Atlanta: A Morphological History

Ref 087

Stephanie Dawn Haynie
Georgia Institute of Technology, College of Architecture, Atlanta, United States
dhaynie_ddesign@earthlink.net

John Peponis
Georgia Institute of Technology, College of Architecture, Atlanta, United States
john.peponis@coa.gatech.edu

Keywords
spatial configuration; spatial morphology; urban growth; urban morphology; morphological history

Abstract

The evolution of Atlanta has undergone distinct phases, each seemingly in association with transportation. In the early 1840s, the city emerged as a pattern of colliding grids coming together around three intersecting railroads. By the late 1890s, the first curvilinear street patterns were introduced in the early suburbs along with the street car as an early form of mass transportation. The increase in the use of the automobile in the 1920s is associated with faster growth in the suburbs, although many of them were still curvilinear. The first interstates were built in the 1950s and pushed urban expansion to a much wider radius around the old historic city center of Atlanta. In the 1960s, cul-de-sacs and residential enclaves became the dominant mode of growth and remain so. And throughout this evolution, the size of urban blocks has tended to increase, while spatial integration has tended to decrease, shown by Peponis, Allen, Haynie et al. in an earlier paper presented at the 6SSS of 2007.

In this paper, we track the evolution of the center of Atlanta more systematically, through the analysis of historic maps: 1853, 1864, 1872, 1886, 1893, 1928, 1955, 1977, and 1995. We consistently look at the area contained within a four mile radius; although this area is not fully covered by urban growth until the 1920s. Our aim is to see how the center of the city has changed as a result of the birth and expansion of the metropolitan area around it.

The relationship between changes inside the historic center and larger scale urban growth was initially described by Doxiadis in 1968, which brought it to the attention of city planners and urban designers. He claimed that as the city expanded, there was a tendency for a continuous rebuilding of the center, which was destructive to historic continuity and urban memory, and that this tendency could be avoided by designing linear centers that grew outward as a function of metropolitan growth. While in Atlanta this is evidently true with regard to buildings, we are exploring how far it is true with regard to the spatial structure of streets. Our results so far indicate that there have been significant shifts in the spatial structure of the urban area even when we do not take into account the "distributed spatial connectivity attraction" exercised by metropolitan growth. Through this period, however, the urban center of Atlanta has maintained a particular characteristic: it is an assembly of distinct clusters of greater street density linked by a set of often disparate long lines of directional reach. Thus, the center of Atlanta appears as a shifting patchwork of distinct sub-areas, not as an integrated system, almost a microcosm of patterns that are much more evident at the metropolitan scale.

1. Introduction

In 2007, the Morphology Lab at the Georgia Institute of Technology was broadly looking at cities across the United States and measuring the various characteristics of their density. They introduced several new measures, specifically metric reach and directional distance, and they compared them to the traditional measures of connectivity used often within the planning community, such as mean length of street segment, block density, as well as intersection density (Özbil and Peponis 2007; Peponis et al. 2007a; Peponis et al. 2007b). In one particular study, they

