# BEHAVIOURAL PROGRAMMING OF SELF-LOCATING URBAN INTERVENTIONS

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ABSTRACT

The paper aims to show an automated methodology for the appropriate redistribution of usable space within urban morphological envelopes. The methodology has been incrementally developed over four years and has been implemented through annual student projects. The influence for the project was taken from the natural environment, which possesses evolutionary patterns that have a base code and inherent programmes (scripts). Natural patterns are generative, the constituents recyclable; artificial landscape patterns fail to evolve, they are deserted rather than recycled. They become patterns in the dust. Inhabited landscape needs a means of starting from simplicity and building into the most complex of systems that are capable of re-permutation over time. The base blocks within this programme are termed sprites: They constitute a small package of spatial information derived from a measured analysis of existing morphologies. This spatial information consisting of that indivisible formulation that generates the overall envelope of the building through its multiplication relative to the particular circumstances. In some cases this 'minimum formulation' is based on the singular human space necessary to carry out a specific task related to that use e.g. administration, in other cases it relates to a constructional format, e.g. production, or the size of a machine e.g. transportation. These sprites are then imbued with interrelated behavioural 'accretive' programmes associated with the parameters that tend to generate their envelope forms termed here 'Megalope Patterns'. Behavioural programmes are interrelated, acting together to create a particular form at a particular location in the existing city.

This paper thence describes the current development of the project's methodologies in terms of a shift from use of the computer as a tool for data manipulation to embracing the computer as a design partner. The generative application of the software used in the project (Archi-CAD) is manipulated through its programming language (GDL) in order to create dynamic, self-locating 'intelligent' scripts which are programmable, in terms of their characteristics, by the students.
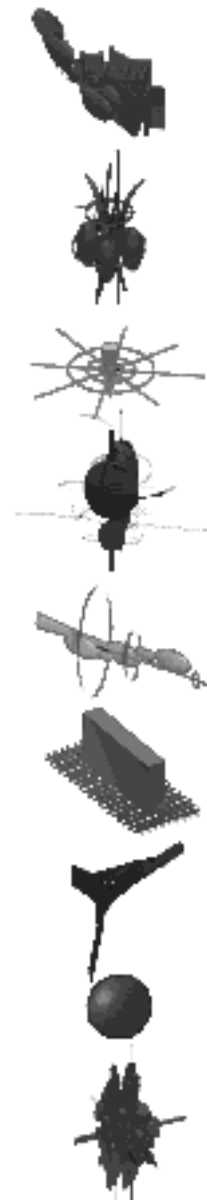
Explorations of self-locating urban interventions as representative artifices originate from an intention to accelerate the learning processes of an urban project which is influenced by contemporary biological theories. These biological theories relate to an ephemeral 'formal' pattern language which is generated through inherent programmes (scripts) that continually reform in response to environmental flows, flux's and rhythms. The premise for the project infers that our comprehension of environment has less to do with defined territories and formal bodies and everything to do with these flows, flux's and rhythms that continually generate temporal forms through their convergence and condensation which are appropriate for a moment in time . Form is hence temporal and transient, and the project endeavours to amend the way that students conceive of the urban landscape, hierarchically relating more to space and its potential of becoming. The project substitutes 'our nature' and its reflective artificial pattern (the urban matrix) for biological nature and its reflective patterns, referencing nature's generative ephemerality as a desirable direction for the future of our urban landscapes.

Nature possesses evolutionary patterns which have a base code, where information is strategically related to the environment to produce forms of growth and strategies of behaviour, optimizing each particular pattern related to the contextual situation. "Codes are fixed but the way they are expressed or repressed is environmentally dependent. The forms and strategies being the result of extrapolated codes to environmental optimization". (Frazer. J. 1995)[1] This natural cycle producing patterned entities from its flowing coded repository which are appropriate for survival. Each entity is an integral part of the natural cycle, formulating in their accretion the dynamic sea which they effect and are reciprocally affected by, producing the constant flow of environmental change revealed through the temporal 'being of things'. The 'being of things' are no longer conceived of as singularities. The figure can in itself be the medium for other entities and systems of figures such as flocks of sheep or blades of grass can be said to form a context. There is then some kind of relationship between the being and the medium, the figure and the field, where 'the being of things' should be seen more as emerging from the medium, rather than distinct from the medium because in some way its existence is interdependent with the medium. 'Being' in this new order consequently consists of open systems that are de-localised and are interdependent with other open systems creating a multitude of space, times and objects in which 'the being of things' is somehow indivisible from the whole, "they are inextricably entangled with other objects and space time as environment." (Mae Wan Ho 1997)[2] through the flows and flux's of background energy. Change becomes everything and the flux's within the background energy flow are capable of disarranging form creating momentarily free radicals which are then able to make new forms and reciprocally new programme permutations where the most appropriate solutions of a contextual situation are chosen to emerge into forms. These generative programmatic relationships generates the growth and adaption of emergent form whose combinations yield the animated patterns of our physical environment through time. These background flows as information programmes of existence are therefore more important than the actual forms that emerge to delineate the spatial matrix.

