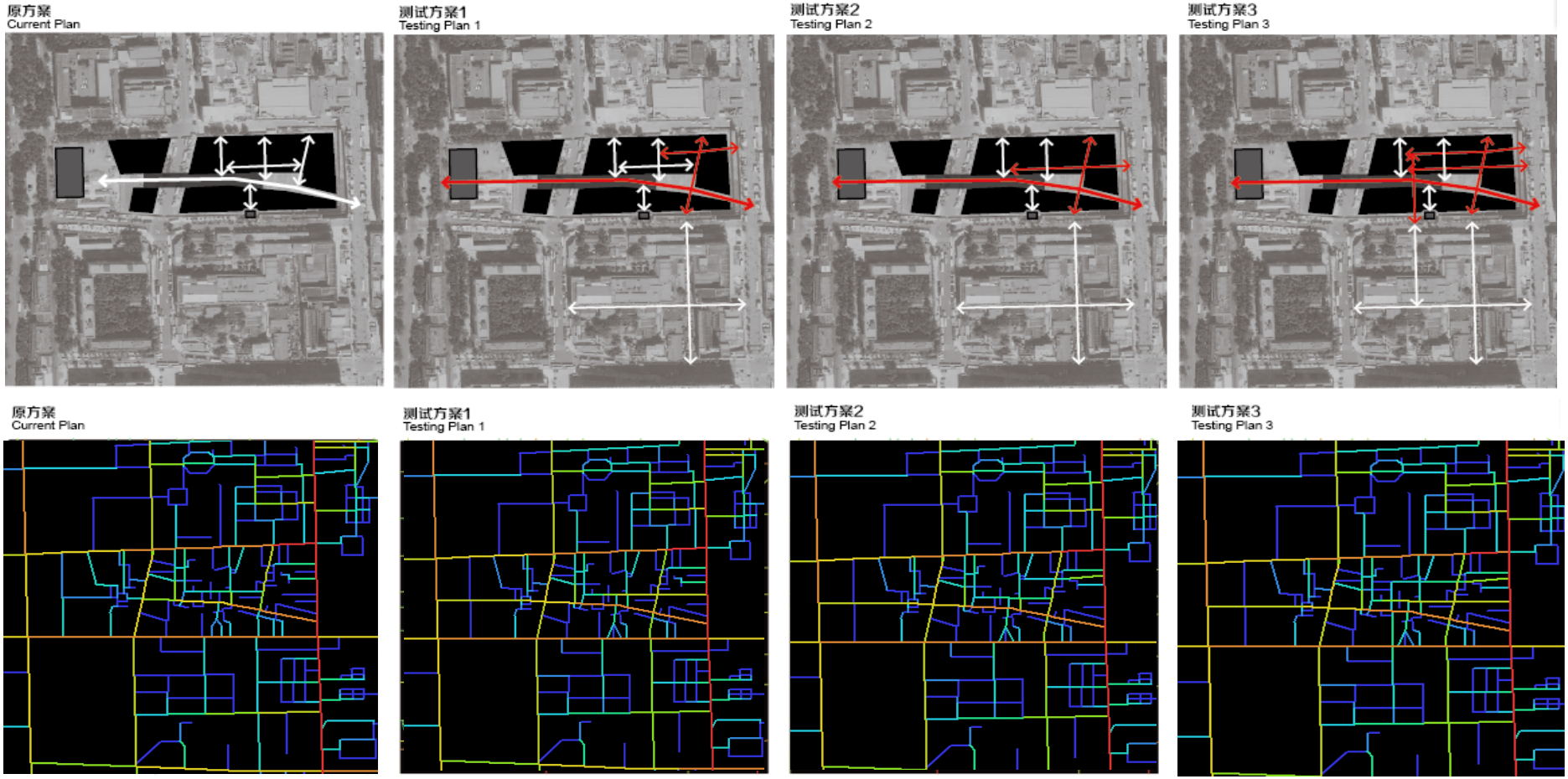
其次，要准备好调研工作。理论上布置流量测点越密越好（极限状态下每个街道段上一个），但需要协调人力资源和调研的范围。