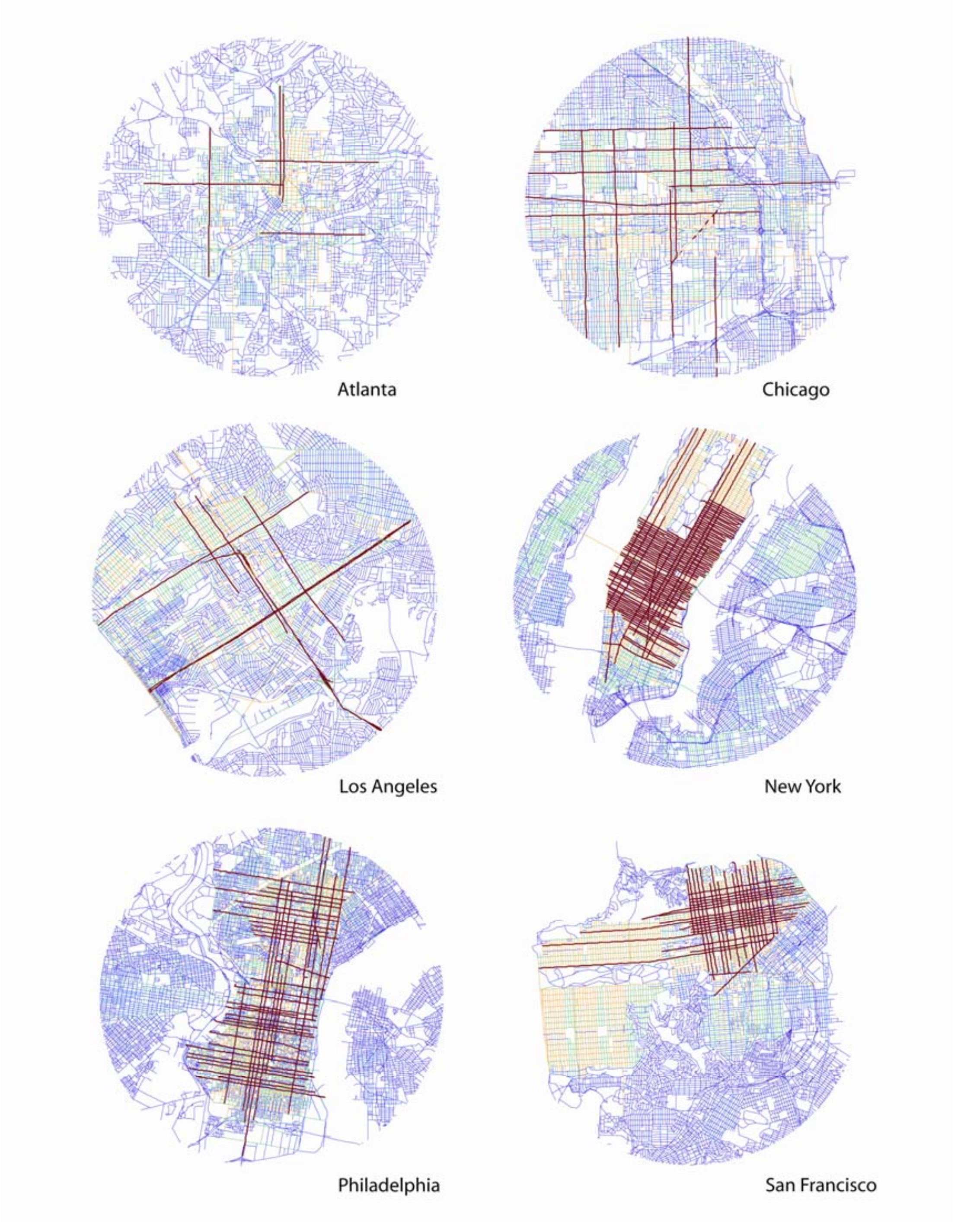

Figure 1

Directional Reach Maps of Major American Cities, shown here for a 4 mile radius with two changes in direction, each change measured at 10 degrees. A full spectrum of color is used to show the 5 natural breaks found within the values, with segments holding the highest values appearing in red.

illustrated the evolution in those measures and the parallel that they had to the planning theories of the time. The early settlement patterns of the city were set in a variety of grid patterns and remained so through the Industrial Revolution. With the emerging interest in the natural landscape during the 19th century, the patterns were modified and infused with more curvilinear forms, and these forms continued with the introduction of the automobile as a new, more independent form of transportation. By the 1960's, interstates and cul-de-sacs had finally succeeded in isolating the people from the city which surrounded them, and the city was completely decentralized and fragmented. As cities grew, their patterns tended to become less dense and less connected, and thus decreased the potential for social interaction. With metric reach, they showed that the measures of certain types of forms tended to cluster, statistically, and that these various measures of density tended to coincide with the characteristics of these types or patterns (Peponis et al. 2007b). More interesting, though, may be the distinctions which emerge within each period and the cases which may defy the prevalent structural properties and tendencies under consideration. Given the similarities within the density measures, specifically that of metric reach and directional distance, how would these cities compare when we take directional reach, a measure more sensitive to syntactic properties, into account?

Using the program Spatialist_lines, developed at the Georgia Institute of Technology (Peponis, Bafna and Zhang 2008), we analyzed the centers of several American cities to create a comparison and to study the structure of street connectivity. Refer to figure 1 for an illustration of cities studied. The value highlighted here is directional reach, which measures the available street length captured while moving outward in every direction from the midpoint of a segment for a set number of changes in direction, with every change in direction measured against a parametric threshold. For this analysis, the threshold was calculated at two direction changes to capture the structures most similar to those emerging from Integration radius 3 in standard axial analysis, with 10 degrees as the parametric threshold. New York, Philadelphia, and San Francisco demonstrate clear, integrated directional reach cores – directional reach cores are comparable to integration cores in typical space syntax axial analysis. Chicago, and possibly Los Angeles, show more decentralized, distributed structures, probably as a result of the bisecting river and interstate systems, but their strong directional reach lines are connected into a system just the same. Atlanta, on the other hand, despite a similar dense grid pattern and disruptions within it, has almost a completely fragmented structure.

Traditionally, cities, or the areas within them, which are considered to be dense by a variety of measures, are believed to be linked to a host of physical, social and cultural characteristics and to sustain urban vitality. These characteristics include increased building densities, pedestrian traffic, or multi-modal means of transportation, as well as increased economic activity and variety within it (Jacobs 1961; Jacobs 1993; Southworth and Owens 1993; Cervero and Kockelman 1997; Siksna 1997; Handy et al. 2003). Others have shown density to support certain characteristics, specifically syntactic integration, which contributed to the intelligible structure of the city (Hillier et al. 1987; Peponis et al. 1997; Jo 1998; Hillier 1999; Hillier 2002; Wang et al. 2007). Denser areas, however, are often associated with the older urban centers. Thus, as Doxiadis (1968) has pointed out, they are subject to continuous re-building and transformation in response to the pressures exercised by urban growth. The question thus arises as to how urban centers maintain their intelligible structure even as their relational properties change as a function of growth, and even as their internal street structure gets modified. We decided to pursue this question by looking more closely at the case of the City of Atlanta.