The city should be considered, as having emerged from the topography in response to forces (emanating from the holistic matrix) as a strategic material redistribution of the earth, similar to Gottfried Semper's mound. This strategic distribution reflecting the local milieus programmatic requirements laid down and adjusted over time. This environmental matrix can consequently be envisaged as sets of interrelated spatial matrices overlaid with interrelated flowing forces as information programmes that unify the diverse elements of 'being' whilst respecting the identity of each. Form is never more than a temporal illusion. The 'temporal being' of things' representing a formal animation of appropriate solutions growing from one super-positioned state to another, revealing the patterns of their strategies and consequently the programmes (scripts) which constitute their 'being' (haecceity). Complex 'beings' learn to read these 'trace' patterns of existence and it is this pattern recognition which is inherent to their comprehension and subsequent manipulation of the environment. Pattern recognition enabling complex 'beings' to successfully project and intervene in the local environmental patterns for their own benefit. Today's cities are artifices; Urban landscapes are both constructed and are consumed as a reflective pattern of the activities of their milieus. The prevalence of this inhabitation as landscape has moved our activity patterns and consequently our urban landscape patterns beyond those of the natural cycle as a reflection of our

own move beyond survival. City landscapes now refer to ourselves, our actions and social strategies, but have failed to evolve relative to the dynamics of our own nature. Past patterns, in their majority retaining an influence on our nature. Natural patterns are generative, the constituents recyclable; our patterns fail to evolve and are deserted rather than recycled. They become patterns in the dust.

Our mapping and classification of 'being' as a formal set of values tends to set up categories in stasis (frozen patterns) when in reality as change is the only permanence both entity's and mediums are in perpetual motion. The way we map, and record initiates and perpetuates a conceptual stasis. We map that which is a moment in time rather than mapping the forces which shape that moment in time and move between the Euclidean dimensions. In effect a new form of mapping is required in order to recognise the dynamics of the environment by realising that entity and medium are an interactive system and that there are only field to field or open system relationships. It is the organisational forces generating processes through which the form emerges that needs to be comprehended in order to design appropriate interrelated, adaptive and generative patterns within urban landscapes. "By comprehending architecture and urbanity as a series of events related to programmes it is possible to envisage a more dynamic state where architectural elements can respond amending local conditions and overall strategies. Or where groups of architectural elements can create new strategies within the existing urban programme. "(Allen. S 1997)[3] Inhabited landscape needs a means of starting from simplicity and building into the most complex of systems that are capable of re-permutation over time.

The aim of the project is to create a set of systematic design aids that enables urban space to become conceptually fluid (through its programmatic abstraction), such that our disbelief in future re-configurations becomes suspended. The project initiates with information gathering from the existing city under three main themes, 'Immutable image', 'Mutable activity uses' and 'Desirability', producing 15 subsets of interrelated information within which there are further sub sets. Immutable image is influenced by Kevin Lynches definitions of 'Image of a City, which are reinterpreted as Routes, Negative Nodes, Positive Nodes, Edges and Fields. These definitions are our psychological foothold in terms of visual identification with place and hence belonging creating 'existence footholds'. Mutable Fabric refers to the spatial activities (facilities) within the fabric envelopes of form. Desirability relates to the existing quality and location of the existing urban landscape. A conflict between the facilities and the fabric of the city is set up over time influencing the desirability because existing formal patterns become inappropriate for our amending 'activity patterns' mainly due to mans developmental dependance on the machine. This facility - 'existence foothold' conflict of inhabited landscape generates an undesirable stasis within the urban landscape which the project attempts to rectify through a set of procedures and conceptual hierarchy changes.

