Designing Desire. A Parametric Approach to the Planning of Landscape Paths

Proyectar deseos. Una estrategia paramétrica para planear los caminos en el paisaje

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ABSTRACT: This contribution wants to explore the potentials of informing the design of large-scale networks of paths with predictive models, capable of combining a simulation of users' behaviors within the space and the geo-morphologic intrinsic characteristics of the site. Our work investigates how a deeper knowledge of topology allowed by new technologies could support the application of behavioral modeling at the landscape scale, indirectly informing the creation of paths in the absence of reliable *in situ* observations on the actual use of a determined area. Thus, the creation of a predictive model capable of simulating users' behaviors according to pre-established parameters can be developed thanks to the cross use of parametric design softwares and territorial informative systems, with the aim of managing and processing a series of useful information deduced both from experience and from the established outputs of studying *desire lines*, for defining a bundle of potential routes in a given spatial context.

KEYWORDS: desire lines; urban design; parametric landscape architecture; behavioral modeling; topology.

RESUMEN: Este artículo quiere explorar los potenciales de informar el diseño de redes de caminos a gran escala con modelos predictivos, capaces de combinar una simulación de comportamientos de los usuarios dentro del espacio con las características geomorfológicas del sitio. Nuestro trabajo investiga cómo un conocimiento más profundo de la topología, permitido por las nuevas tecnologías, podría apoyar la aplicación de modelos de comportamiento a la escala del paisaje, indirectamente informando acerca de la creación de caminos en ausencia de fiables observaciones *in situ* sobre el uso real de un área determinada. De esta manera, se puede desarrollar un modelo predictivo capaz de simular los comportamientos de los usuarios según los parámetros preestablecidos gracias al uso cruzado de software de diseño paramétrico y sistemas informativos territoriales, con el objetivo de gestionar y procesar una serie de informaciones útiles deducidas tanto de la experiencia como de los resultados establecidos del estudio de las *desire lines*, para definir un conjunto de rutas potenciales en un contexto espacial dado.

PALABRAS CLAVE: desire lines; diseño urbano; arquitectura paramétrica del paisaje; modelos de comportamiento; topología.

1. Desire Lines: from Social Signifiers to Potential Design Tools

Providing realistic and plausible models for designing large-scale/landscape elements, such as the pedestrian road system of a determined rural site, is a challenge that requires knowledge from several disciplines (Dorato, 2016). Research on the accurate modeling not only of buildings and urban spaces, but also of territorial and landscape environments is today of particular interest to urban planners and landscape architects, parks and emergency management authorities, as well as – indirectly - tourists and visitors, for the growing requirements of quantity and quality (i.e. territorial fruition, accessibility, and safety) are imposing the need for alternative solutions that allow for efficient, computer-aided design.

By integrating the concept of *desire lines* to the planning process, and by recognizing its potentials as an operative tool capable of informing and supporting complex landscape design choices, this article wants to emphasize the available resources for defining a new "landscape behavioral model": considering and blending together topographic and site-specific features with people's potential preferences and needs when crossing the landscape. The following chapters will give a partial review of some past and contemporary applications of desire lines-oriented interventions at the urban level, then shifting the problem to a broader territorial scale, and discussing a new methodology. We introduce an original *modus operandi* related to a digital script in *Grasshopper – Rhinoceros*, capable of combining countless parameters for defining a parametrically-controlled bundle of "desire paths" through the landscape. By presenting a sample application to be tested in further operative interventions, we aim at creating consensus for additional, interdisciplinary investigations.

The notion of *desire lines* (also defined as "desire paths") refers to the well visible traces left on the ground, or any other solid surface, by an act of continuous movement. As highlighted in the volume "Universal Principles of Design" (Lidwell, Holden & Butler, 2010), the use of this term concerns the worn paths where people generally walk (or cycle, or move by using other means of transport), representing a clear indication of how a determined environment is actually used, while bringing to light the preferential ways of interaction within a place.