2. Data Collection and Methods

Historical maps were collected from the archives of the Atlanta Historical Society and from the library at the Georgia Institute of Technology. The 1853 map of Atlanta, drawn by Edward A. Vincent, is the oldest street map held within the collections and is always shown as the original map of the city. The 1864 map is a Civil War map showing the line of defenses for the city. The 1871, 1886, and 1892 maps are all directory maps for the city. The 1928 map has been compiled from maps created by the US Geological Survey. And lastly, the 1955, 1977, and 1995 maps are all road atlases. These maps were scanned and then redrawn as street center line maps more appropriate for analysis with GIS-based software developed at Georgia Tech (Peponis, Bafna and Zhang 2008). Discrepancies and slight distortions were common within those maps surveyed prior to 1928 and have been corrected when and where possible, and when available supplementary evidence warranted such corrections.

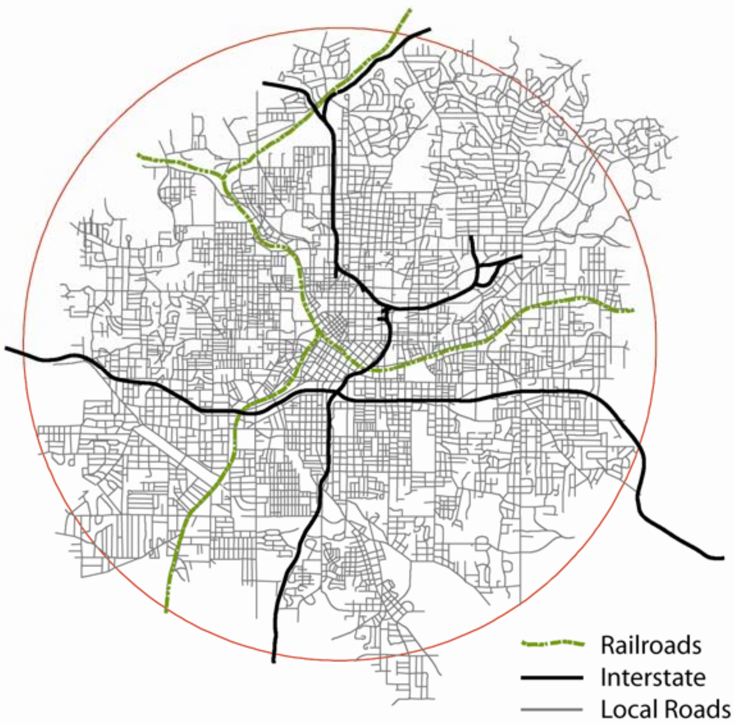

Figure 2
Map of Atlanta in 1995 illustrating the location of the railways and the interstate highway system in relation to the local street structure. The inherent creation of discontinuity across the structure of the city is evident.

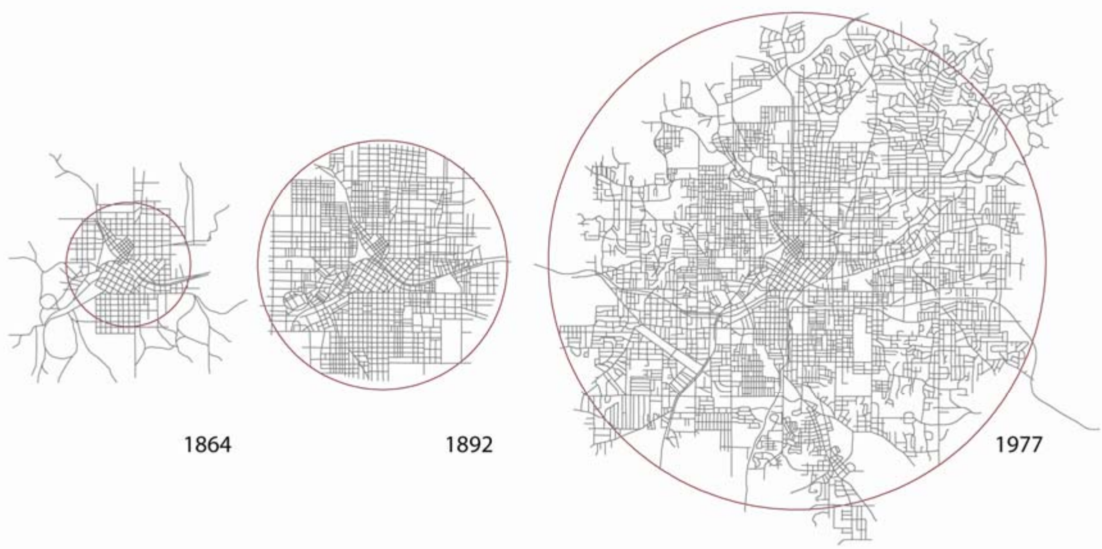

Figure 3
A sample of Atlanta maps to illustrate its evolution and patterns of growth. In 1864, the city limits are shown in red at a one mile radius. In 1892, they are shown at a two mile radius. By 1977 the central area of the city has reached its densest at a four mile radius, and it has changed relatively little since then.