The information gathered from the existing city are interpreted as sets of visual patterns, termed veneers, within extrapolated layers over representative artificial landscape. These veneers, as information patterns, are used as a visual aid taking advantage of our natural abilities to comprehend, project and intervene in
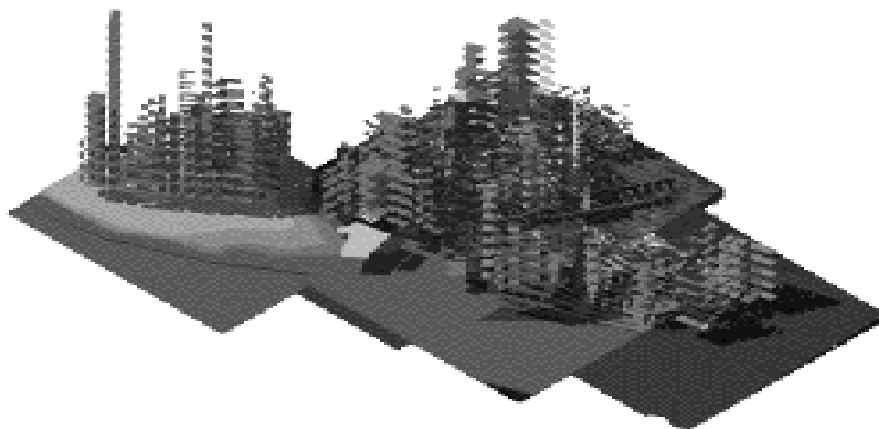
1. Extract of veneer model from 1999 project

pattern language. The veneers form the anchors and categorization platforms for a more complex set of three dimensional patterns imbued with behavioural strategy's for existence within the urban landscape.

The base blocks of this three dimensional pattern system are termed 'sprites'. These base units are intended to generate the formal patterns within the artificial landscape through flocking. Their dimensions are derived from the spacial formations of our 'activity uses' and there are nine kinds of sprite pattern associated with the following categorization of 'use types', Accommodation, Administration, Communication, Education, Entertainment, Production, Retail, Service, Storage. The sprites associated with each of these 'use types' emerge from a study of existing use typologies related to the nine categories above. Each sprites three dimensional space is the irreducible activity space associated with the primary functioning of that particular use type. For instance mans relationship to various space specific activities, such as office procedure's, which becomes a measure for delineating the 'space-shape' that is termed a sprite (i.e. human actions in space which can be seen as a use programme). The building envelope is the summation of these units through repetition for other programmatic requirements such as sociability, economy and or process. This definition norm does not however directly relate to all of the uses type, the sprite formulation, can relate to any of the following, (1) based on personal/machine action space (2) based on machine/human manoeuvres and resting positions (3) based on construction.
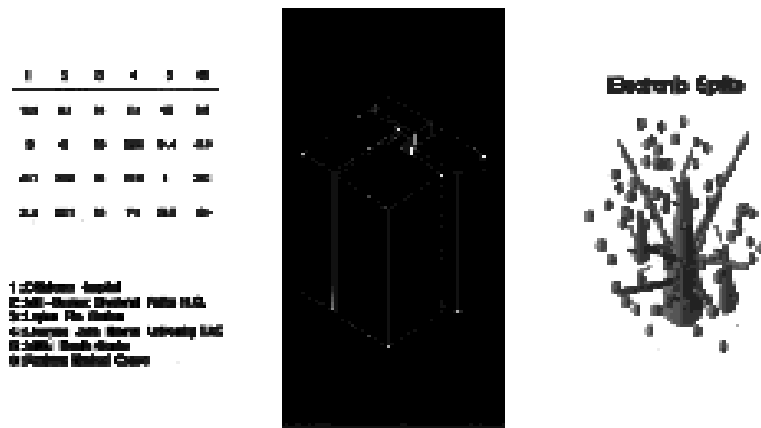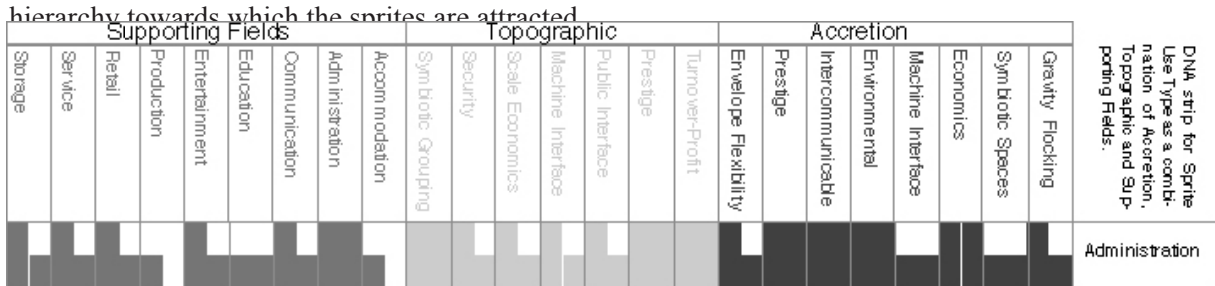