观测点选择：1，城市街道上共72个观测点；



2，三个案例建筑内共346个观测点，893个店铺。

各测试方案的空间参数对比

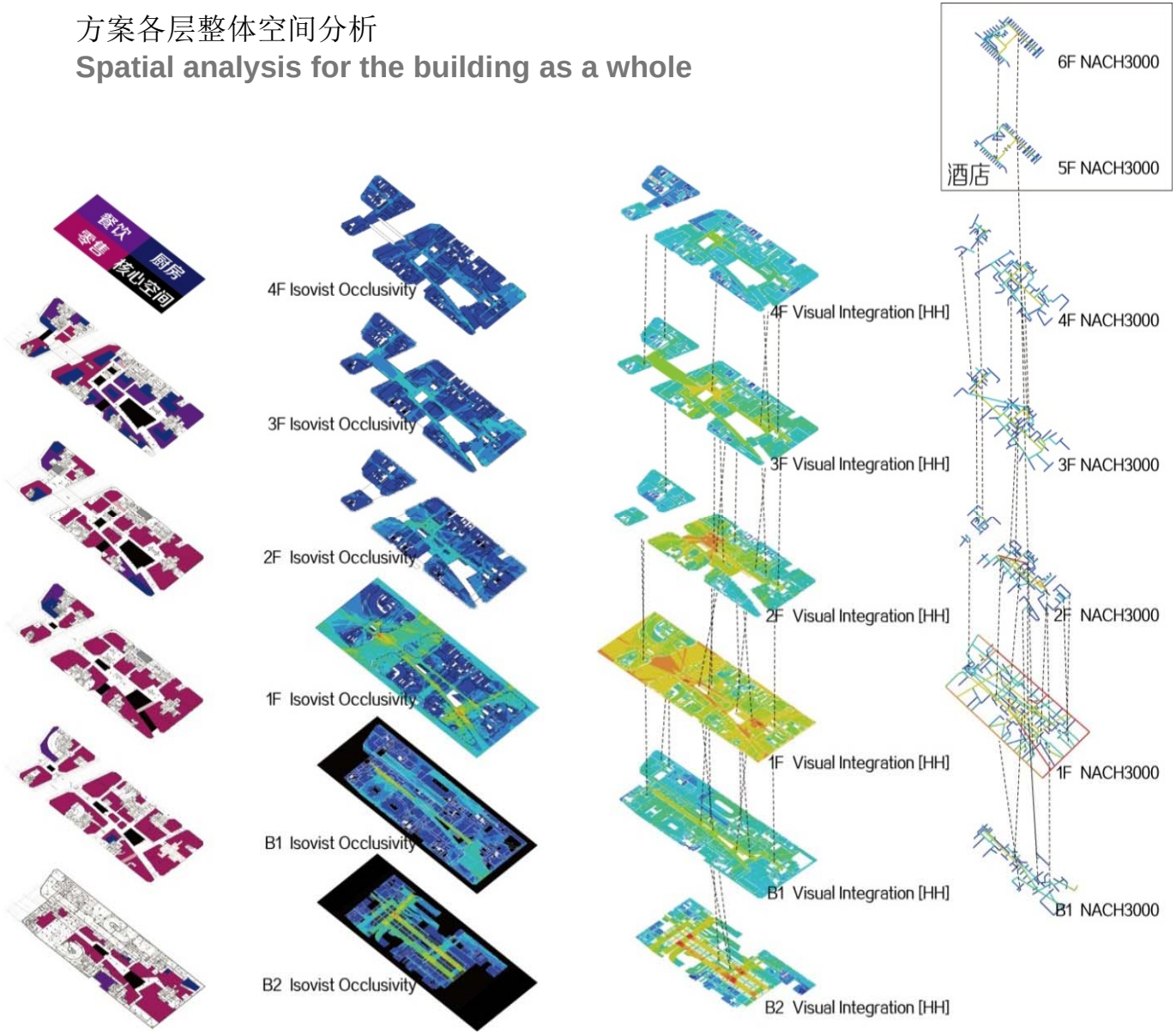


	原方案 Current Plan	测试方案1 Test Plan 1	测试方案2 Test Plan 2	测试方案3 Test Plan 3
3公里平均整合度 Integration R3km	849.766	885.354	894.86	907.301
3公里平均穿行度 NACH R3km	0.789115	0.832781	0.822277	0.844327
数值增里 Value increased	_	4.19%	5.31%	6.77%
折合流里增里 Flow increased	_	17.83%	22.98%	29.96%

测试方案1对原方案改动微小，但仍可获得17.83%的人流量提升。地面层的空间格局对整个建筑的人流量有很大影响。

Testing plan1 has minor change in the original plan. However it still can boost up the flow up to 17.83%. The spatial structure of the ground floor have very crucial influence on the flow of the whole building.

方案各层整体空间分析
Spatial analysis for the building as a whole



根据现有方案的各层平面详图，我们建立了立体的线段分析图和视域分析图。根据这些立体空间分析模型我们将逐层对现有的业态构成方式进行分析，发现问题点并提出优化建议。

Based on detail floor plans, we establish our 3D segment model and VGA models. Using these 3D spatial models we will analyze the potential problems in current plan for each floor and give our suggestions for improvement.