Atlanta is a composite of major transportation systems, both old and new, as seen in figure 2. Prior to the establishment of the railroad, the city did not exist. It was chartered by the Georgia General Assembly in 1837 as a point of termination for the newly constructed Western & Atlantic railroads but not actually established formally as a city until 1847. It was created essentially in an uninhabited area of north central Georgia on a relatively flat piece of land a midst a much more hilly terrain. So in contrast to older cities in America, the railroad was laid first with the local streets laid in response to it (Russell 1988). The city grew outward in all directions, as many cities in America did, particularly along major streets of influence and along areas with access to the street car (Preston 1979; Carson 1981). It reached its ideal subdivision around the 1940s, at which time the interstate began to be interjected to allow for greater ease in access to and through the city (Martin 1975). And yet through each phase, the measures of density remain relatively consistent with those other major cities shown in figure 1, and remain congruent with most of the traditional downtown areas in America constructed prior to 1925 (Peponis et al. 2007b). Refer to table 1 for a sample list of Atlanta's density measures as they relate to the historical evolution of the city illustrated in figure 3.

Atlanta	Area (square miles)	Sum of Street Length (miles)	Street Density (area/sq mile)	# of Road Segments	Mean length of Road Segment (feet)	# of Blocks	Block density (blocks/sq mile)	# of Intersections (with directional choice)	Intersection Density (Intersections/sq mile)	Mean Reach Value (1mile)	Directional Distance Value (10 degrees, 1mile)
Map of 1864	4.61	93.81	20.35	833	595	333	72.25	454	98.50	29.74	2.94
Map of 1892	9.65	228.49	23.68	2833	426	1183	122.58	1574	163.09	38.42	2.55
Map of 1977	36.53	729.23	19.96	9060	425	2519	68.96	5818	159.27	27.52	3.48

Table 1

Comparative measures of density for Atlanta, analyzed at 1mile, 10 degrees, 0.10

4. The structure of Atlanta

The original form of Atlanta has often been described as a series of colliding grids. Refer to the 1864 map of Atlanta in figure 3 for illustration. This collision occurs at the center because each owner of a land lot intersected by the railway chose to divide his land, speculatively, on both sides of the railway, into grid patterns of no particular size or relation to any other adjacent parcel. Instead, each pattern was oriented parallel to the railroad. This collision continues to occur as the city grows outward because land owners divided their parcels separately in relation to their own land lot boundaries. As a result of this independence, the various grid patterns came together at the boundaries of the land lots and created a multitude of triangular intersections and irregular block forms. Over time, the original center remained fairly intact with selective and sometimes strategic modifications. Some blocks were simply consolidated while others were subdivided. Some streets were aligned to decrease congestion around misaligned intersections and lengthened to connect points of interest across long blocks.

By the late 19th century, the city was well established within a two mile radius and well supported by an extensive street car system. Refer to the 1892 map of Atlanta in figure 3 for illustration. In contrast to the original structure, much of the surrounding area had been developed into relatively congruent grid patterns, and in most cases, the old winding paths that had lead you out of the city and had followed the immediate terrain, were replaced with this much more rectilinear pattern. This congruency and regularity were far more compatible with the transportation system established and allowed for much greater ease in mobility for the street car.

Yet for those areas outside the range of the street car and for those who sought the independence of the automobile, the first curvilinear forms emerged and established the suburb - the newly settled areas just outside the city limits. In Atlanta, the first two suburbs were Inman Park, founded in the 1890s, and Ansley Park, founded around 1905, and they established the new standard for development as the appeal and access to the automobile gained strength. As the city began to grow outward, in all directions not just to the north and east, the notions of the rectilinear grid were discarded and the streets responded to natural landscape as we often see today. Reference the 1977 map of Atlanta, shown in figure 3, for an illustration.

With the increase in the use of the automobile, state highways were introduced to facilitate higher volumes of traffic, and then finally, in the 1950s, the first interstate system was constructed with limited access through the central city core (Preston 1979). These new modes developed to support the automobile then allowed for much further expansion in the urban fabric, far beyond the four miles studied here, and drastically modified the continuity of concentric development that had largely been taken for granted in the earlier phases of development.

5. Analysis

Figure 4
Directional Reach Maps of Atlanta, shown here for two changes in direction with the parametric threshold set at 10 degrees. A full spectrum of color is used to show the 5 natural breaks found within the values, with segments holding the highest values appearing in red.

Again, using the program Spatialist_lines, a directional as well as a metric analysis was run on each GIS map to study the structure of street connectivity and to investigate its evolution with two particular values highlighted here, directional reach and metric reach. Remember that Directional Reach measures the available street length captured when given a directional threshold, and Metric Reach measures the available street length available while moving outward in every direction from the midpoint of that segment for a set distance independent from changes of direction.