The arise of such lines in the urban or landscape setting represents, according to scientific literature, the appearance of the actual needs or preferences of the users who, independently from the paths identified by the official design, leave a trace of what – in most cases – represents the shortest or easiest itinerary for moving from point A to point B. As Norman (2011) underlines, "Messy trails of people, worn-down dirt paths through the lawns, grasses and even flowerbeds are *social signifiers*, a clear indication that people's desires do not match the vision of the planners. People try to simplify the paths they take when walking, taking short routes rather than long ones, even if it means walking across gardens or scampering up hills. (…) Human-made trails are called "desire lines", for they reflect desired paths even though the formal layout of streets and sidewalks do not accommodate them" (p.126).

According to anthropologist Tim Ingold (2007), human beings generate lines wherever they go, and whatever they do: the creation of lines (being the physical paths marked on the ground; the graphic signs of writing and drawing; the ephemeral lines pictured in the air while gesticulating, and so forth) subsumes all aspects of everyday activities, thus bringing them together into a single field of inquiry. The observation of the appearance of desire lines within the physical space of a city, as well as their interpretation as a socio-behavioral phenomenon, has mainly been developed by the social and human sciences, and only as an afterthought adopted by the planning disciplines in some experiences of urban design or redevelopment of public spaces. In fact, if "social desire paths reflect emergent phenomena that occur when individuals interact with formal social structures that are not working for them" (Nichols, 2014: p.167), similarly desire paths are "the ultimate unbiased expression of natural human purpose" (Myhill, 2004: p.293) referring to the traces left on the ground where people naturally walk, regardless of formal pathways.

As also Charlotte Bates (2017) reminds us, this topic lends itself to an interdisciplinary approach: blending together sociological perspectives – mainly overlooking the materiality of space, focusing on the social and political relations which develop in it – and those of urban and landscape design, centered on the physical features of public space, while often underestimating its non-physical qualities. Moreover, and as later partially discussed in this article, the recent surge in urban data and its availability via the Internet is fomenting a significant amount of research also in the field of computer graphics, as well as in a number of applications in urban planning, emergency management, and visualization (Vanegas et al., 2010). Thence, in such perspective, focusing on the "desire lines" - understood as a phenomenon also capable of informing and supporting the design and planning processes - is a challenge that requires knowledge from several disciplines, and that could greatly benefit from a holistic approach and multi-disciplinary collaborations.

Fig. 1

An example of desire lines diverging from the designed paths, generated by cyclists and pedestrians across the grass of two Copenhagen public parks (photo by the authors, 2016).

As for the appearance of this concept within the planning disciplines, some contributions of scientific literature attribute the genesis of the so-called desire lines to French philosopher Gaston Bachelard, however perpetrating a conceptual mistake. In fact, in his book *The Poetics of Space* (Bachelard, 1964) while applying the methods of phenomenology to architecture (meaning how physical space may influence poetic imagination and people's emotional responses to the environment) the author encourages architects to ground their work on the emotions that it will evoke instead of on principles and predetermined rules: emphasizing imagination and *rêverie*, rather than people's behaviors and choices. So, despite the author stated that "(...) each one of us, then, should speak of his roads, his crossroads, his roadside benches, each one of us should make a surveyor's map of his lost fields and meadows" (Bachelard, 1964: p.11), he did not refer to the actual *tracing* of desire paths, but rather to the memories and feelings echoed by determined spaces, and how these could be understood and interpreted as emotional itineraries and eventually emotional maps.

One of the first official uses of the concept applied to urbanism could be found in the final report of the "Chicago Area Transportation Study" (1959). Among other cases, the precepts of this document were then adopted, in the United States, in the re-design of New York Central Park's paths, paving the desire lines traced by visitors over time, as illustrated by Elizabeth Barlow Rogers (1987), and in the development of the inner footpaths of many University campuses. As for this latter case (e.g., UC Berkley, University of Florida, Virginia Tech, and others) especially since the 1970s, the design of the pedestrian routes between buildings has tried to give an answer to the actual on-site traveling needs and habits of the students, formalizing paths only after a careful observation and understanding of people flows across the space.