2 Formulation of Sprite

Within this sprite, 'space shape' system the physical arrangement of enclosure to the activity space is disassembled becoming events platforms of programmatic use without formal bounds such that space as delineated 'free radicals' can flow to create new configurations and permutations. This disintegration of activity spaces definitive enclosures to this vestigial state is conceptually important in order that the design of the urban landscape can become hierarchically more concerned with the 'techne' of space making from its programmatic behaviour rather than the 'techne' of form making. These sprite 'spatial shapes' are then imbued with the programmes associated with their urban 'behavioural nature'. This behavioural nature is broken down into three main categories, accretion, topography and field to field relationships related to how they tend to flock and group generating distinctive morphological shapes that desire particular locations within the urban landscape. These behavioural programmes are likewise derived from the typologies studies together with observations of the existing urban landscape in use. The programme for a particular use type might be written as follows:

Topographic; 1 Locates adjacent to major infrastructure routes and nodes. 2 Locates centrally to the overall market field 3 Ease of goods and market access essential 4 Public face and image a major consideration, (address hierarchy). 5 Can afford higher rents relative to turnover and profit margins. 6 Gravitates to ground level, or the pedestrian access plane. 7 Tendency to group symbiotically and form a gravitational matrix along major routes and nodes. 8 Improved logistics through the shared route and node as image. 9 Size determines gravitational attraction.
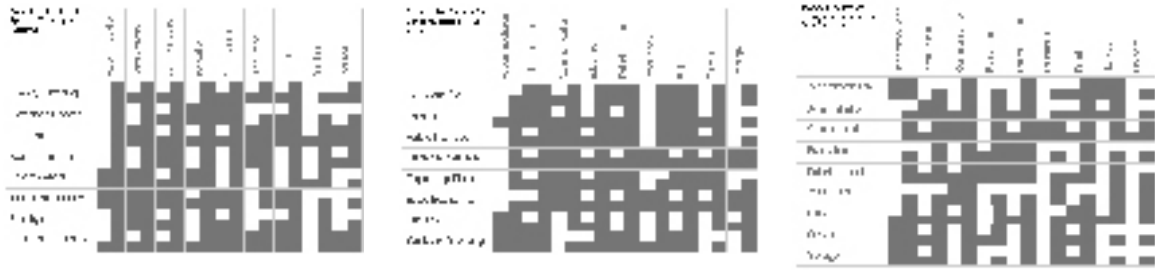
3. Gravitational Weighting Graphs

These written definitions are subsequently edited into a series of graphs which include all the programming reasoning for the 'use types' with gravitational weighting variance from one to four (zero does not exist as the use type would float). The code of each use type emerges from this process as a DNA strip which is imbued as gravitational attraction into the sprite 'space shapes' determining how that sprite behaves relative to the artificial urban matrix. The existing urban topography is also coded, and may possess existing infrastructure features related to the adapted categories from Kevin Lynches 'Image of a city' i.e. Routes, Positive Nodes Negative Nodes, Edges and Fields, which generate the gravitational hierarchy towards which the sprites are attracted.

Supporting Fields									Topographic							Accretion								DNA strip for Sprite Use Type as a combination of Accretion, Topographic and Supporting Fields.
Storage	Service	Retail	Production	Entertainment	Education	Communication	Administration	Accommodation	Symbiotic Grouping	Security	Scale Economics	Machine Interface	Public Interface	Prestige	Turnover-Profit	Envelope Flexibility	Prestige	Intercommunicate	Environmental	Machine Interface	Economics	Symbiotic Spaces	Gravity Flocking	
																								Administration

4. DNA Strip

Manifesto's for potential future city's are developed and the DNA strip programmes of the sprites are amended to match these manifesto aims. These amendments to the programming of the sprites initiates a mobility and flow of the sprites as momentarily free radicals generating new flocking patterns and consequently new morphologies at different locations. This mobility of the sprites does not in itself necessitate the destruction of existing fabric, rather they flow and reform into new patterns based on the manifesto aims leaving the formal aspects of the urban landscape intact. Pattern conflicts between Mutable facility and Immutable Image can be then be assessed in terms of retaining and or replacing the existing fabric within the holistic concept of the proposal. Thus the project with an automation location system can assess the difference between several future city aims against the existing fabric of the city.