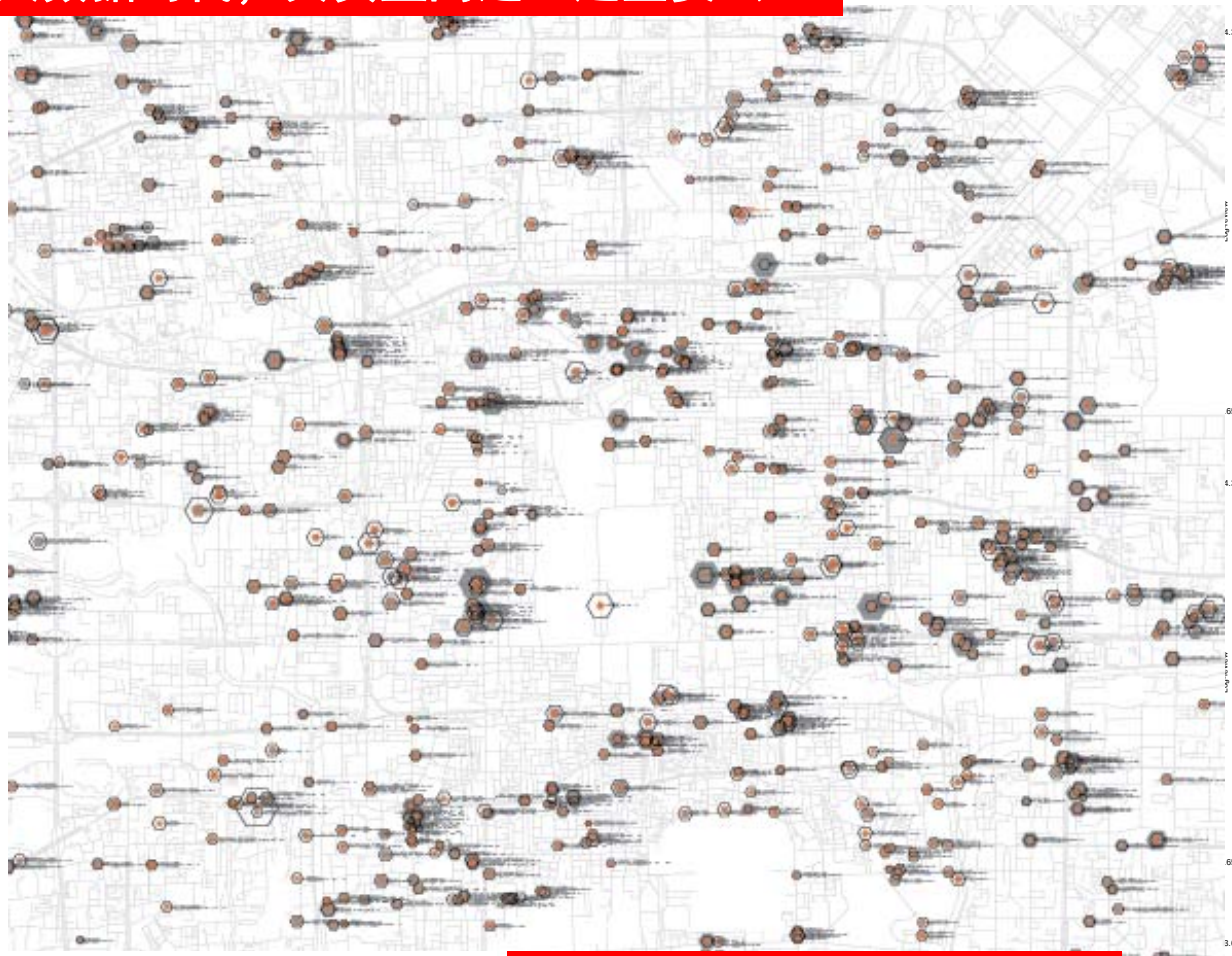
社区与空间 北京日常生活中心的空间分布

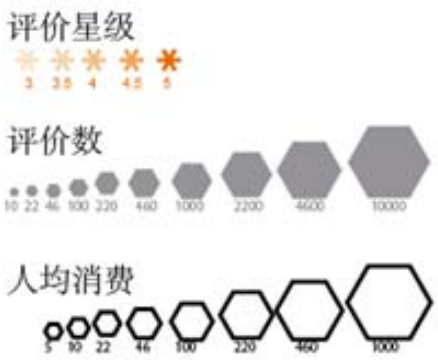
本研究旨在以北京为例分析社区级活力中心分布的空间逻辑，以及菜市场规模与层级空间网络的关系（中心地模型的基础）从而解释：1，统计结果中体现的“幂率”（scaling law）； 2，“距离”对菜市场分布的影响。