In this perspective, a particularly meaningful experience, which also resulted into in a series of three publications by Christopher Alexander and colleagues (i.e. *The Oregon Experiment*, 1975; *A pattern Language*, 1977; and *The Timeless Way of Building*, 1979;) is the one carried out at the University of Oregon, defining a new design paradigm in the approach to community planning. At the core of this "experiment" was the conception that people should design for themselves their own living environments, and even though implying a radical transformation of the architectural profession, the idea came from the observation that most of the wonderful places of the world were made not by architects but by the people themselves. The proposed process, in order to create a human-friendly and supportive environment, was based on six main principles of implementation, yet prescribing "feeling" as the primary criteria for generating physical changes to any site. Also thanks to the active involvement of people in the construction of their community (i.e. *The principle of participation*), and believing that planning and design should be guided by a process allowing "the whole to emerge gradually from local acts" (Alexander et al., 1975: p.5) (i.e. *The principle of organic order*), the authors greatly contributed to the debate of grounding community planning on people's behaviors and choices, supporting in a way the observation and use of desire paths within the planning practice.

2. Behavioral Modeling in Urban and Landscape Interventions

Most recently, several experiences of integrating desire lines within new urban designs have been carried out in several European countries, often combining the direct observation and tracking of the phenomenon to the use of softwares for data gathering and elaboration into simulation models. In Copenhagen, for instance, the experience of the *Copenhagenize Design Company* (2013) has showed how, through the application of the concept of desire paths to the Bryggebroen shared space, it has been possible to assess and map daily use flows and, according to the emerging conflicts and dangers, make innovative proposals for developing a new set of possible urban layouts based on people's preferences, and able to tackle existing issues. As declared by architects, the final aim of such work was to minimize the number of "informal" and autonomous paths covered by the area users, channeling and integrating them instead within a single new layout of the urban space, better answering to the traveling needs of the population.

Another example of how desire lines were able to inform and reform the practices of urban design is the redevelopment of General Gordon Square in Woolwhich, South London. For the transformation of this site, and in addition to on-site observations, landscape architects Gustafson Porter + Bowman turned to *Space Syntax [1]* for examining the relationships between the built fabric of the city and urban activity patterns, carrying out surveys and special modeling, studies of pedestrian behaviors, and spatial accessibility analysis. More specifically, the analysis of accessibility was used for creating multiple scenarios and considering, according to possible design features, the various solutions and their overall repercussions. Furthermore, the same methodology has been also applied to understand how different project alternatives might influence a series of economic and social issues: from the profits of commercial activities overlooking the square, to the safety of pedestrians, and the possibility of a good orientation within the public space.

According to the principal problems observed during the analytical phase, and to the results obtained by scenario prefigurations, the architects developed a design capable of increasing visibility into and through the space; reducing level changes and visual clutter; and aligning pedestrian crossings to desire lines. Finally, by broadening the scale of intervention for fully satisfying movement needs among local polarities and main functions, the designers opened up a diagonal route through the centre of the square, directly connecting the transit system stops with the commercial street, according not just to the fastest itinerary criterion, but rather guaranteeing also the most pleasant one.

Fig. 2

Aerial view from Google Earth of General Gordon Square in Woolwhich, London. On the left, the square before the intervention by Gustafson Porter + Bowman (2011); on the right, the actual layout of the urban space, with the main paths following desire lines.

A similar way of designing and conceiving urban modeling in a non-geometrical way is known as "behavioral modeling" (e.g., Batty, 2009; Vanegas et al., 2009; Alkheder et al., 2008; Waddell, 2002): meaning the use of programs and softwares to predict, with great accuracy, the ways in which people will move and interact through a determined space, and under given circumstances. Even though today the term mainly refers to the design of buildings and small urban portions capable to accommodate large crowds (e.g. stations and terminals, stadiums, commercial streets, and so forth) with the main objective of enhancing safety, comfort, and efficiency conditions to assure optimum circulation, the range of factors and events, as well as the scale of implementation is potentially greatly increasable, opening to new applications especially at the urban and landscape levels.

In fact, behavioral modeling grounds on applications such as the already cited *SpaceSyntax*, and other parametric softwares (predominantly originated from partnerships between scientific institutions and software companies) like *SimWalk* and *MassMotion Flow*; these use algorithms, real-world studies, and complex building code equations to simulate crowd movements and predict people's use of space. In addition to the shared aim of simulating human dynamics in space for reaching optimal design flows, what actually relates all these softwares is their reliance on agent-based modeling in which every single person is represented by an individual collection of data, in a one-to-one simulation. Given a determined terrain (for grid sizes are determined by the designer), factors such as the desire to choose the shortest path between point A and point B, or to avoid longer itineraries, are independently modeled across every agent in the simulation; thus, the number of agents modeled and the factors affecting their decisions can range from one to countless, limited only by processing power.