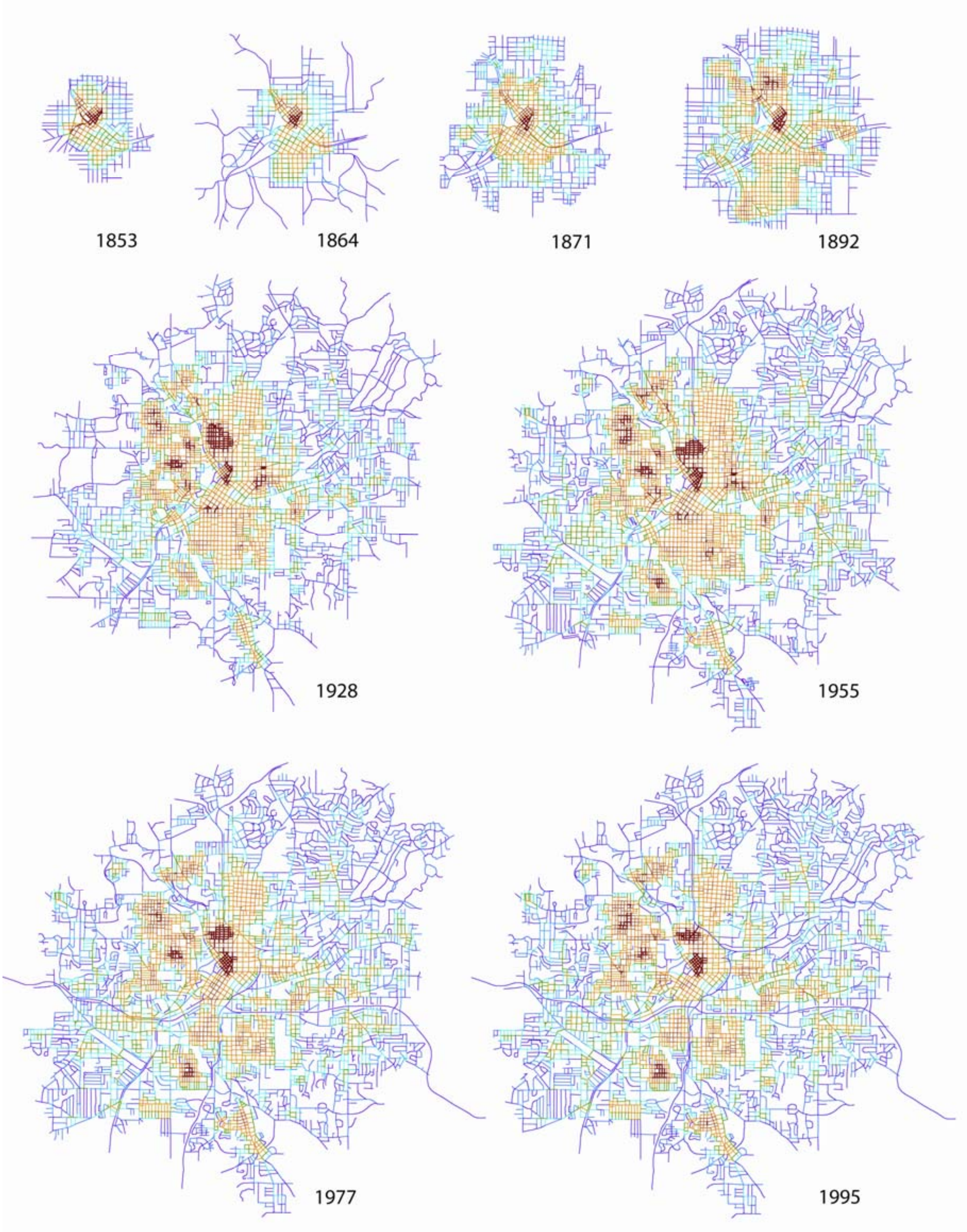

Figure 5

Metric Reach Maps of Atlanta, shown here with a maximum reach set at a quarter mile. The emergence of clusters of higher local density is evident, shown in red.

Figure 6

Evolution of the Directional Reach cognitive core of Atlanta, shown in red, and its ever increasing fragmentation of the city structure is evident. In particular, the strongest lines occupy areas increasingly distant from the center, creating a network that is initially less invested with buildings and land uses, as if to anticipate a subsequent phase of growth.

Initially, Directional Reach was calculated at two direction changes to capture the structures most similar to those emerging from Integration radius 3 in standard axial analysis, with 10 degrees as the parametric threshold. Insofar as directional reach is sensitive to direction changes, a cognitively relevant property of street systems, we will refer to the subset of high directional reach streets as the "cognitive core" of an area. The first map of 1853, shown in figure 4, reveals two relatively independent cognitive structures, one to the north and one to the south, with only three points of intersection between them. These structures are distributed around the central point of the city – the train station. The core leads to the central area, but it doesn't move through it. In 1864 and 1871, the connections, north to south, continue to erode and each structure becomes more and more independent. In 1892, there is a complete shift of the structure to the south side of the city, and a strong, relatively dense structure emerged and continued through 1955. But, in 1977 and 1995, the interstate system is introduced and bisected the dense structure of 1955. Ironically, the state capital building and block is the only political, economic, or culturally significant element that has consistently remained a part of the cognitive structure of the city. All other major reference points and landmarks have periods of inclusion, but are not consistently attached to the core.