社区级中心的确定

菜市场，副食店，小百货，棋牌室等

大数据时代，真实空间选址还重要么？

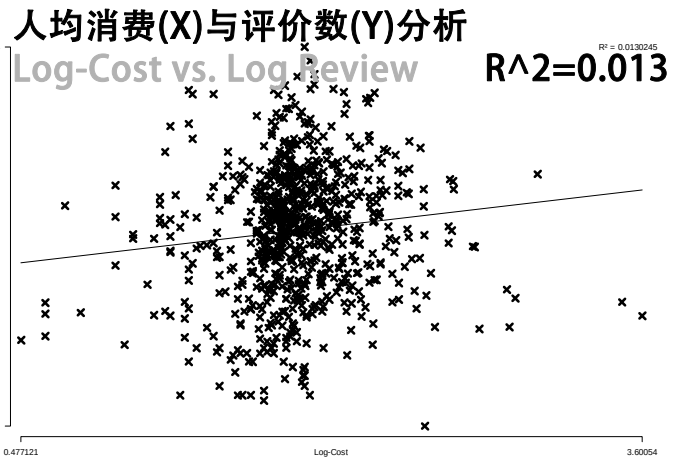


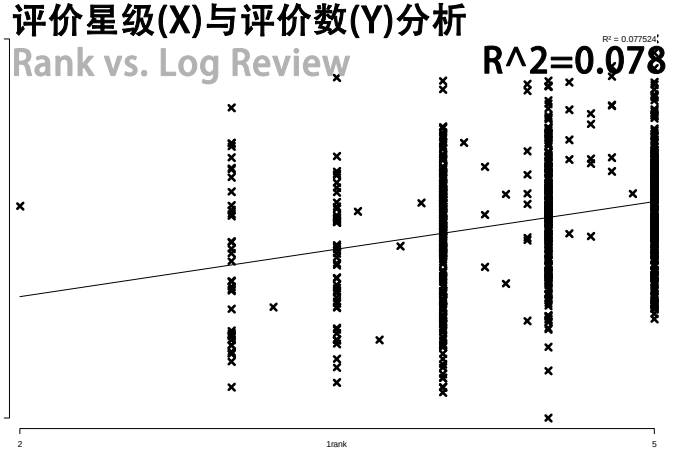


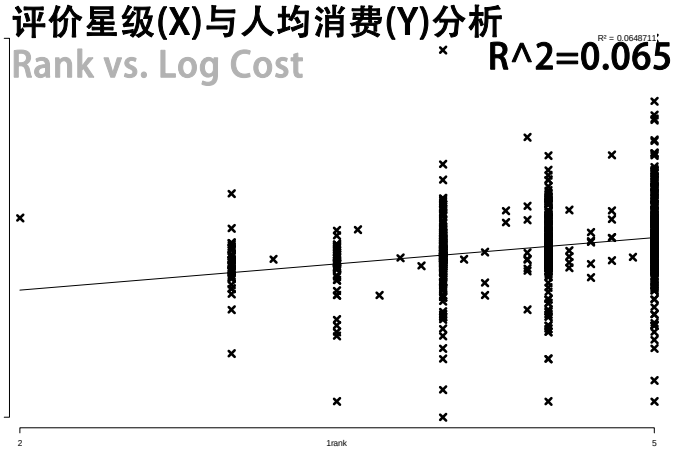
便宜的不一定人多……

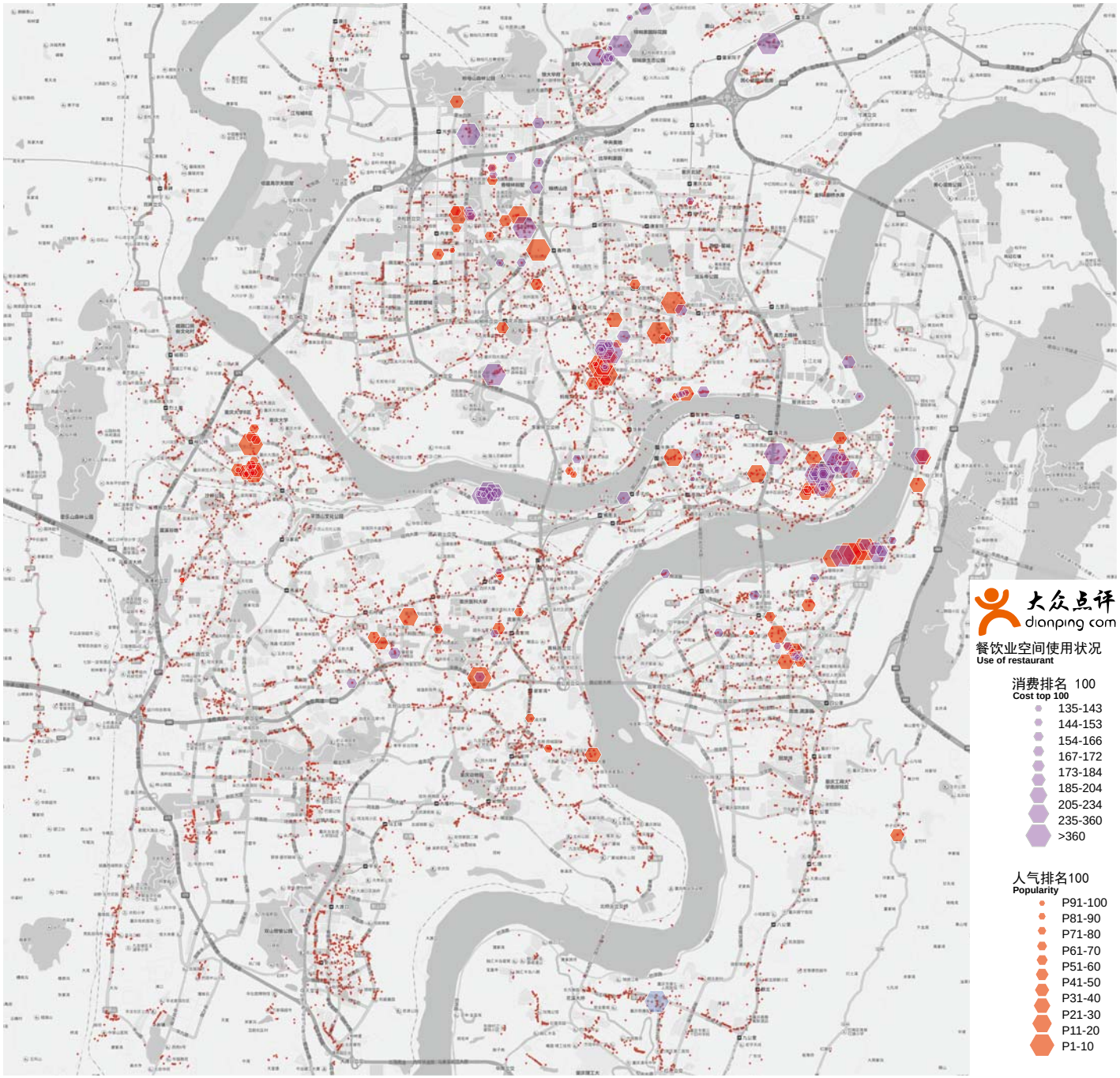
人多的不一定好吃……

好吃的不一定贵……









Data from Baidu Map and Dazhongdianping

网络大数据分析
Web Data Analysis

为验证现状模型的有效性，且量化预测未来重庆北部新区基地内的功能用地发展趋势，本研究将对网上海量的商业功能数据进行空间分析计算。左图为基于大众点评网对重庆地区所有餐饮业的空间落位，以及人均消费和人气在前100名的餐饮业空间分布分析，其结果验证了之前空间模型对各级中心的计算结果。

To verify the spatial model on the existing condition and to predict the future development tendency, we study the web-data on the commercial functions. The left map gives an example on the restaurants from Dazhongdianping. It shows all the locations and the top 100 expensive restaurants and top 100 popular restaurants.

网络大数据给了我们重新认识中心性的视角。

“数据化设计”的理念

对空间研究的意义

大量降低实地调研工作量
新的用户评价数据
远程科研与基地分析
检验空间模型理论假设的“基础科研”

以项目当地各类实测数据为基础，基于空间数据分析明确问题、需求和各相关现象的因果关系，并通过建构数据链来确定设计相关参数体系关系的设计方法。

研究型设计的关系：数据化设计更具体。（空间导向型的研究，关注使用者行为与空间关系的学科基础科研）
与实证型设计的关系：数据化设计更贴近人。（更接近研究人的科学，而非物理或生物学）
与参数化设计的关系：数据化设计不排斥形式美，但完全摆脱以数字为基础的形式游戏。

信息时代最有价值的不是特定的软件（拥有分析工具的人）或数据资源（拥有数据的人），而是将二者结合的基础科研（拥有数据分析能力的人）！


立足科学，以人为本……
Science based, human focused…
我们一直在努力…… 期待各位的加入！！
We are working on it… Join us please!!

常见问题解答

一些常见的技术问题与理念问题解析。

技术类问题

1，为什么我的轴线分析结果看上去很怪？

大多数情况是由于在CAD里绘制轴线图时有个别线段未与其他线段相连。可以通过观察Node Count参数检查，如绝大部分为红色，少数为蓝色，则蓝色部分未与主体相连。有些时候在做完一系列“Unlink”后还会出现这种情况，需重新检查。