If at urban level the experimentations and modeling attempts of using data directly coming from desire paths to inform and drive transformation projects are growing, at the landscape scale such an approach is still little used, due to a series of limitations. The main one concerns the scarcity of reliable and easily measurable data on territorial use, mainly deriving from the complexity of dealing with more sporadic and spread out fluxes, especially if compared to those of a single building or a delimited public space. Also, another constraint has referred to the accuracy of territorial representation, which for long has not provided sufficiently detailed data for behavioral modeling purposes (as, for instance, low resolution digital terrain models). However, during the past few years, the great improvements of digital CNC technologies (i.e. *Computer Numerically Controlled*) and the theoretical work carried out around their meaningful use within the field of large-scale landscape design (Girot et al., 2010), has allowed to overcome many representation issues, while outlining the potentials of a different approach.

Thanks to a better and more accurate description of landscape, for example through the use of *Lidar [2]* and point cloud survey techniques (Lin & Girot, 2014), the conventional approach to landscape design, grounded on the preeminence of images and plans over the understanding of the site, has been inverted. In particular, the notion of *topology* as discussed and introduced in the disciplinary debate by Christophe Girot and his affiliates in the volume “Topology: Topical Thoughts on the Contemporary Landscape” (Girot et al., 2013) has been a turning-point in such direction, outlining the priority of site-based information in the determination of landscape architecture. The term *topology*, chosen by the authors for its potential to establish a general theory of design at the landscape scale (as the term “tectonic” did in the architecture field), refers to those physical and morphological qualities which represent the structural bond between landscape appearance, consistency, and dynamics. As noticed by Hays (2015), such position aims at overcoming false expectations derived from idealized formats of landscapes, bringing back the design process to firstly consider local conditions in all their physical complexity, in order to “(...) return to a more original intelligence of terrain” (Girot et al., 2013: p.79).

Moving within such a theoretical framework, our work investigates how a deeper knowledge of topology allowed by new technologies could support the application of behavioral modeling on a broader scale, indirectly informing the creation of paths in the absence of reliable *in situ* observations on the actual use of a determined area. Thus, the creation of a predictive model capable of simulating users behaviors according to pre-established parameters can be developed thanks to the cross use of parametric design softwares and GIS-based informative systems, with the aim of managing and processing a series of useful information deduced both from experience and from the established outputs of studying desire lines, for defining a frame of potential paths in a given spatial context.

3. *Meshwork* Vs *Network*: A Methodological Approach

In a general perspective, this work attempts to emphasize the relations between topology and spatial behaviors, using desire paths as a landscape design and planning tool. An operative application of such procedure might concern, as for our case, the implementation of light infrastructures and mobility schemes in rural and forest sites, especially if belonging to natural parks or protected areas. In these contexts, the existing paths frequently correspond to the old agricultural or pastoral layouts, yet conceived in different environmental conditions and with the aim of fulfilling opposite purposes to the actual ones (e.g. recreational and sport-related activities, cultural and environmental tourism, sightseeing, and so forth). In most cases, the current characteristics of existing rural roads and trails are far from satisfying the necessity of providing accessible, safe and pleasant itineraries and, similarly, existing networks struggle to generate optimal circuits for guaranteeing longer and more cost-effective visits in these areas, also capable of discouraging the so-called “hit and run” experiences.

Given these assumptions, the need of rethinking such networks at territorial scale also represents a chance to introduce the conceptualization of desire lines to the attention of territorial managing authorities, in order to support and drive their decision-making processes and development strategies. Within such framework, this research aims at developing a predictive parametric modeling system based on desire lines, understood as an apparatus able to modify and adapt existing paths - or portions of paths - according to both local topology and visitors expectations and demands.

However, to the project purpose such operation requires an additional level of filter, especially concerning the control of the potential conflicts which might derive from the overlapping of official planning and informal practices (as the very appearance of desire lines in a certain territory underlines). In fact, as suggested by some authors (e.g., Norman, 2011; Nichols, 2014), the notion of desire paths includes and generalizes a series of subjective and preferential behaviors which, sometimes, may risk to get in contrast with those social conventions and rules recognized by design. In some cases, it is proper to ignore or even compel certain behaviors in favor of bigger reasons prescribed, for instance, by users safety when crossing a determined landscape.