The project thus begins with the construction of a 'static' 3D CAAD model, using Graphisoft's Archi-CAD, built over a scanned or digital map which has a contoured landscape overlaid. Colour-coded veneers are constructed over the model, following each building footprint and representing each building storey, each colour (and corresponding material for photo-rendering) representing one of the nine use categories. The location of the veneers on the Z-axis is exaggerated for clarity (but can of course be restored to true scale to produce a traditional city model.) The resulting 3D database can be interrogated from differing projections in order to understand the complex relationships between activity use and location.

The topography is then analysed, and the results are added to the model's plan in the form of Zone Stamps. Archi-CAD's Zone Tool allows the user to define spatial units within a project which may be 'stamped' with textual fields of data about the unit. The Zones may then be grouped in Zone Categories. The result is a topography which is 'zoned' in terms of attractivity.

Following this stage, the 'Sprites' are introduced in order to begin to generate the 3D pattern system. In terms of the CAAD model this requires a shift from the static to the dynamic. This has involved designing in a level of inter-activity between elements (sprites and location) within the 3D model or database, by allowing the sprites to be imbued with scripts representing their 'codified DNA'. In addition to allowing the model to be generative, this programming allows the student to further externalise the rules by which the Sprites interrelate (and hence the student's understanding of 'the being of things'.)

The 'physical' embodiment of the sprite is constructed using visual CAAD tools and is then saved as a Library Part—parametric objects which may be placed into the model. The Library Part is edit-able via its GDL script (Geometric Description Language). Firstly, a 'mover' algorithm is added in order to allow the Sprite to make definable steps across the model. This can be a standard, parametric algorithm which can be applied to each type of Sprite. Secondly, a 'location-tester' algorithm is added in order to interrogate the zoned topography after each movement to verify the suitability of this location for the Sprite. The method employed to achieve this is explained in Brown & Moorhouse (1999). The relationship between the 'mover' and 'location tester' is thus cyclic, and only after predefined criteria have been fulfilled does the body of the Sprite locate. In this way, the generation of the model is order-dependent in terms of the which Sprites are 'fired' at the model first.

Two developments of this approach are currently in progress. Firstly, the process itself is largely invisible—there remains no trace of the process when the end product is reached. One way of achieving this is to take a camera shot after each move. By including Archi-CAD's Global variable for Camera Frame Number in front of the 'mover' algorithm, and using the 'Rebuild between frames' command from the Special menu (Nicholson-Cole 1998)[4], the process can be catalogued by animation frames. Secondly, by incorporating Archi-CAD's Properties Database (primarily designed to deal with quantity calculations) it is intended that the model should be able to regenerate over time.

To utilise the computer as a visual aid that replicates the internal workings of the mind where space and hence its demarcations become plastic. Reality and imagination become intertwined, the interests of the mind determine how we see our world and reciprocally how we build it.
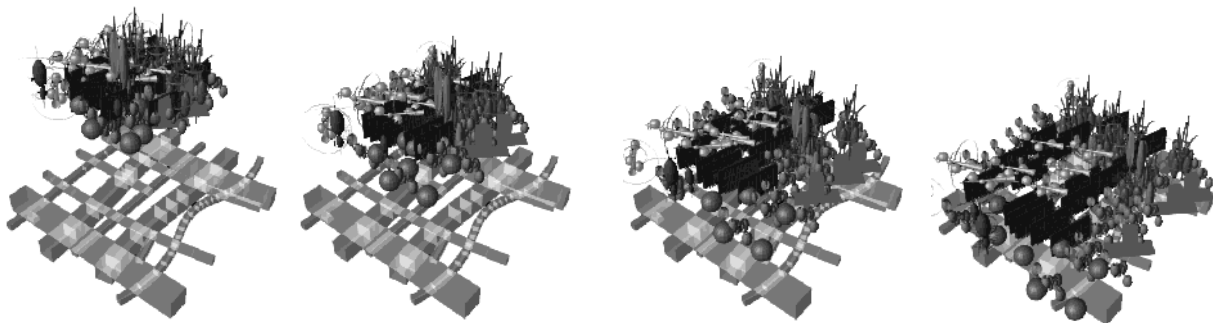
5   Schematic Generation of City Model

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4   D. Nicholson-Cole, The GDL Cookbook Marmalade, Nottingham (1998).