Figure 7

Core Cognitive Structure, shown in red, overlaid the densest zones of Metric Reach;
A: Atlanta in 1864, directional reach at two changes superimposed on metric reach at ¼ mile; B: Atlanta in 1977, directional reach at two changes superimposed on metric reach at ¼ mile; C: Atlanta in 1871, directional reach at two changes superimposed on metric reach at ½ mile; D: Atlanta in 1995, directional reach at two changes superimposed on metric reach at ½ mile

Metric Reach was calculated at a quarter mile (shown in figures 5 and 7), a half mile (shown in figure 7), and at 1 mile (not shown here), with 10 degrees used as the angle to calculate directional distance within each range. Initially, the densest areas of the city remain central and they align with the central business and retail district. In 1892, a second area begins to emerge, and by 1928, several areas are evident, fully developed, and distributed, with no consistent association to economic or residential areas of significance within the city.

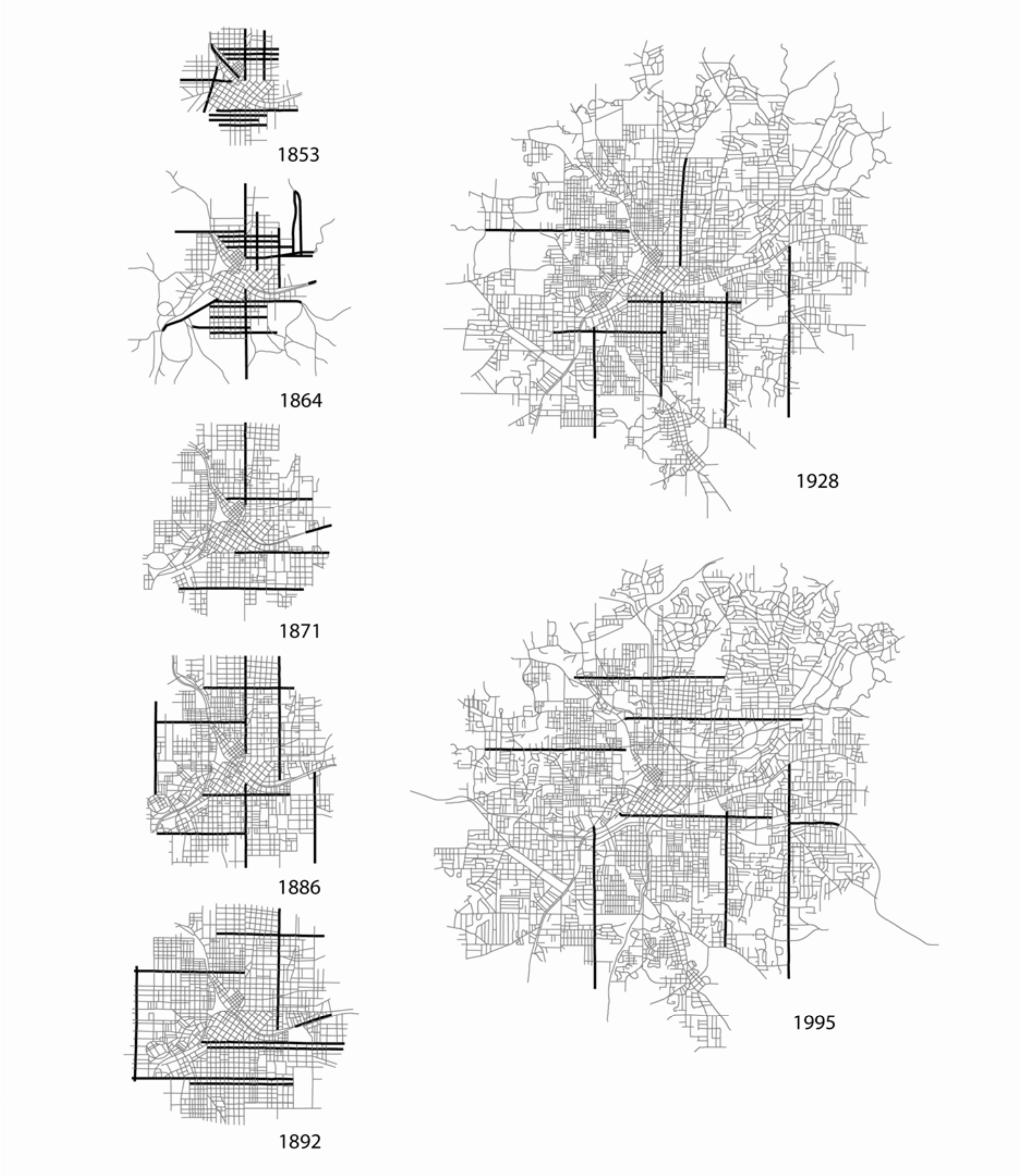

Figure 8
Maps of the Longest Lines found in Atlanta – defined here as those segments with the highest Directional Reach when measuring zero changes in direction, with 10 degrees as the threshold of direction change