By grounding the design process on topology – or more specifically, on the “constructive understanding of landscape” (Girot et al., 2013: p.79), it is possible to consider divergent forces as equal inputs of the parametric modeling: factors featuring desire lines (like distance, slope, etc.), as well as project prescriptions or rules and social conventions can work together as agents informing the final design.

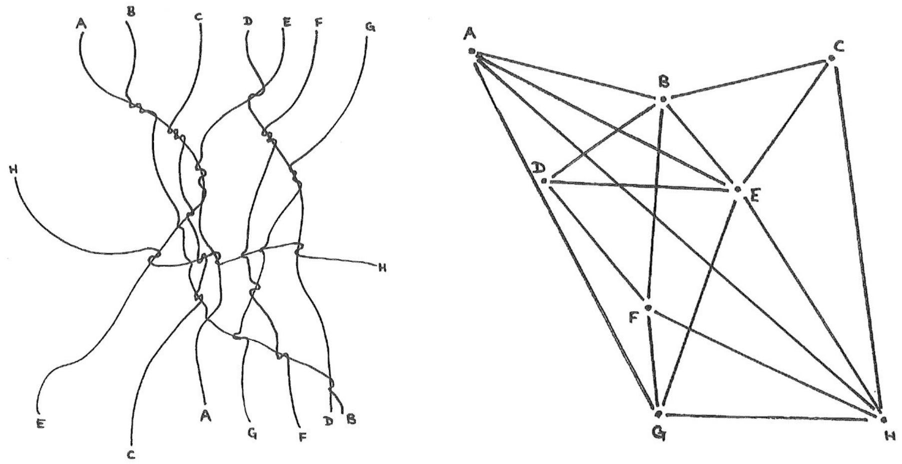
The main outcome of such an operation represents the synthesis between formal and informal variables prefiguring alternative landscape layouts (depending on the importance assigned to each factor), but yet all perfectly adhering to the site's morphological and environmental characteristics. According to this approach, the bundle of possible, parametrically generated paths cannot be described in terms of *network*, but it'd better pertain to the definition of *meshwork* as described by Ingold (2007) in his “Taxonomy of Lines”. Here, the author establishes an interesting terminological and logical dichotomy between meshwork and network, suggesting how all places and landscapes – even though in their variety – could be understood as a knot of entangled lifelines, a meshwork of reticular patterns left on the ground by people's movements. By recalling Henry Lefebvre's reflections in “The Production of Space”, and the philosopher's interpretation of the meaning of *meshwork* – i.e., an intertwined environment which is more *“*archi-textural*”* than architectural: “(...) the reticular patterns left by animals, both wild and domestic, and by people (in and around the houses of village or small town, as in the town immediate environs)” (Lefebvre, 1991: p.117-18), Ingold counterposes to such model the most commonly used one of the *network*: a series of lines marked in space, with the principal aim of directly connecting points and polarities.

As schematically illustrated in Ingold's diagram (Image 3), opposing a twine of winding, interwoven routes to a set of geometrically straight lines, it is in the entanglement of lines and not in the connection of points that the actual mesh is constituted: a metaphor of the desire paths and of all those lines along which life is lived. Moreover, Ingold (2011) writes: “Proceeding along a path, every inhabitant lays a trail. Where inhabitants meet, trails are entwined, as the life of each becomes bound up with the other. Every entwining is a knot, and the more that lifelines are entwined, the greater the density of the knot” (p.148).

So defined, the meshwork could also be useful to disclose the geographic, geo-morphologic and topographic characteristics of the investigated site, while the network represents an abstract possibility of connecting knots (an approach frequently used by planning and design); thus, the meshwork could potentially configure itself as a sort of territorial “behavioral map”. In such perspective, it is interesting to recall Rebecca Solnit's words: “Walking has created paths, roads, trade routes; generated local and cross-continental sense of places; shaped cities, parks; generated maps” (Solnit, 2001: p.4). In fact, whether desire lines are considered as “relicts of walking” (Luckert, 2012), the footprint of people's preferences when moving through space, or citizens response to design and planning implementation, they are without any doubt a physical trace, “(...) a geographical feature – something that might be recorded on a map” (Luckert, 2012: p.318). Thus, actually, a meshwork of desire lines is a map itself.