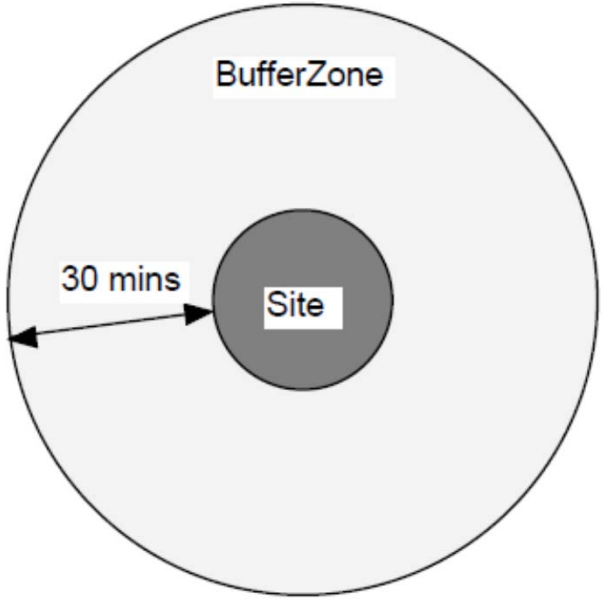
注意：即便做线段分析，也需要保证所有线的连接。

2，分析的范围画多大合适？理论上越大越好

而实际操作中确定分析范围的主要可参考两点：

1，城市区的自然边界（如道建设区域的边界、河流山体等界限）；

2，人为设定的缓冲区（一般根据所分析内容涉及的交通方式确定，取该交通方式下基地周边30分钟可达范围）。



理念类问题

1，空间与功能的关系是否是鸡与蛋的问题？与建筑和规划师常识相反的假设： 从空间到功能，而非从功能到空间。

2，如何体现其他因素的影响？空间句法的“空间决定论”倾向。

3，为何在算法中如此强调“直线型空间”的作用？公共交通如何体现？不同的寻路逻辑是否会导致不同的空间逻辑？

……

理念类问题

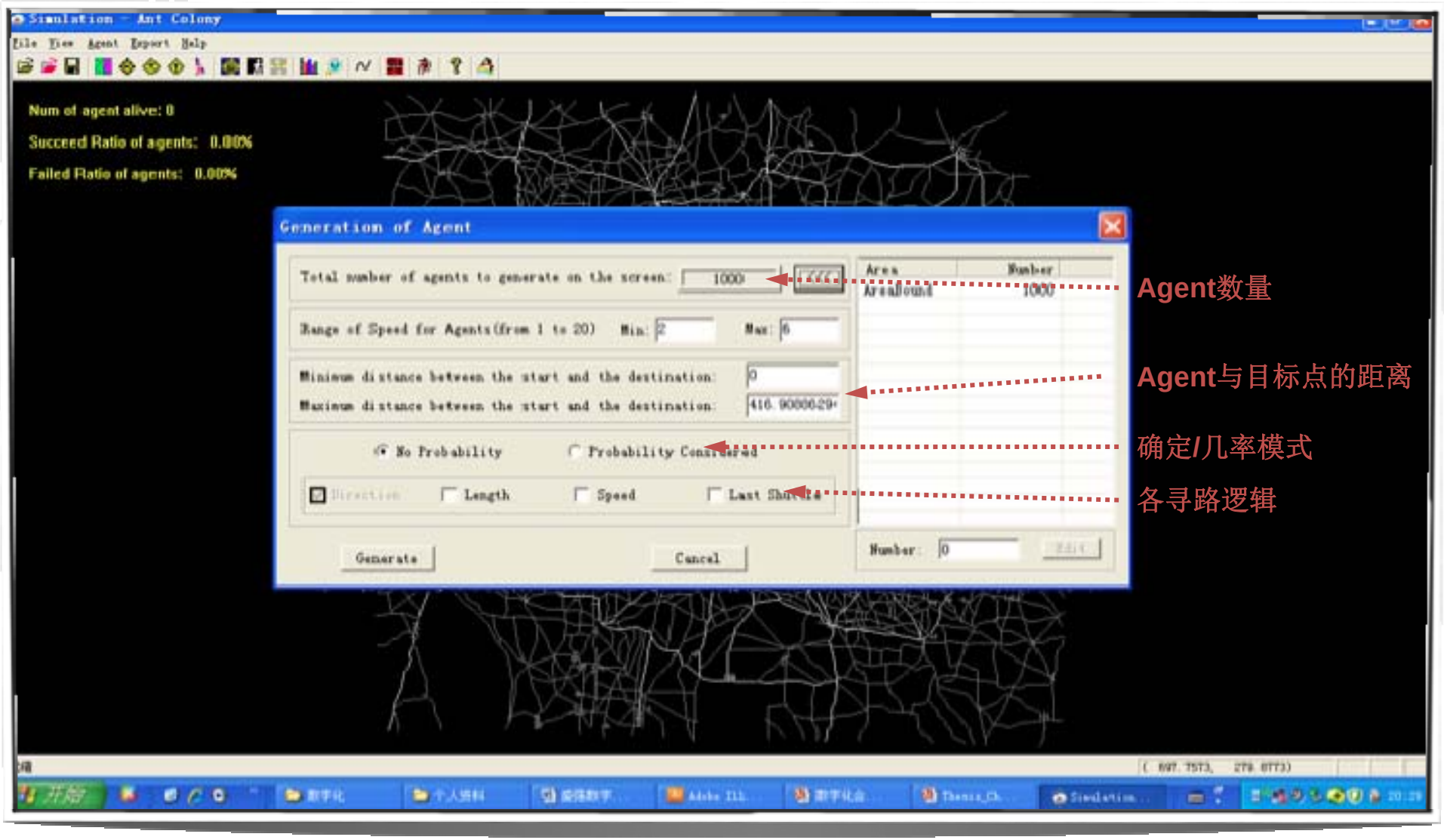
1，空间与功能的关系是否是鸡与蛋的问题？与建筑和规划师常识相反的假设： 从空间到功能，而非从功能到空间。

从简单系统中的“线性因果关系”到复杂系统中“非线性因果关系”。

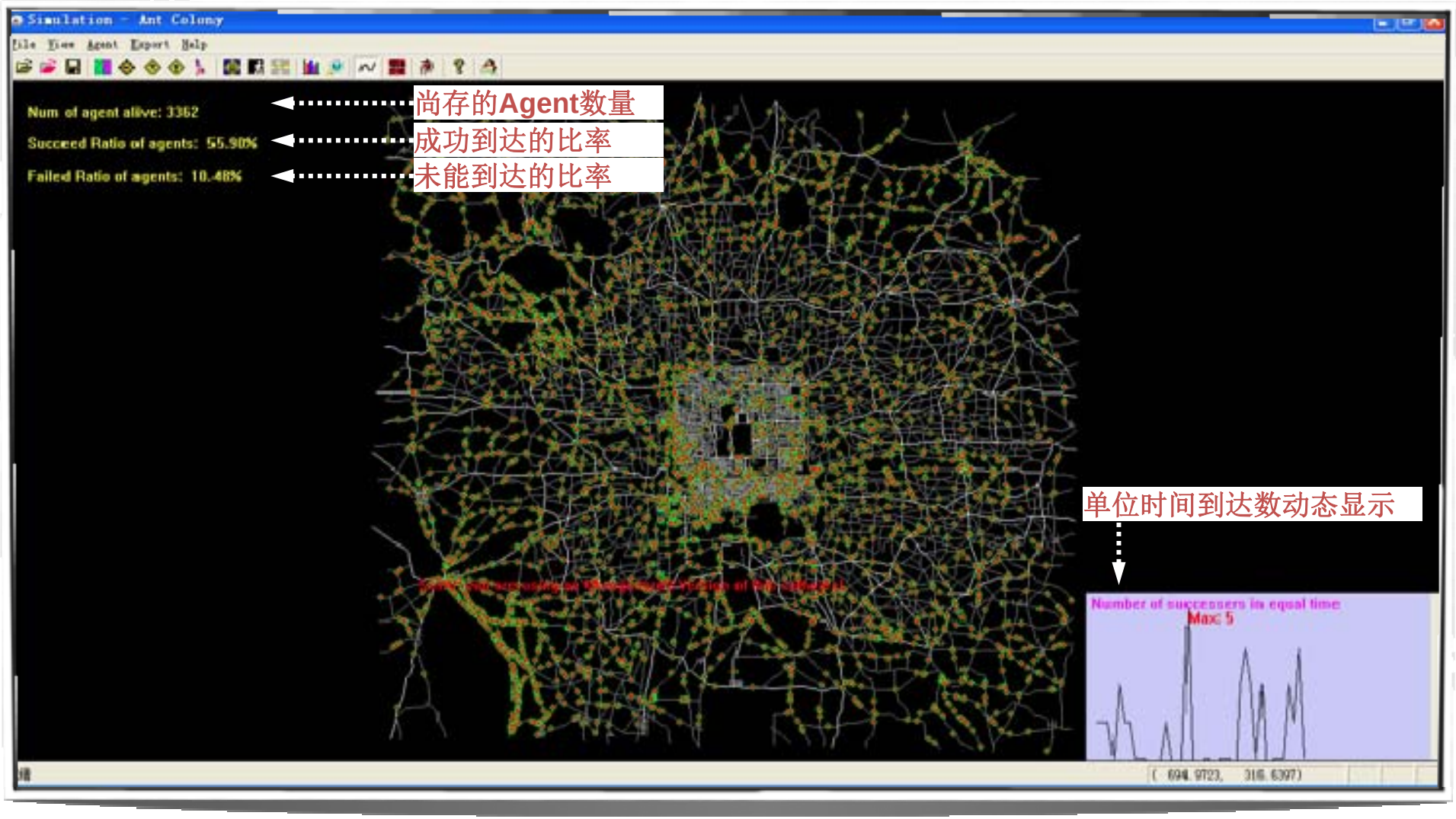
Up til now, a building exists in average 100 years...
…..while the functions inside buildings changes in average every 10 years...
….while a street can exists in average 1000 years….!