To highlight the salient character of Atlanta's evolution, directional reach was divided into ten intervals by natural breaks, with the interval of highest reach values highlighted in red and all other intervals in grayscale, as in figure 6. In 1864, the core cognitive structure is already split, with parts of Peachtree and West Peachtree Streets completely isolated as individual linear elements to the north. The structure continues to fragment and shift around the center until 1928, when it finally seems to culminate into a relatively stable centripetal form more closely resembling those models illustrated earlier by New York, Philadelphia, and San Francisco. Paradoxically, the area highlighted in Atlanta is not of significance. In 1928, this area is a lower to middle class residential neighborhood with only moderate, local retail activity, and today, it remains in economic decline. By 1955, the city's cognitive structure has clearly resumed its pattern of decentralization and fragmentation.

When the core cognitive structures are overlaid the densest areas of Metric Reach, as shown in figure 7, additional difficulties in the relationship between structure and density are discovered. The core structure reaches the more dense areas in the city, but rarely does it penetrate or pass through them. In addition, the points of intersection that occur in the core cognitive structure rarely coincide with areas of highest density. We should note, however, that for those few occasions when the cognitive core and the densest areas coincide, they were commonly perceived to be significant during the corresponding periods. For example, in figure 7c, two such areas of coincidence occur. One highlights the state capitol while the other highlights the original governor's mansion. In figure 7d, there is one area of coincidence, Five Points, known as the central reference for the city's downtown district, associated with the transit station where the two transit lines intersect. The prevailing character of Atlanta's growth is one of dissociation. Dense areas and cognitively significant streets come together in such a way as to suggest a balance of continuity and disjunction: a sifting urban patchwork. The resilience of this character is in contrast to the instability of conditions on the ground.

Then lastly, directional reach was calculated at zero changes in direction to highlight the 'longest directional elements' within each map – equivalent to the longest axial lines in traditional analysis. Few, if any, lines radiate from the center, which is counter intuitive to the traditional notions of city growth (Doxiadis 1968; Hillier 1999). In fact, after 1864, these lines scarcely form a structure at all. They stand in juxtaposition to one another, distributed throughout the urban area like a composition of modern art. There is no clear pattern of intelligibility, no sense of connection, or orientation. These disparate lines, particularly those of 1995, resonate with the sense of fragmentation still experienced today when trying to traverse the city.

6. Discussion

We have shown that the center of Atlanta, despite the density of its streets, as compared to the surrounding metropolitan fabric and despite the fact that it compares rather well in metric reach to other cities examined, is nevertheless characterized by a historically persistent pattern of disconnection and fragmentation. We looked at how the infusion of the automobile, more specifically the interstate, has modified the intelligible and cognitive structures of the city. Whatever measures were taken to realign streets and strengthen connections have never compensated for the centrifugal tendencies of the overall pattern of growth. For example, aware of these divisions throughout the city and the disruption caused by the railroad, the city created the first in a series of bridges more clearly linking the north to the south in the early 1850s at substantial cost. And connections to the west were also formed shortly thereafter (Russell 1988). But unfortunately, none had any real impact in stitching the city into any intelligible cognitive structure with a central spine drawing to it intense activity and radiating influence. Similarly, as the interstate is interjected within the city street structure during the 1960s, bridges are constructed in an attempt to reconnect the broken local street structure, but the efforts fail and the fragmentation is actually intensified. As a result of this fragmentation, and the dispersed cognitive integration and density, the city functioned, and still does, as a negotiated patchwork of dispersed areas of interest.

The complement of this condition is the importance continuously attributed to Peachtree Street as the main spine of Atlanta. Peachtree lies on the directional reach core only in parts at the very best. The segments of Peachtree Street which lie on the cognitive core more closely align with the fundamental principles of good urban design. For example, from 1864 to 1892, Peachtree Street, from the intersection at Forsyth Street to West Peachtree Street, is highlighted, and historians have described this area as vibrant with shops and people, all serviced by the street car (Preston 1979; Carson 1981). This area is lost in 1928 and 1955 but reappears in 1977 and 1995 when the city underwent a resurgence of interest and renewal in this downtown area, particularly with the construction of the Equitable Building, completed in the late 1960s, and the Georgia Pacific Tower, completed in the early 1980s. Today it has a sense of a real urban street and the pedestrian traffic found there is proportional to the statistical expectation which arises from the association of pedestrian volume and measures of reach and directional distance (Ozbil and Peponis 2007). Such significant correspondences between the syntactic core and segments of Peachtree Street notwithstanding, Atlanta seems to project a symbolic spine in order to compensate for the instability of functional connections. Recent discussions to realign Peachtree Street in the south portion of the city as part of new investments aimed at turning the Peachtree corridor into an even more significant reference for the city as a whole bear the marks of the traditional tension between symbolic projections and functional connections or interfaces.

7. Conclusion

The center of Atlanta has undergone significant changes associated with urban growth, not least of which is the creation of the interstates in the late 1950s. It has also undergone significant re-building with waves of new investment, and urban clearance. These changes, however, cannot be seen as attempts to re-invest, to extend, or to transform a historically stable syntactic core of streets. Instead, the city has been characterized by a persistent pattern of disconnection and fragmentation. This pattern is all the more noteworthy given the high overall density of the street network. The pattern almost prefigures the larger scale tendencies that characterize the metropolitan area as a whole. At its center, as well as globally, the relational structure of the street network of Atlanta is continuously negotiated and continuously changing.

When we look carefully at the evolution we find that the cognitive core remains unstable. The original cause of fragmentation can be sought in the manner in which the railway crossed properties and the manner in which land subdivision developed without an overall plan. However, the failure to create stable connections, and the fact that no stable cognitive core has emerged seems to suggest that the structural features described in this paper may have deeper social origins and social functions, or be associated with continuing institutional inertia. At this stage, we are not advancing any hypothesis to explain this pattern of fragmentation, but from the point of view of our analysis, the interstates of the late 50s and 60s might have had significant impacts in fragmenting the urban fabric of the day, but at the same time they are yet another episode in the continuing underlying formation of the urban patchwork. While the original cause of fragmentation might have been pragmatic due to the manner in which the city evolved, developing to either side with the railroad at its center, it is possible that the persistence of fragmentation reflects social or political processes; though, we have no basis for formulating hypotheses as of yet.

References

Carson, O. E. 1981. *The trolley titans: a mobile history of Atlanta*. Glendale, Interurban Press.

Cervero, R. and K. Kockelman. 1997. Travel demand and the 3Ds: density, diversity, and design. *Transportation Research Part D* 2(3): 199-219.

Doxiadis, C. A. 1968. *Ekistics: An Introduction to the Science of Human Settlements*. New York, Oxford University Press.

Handy, S., R. Paterson, et al. 2003. *Planning for Street Connectivity: Getting from Here to There,* American Planning Association, Planning Advisory Service.

Hillier, B. 1999. Centrality as a process: accounting for attraction inequalities in deformed grids. *Urban Design International* 4(3): 107-127.

Hillier, B. 2002. A theory of the city as object: or, how spatial laws mediate the social construction of urban space. *URBAN DESIGN International* 7(3-4): 153-179.

Hillier, B., R. Burdett, et al. 1987. Creating life: Or, Does Architecture Determine Anything ? *Architecture and Behaviour* 3(3): 233-250.

Hillier, B., A. Penn, et al. 1993. Natural movement: or, configuration and attraction in urban pedestrian movement. *Environment and Planning B: Planning and Design* 20(s 29): 66.

Jacobs, A. B. 1993. *Great Streets*. Cambridge, Mit Press.

Jacobs, J. 1961. *The Death and Life of Great American Cities.* New York, Random House.

Jo, S. 1998. Spatial Configuration and Built Form. *JOURNAL OF URBAN DESIGN* 3: 285-302.

Martin, J. 1975. *Mule to MARTA*. Atlanta, Atlanta Historical Society.

Ozbil, A. and J. Peponis. 2007. Modeling street connectivity and pedestrian movement according to standard GIS street network representations. *6th International Space Syntax Symposium*, Istanbul, Cenkler.

Özbil, A. and J. Peponis 2007. Modeling Street Connectivity and Pedestrian Movement According to Standard GIS Street Network Representations. *6th International Space Syntax Symposium*, Istanbul Technical University, Cenkler, Istanbul.

Peponis, J., D. Allen, et al. 2007. Street Connectivity and Urban Density *6th International Space Syntax Symposium*, Cenkler, Istanbul, Istanbul Technical University.

Peponis, J., D. Allen, et al. 2007. Measuring the Configuration of Street Networks. *6th International Space Syntax Symposium*, Istanbul Technical University, Cenkler, Istanbul.

Peponis, J., S. Bafna, et al. 2008. The connectivity of streets: reach and directional distance. *Environment and Planning B: Planning and Design* 35: 881-901.

Peponis, J., C. Ross, et al. 1997. The Structure of Urban Space, Movement and Co-presence: The Case of Atlanta. Geoforum 28(3): 341-358.

Preston, H. L. 1979. *Automobile Age Atlanta: The Making of a Southern Metropolis, 1900-1935.* Athens, The University of Georgia Press.

Russell, J. M. 1988. *Atlanta, 1847-1890: City Building in the Old South and the New*. Baton Rouge, Louisiana State University Press.

Siksna, A. 1997. The Effects of Block Size and Form in North American and Australian City Centres. *Urban Morphology* 1: 19-33.

Southworth, M. and P. Owens. 1993. The Evolving Metropolis: Studies of Community, Neighborhood, and Street Form at the Urban Edge. *Journal of the American Planning Association* 59(3).

Wang, J., Q. Mao, et al. 2007. An Evolvement Model for a Metropolis: a case study on the evolution of spatial and functional patterns of Beijing city. *6th International Space Syntax Symposium*, Istanbul, Cenkler.