理念类问题

3，为何在算法中如此强调“直线型空间”的作用？公共交通如何体现？不同的寻路逻辑是否会导致不同的空间逻辑？

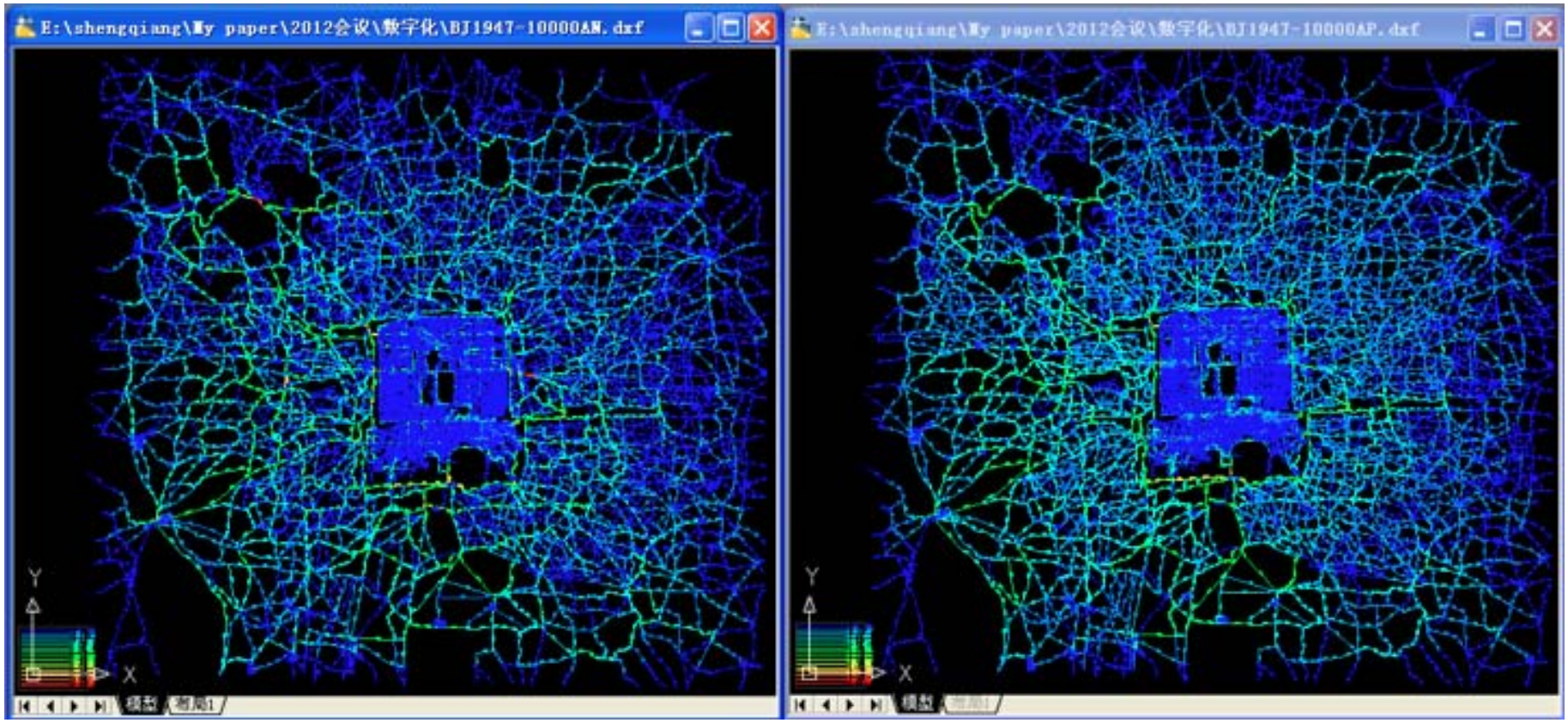


理念类问题


Simulation - Ant Colony
File View Agent Export Help
Num of agent alive: 3362
Succeed Ratio of agents: 55.90%
Failed Ratio of agents: 10.48%
尚存的Agent数量
成功到达的比率
未能到达的比率
单位时间到达数动态显示
Number of successors in equal time
Max 5

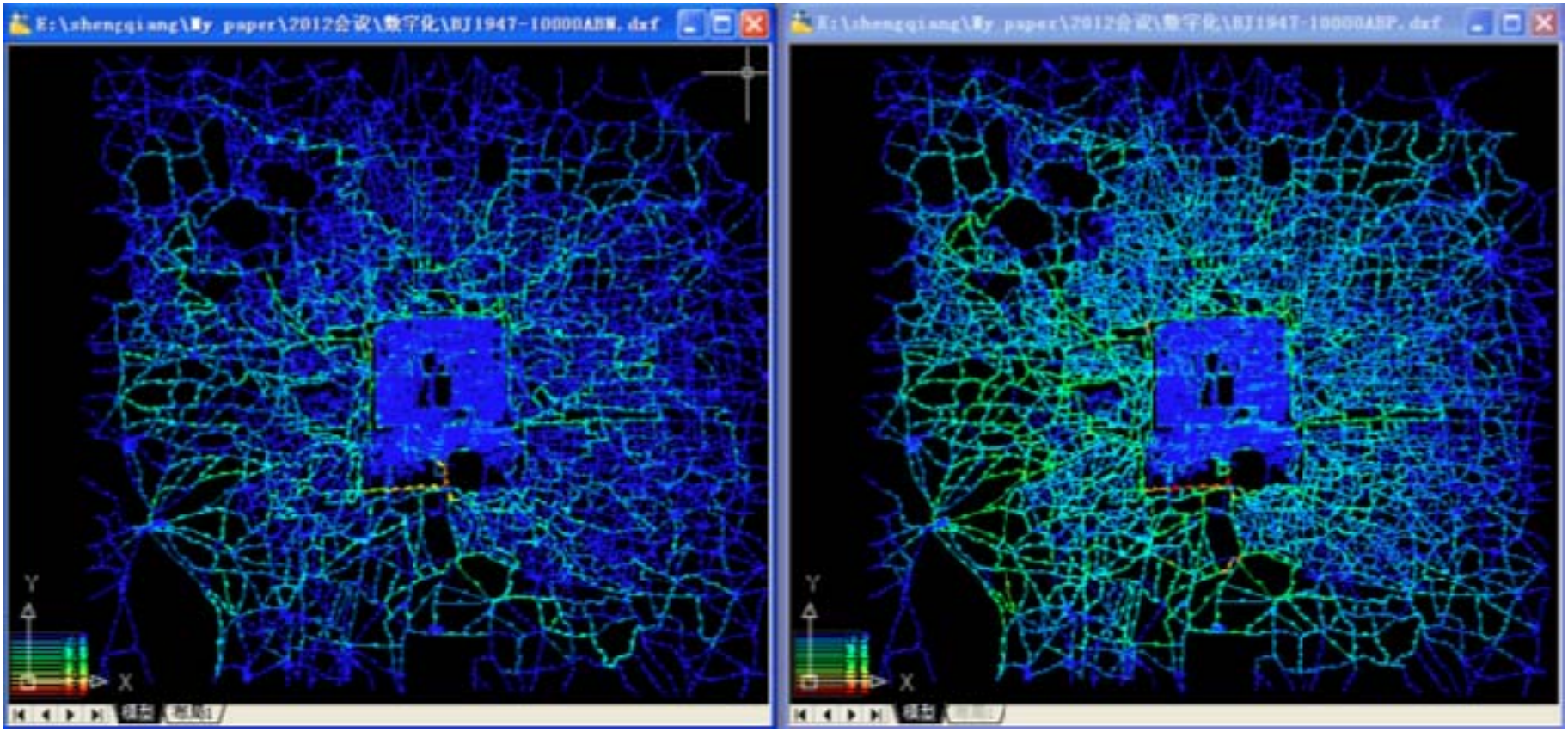
理念类问题

寻路逻辑A为系统默认的寻路逻辑，用户不能选择将该逻辑的影响关闭。A体现的是Agent与目标点之间方向的影响。在Agent运行至每个道路交点时，都将根据目标点与备选道路的夹角方向来决定下一步选择道路的几率。



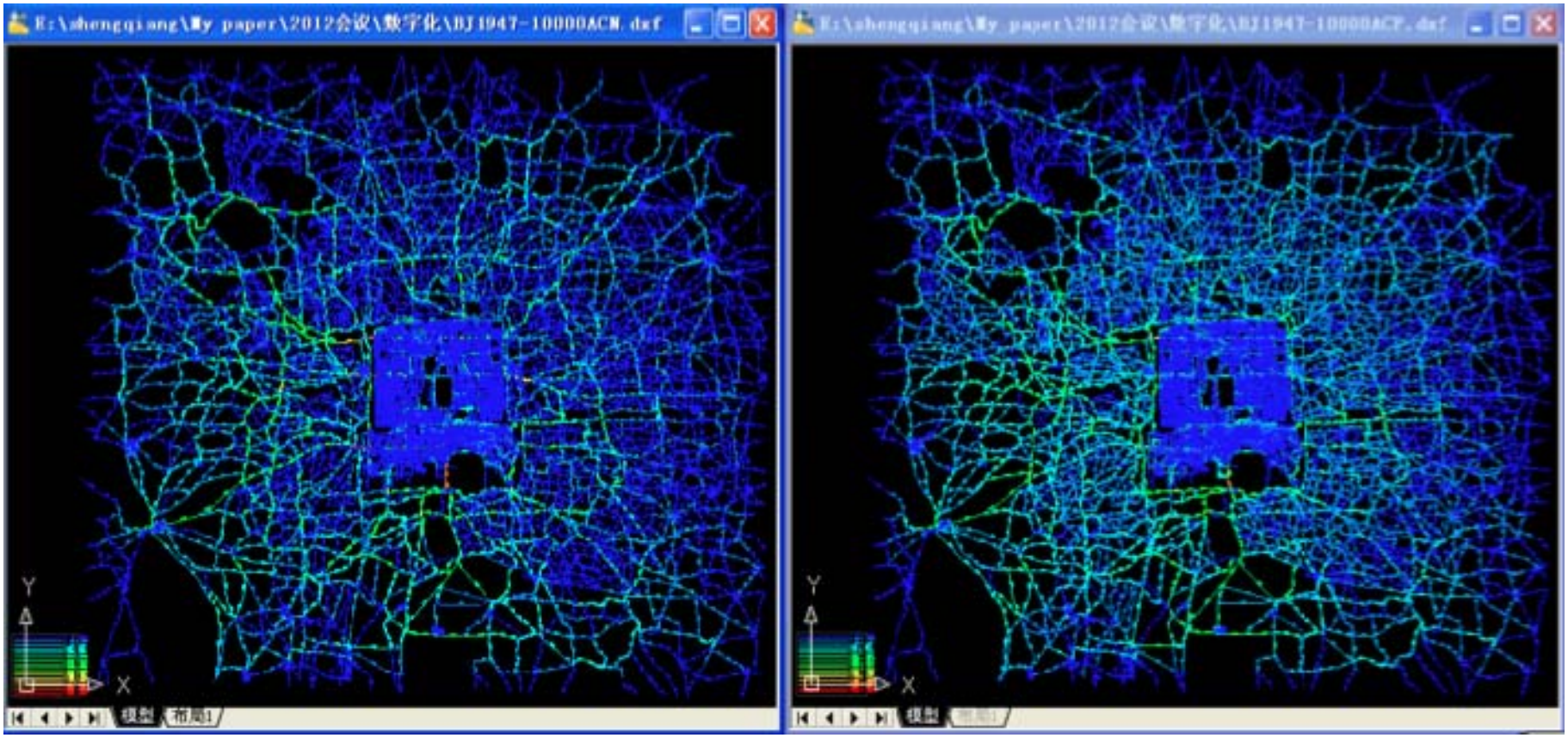
理念类问题

寻路逻辑B的规则为Agent在做道路选择时会趋向较长的线段。预计这个规则导致的效果会与空间句法的算法近似，给长直线空间一定的优势。空间句法学者对真实使用者在空间中行为的观测也支持了该逻辑的合理性。



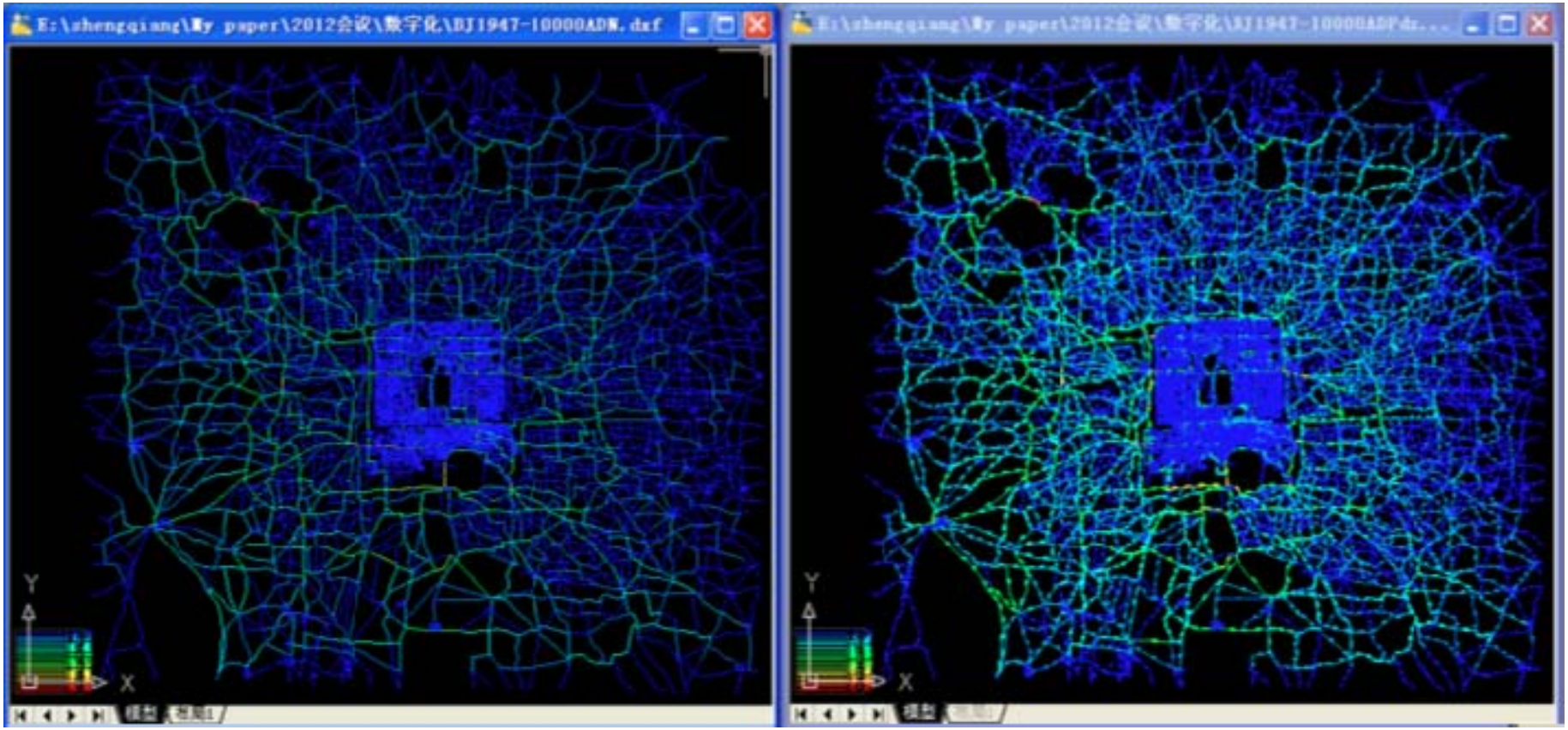
理念类问题

寻路逻辑C将引入道路的等级差异：ROAD_3图层默认权重为ROAD_2的两倍，ROAD_2图层的默认权重为ROAD_1的两倍，该倍数关系同样可以在高级初始设置中修改。引入此逻辑意味着道路可以不在被视为是均质的直线段，而可以模拟由宽度、速度等客观因素造成的优势。该逻辑与其他逻辑复合应用时直接通过乘积影响原有的几率分配。



理念类问题

寻路逻辑D将Agent的道路选择几率建立与前次模拟的结果之上。在下一次生成Agent进行模拟之前，使用者可以导入之前存储过的流量文件，则每条道路在之前模拟的通过Agent数自动成为本次模拟道路选择的几率分配。与逻辑C类似，逻辑D的影响也是通过乘积的简单算法实现。该逻辑以一种“从众心理”的方式试图为Agent引入一定的学习和记忆功能。



理念类问题

使用者需要在生成Agent的界面内选择是否打开几率开关，如果选择的是几率模式，则Agent在做道路选择时受几率影响，而当选择确定道路模式时，Agent将只选择几率大的道路，而不进行随机的选择。

	A	AB	AC	AD	ABC	ACD	ABD	ABCD
确定模式	77.10%	60.11%	72.23%	77.33%	62.06%	78.96%	71.24%	71.80%
几率模式	66.40%	60.87%	67.91%	74.36%	61.49%	75.65%	71.35%	71.59%

阶段结论：

-几率模式在绝大多数情况下略降低了Agent的成功率。

- 各个不同组合对提高Agent成功率的影响有限，这说明 个体的智能对整体规律性影响很小，所谓的“智能”应该更多的预存贮在系统整体的环境设定，即路网形态本身。