By channeling such concept to the project practice and to the operative case of defining paths at territorial and landscape scale, the generation of the meshwork – lacking direct data and observations – could be parametrically controlled starting from a topographic base, and a series of factors modeling visitors behaviors in a determined context.

Fig. 3



Tim Ingold's diagram: the meshwork of entangled lines and the network of connected points (Ingold, 2007: p.82).

4. A Parametric Application to the Landscape Scale

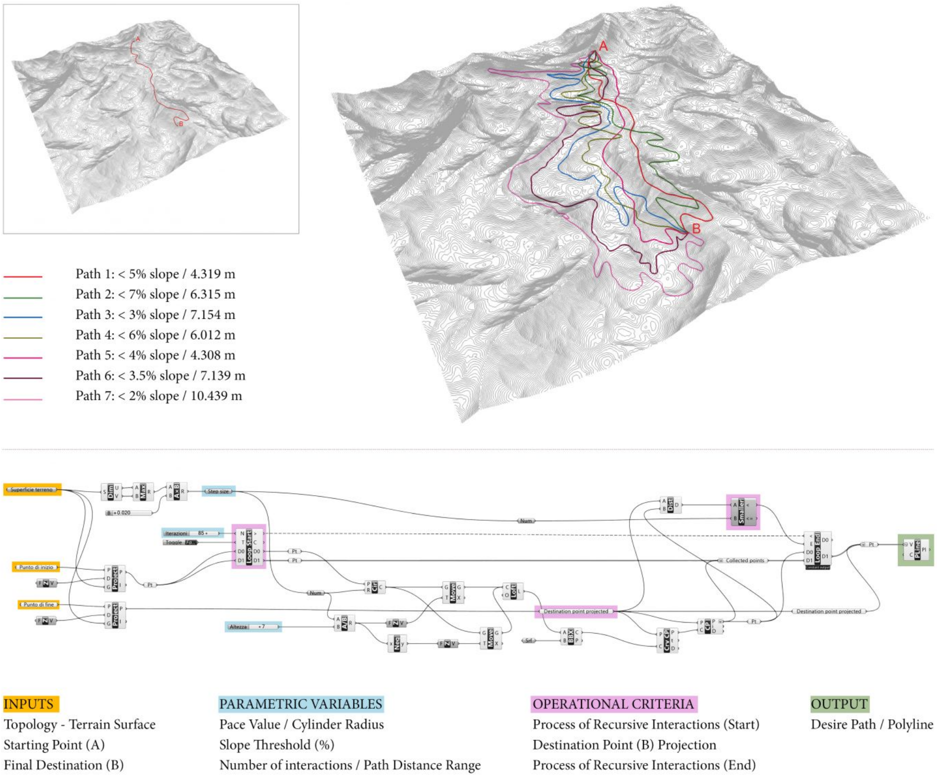
The suggestion of using the phenomenon of desire lines not just for reading and understanding a site and people's preferences towards it, but also and above all as an operative design tool, is to be conceived as a way of defining the field of action of a potential meshwork of routes describing a behavioral model deduced from parametric variables.

In the present contribution, we will only describe one possible pilot case: a first operative experimentation yet concerning a generic section of landscape, working as a "tutorial" preparatory to further applications in actual contexts and with real stakeholders. For establishing the parametric input values which would determine the potential bundle of desire lines on the territorial sample, we only took into consideration those factors directly connected to spatial accessibility and walkability: in particular, slope and the distance covered between the nodal points of the meshwork, both deduced from scientific literature as some of the most significant parameters in the individual choice of taking one path instead of another. As we will better explain below, more variables can be added to these two fundamental parameters, all capable of modifying – either constraining or enlarging – the meshwork of potential itineraries.

Image 4 shows the illustrative case of connecting two points, A and B, located on a surface of 5x5 Km generated with *Grasshopper* in *Rhinoceros*, thanks to the *Elk* plugin, importing random data in *.hgt format available on the NASA database "Shuttle Radar Topography Mission" (SRTM), whose degree of definition is close to 9 meters. Once placed the two points on the surface, a first conjunctive path is automatically generated, applying a script inspired to the model developed by Claghorn (2015), and capable of defining the fastest connection without exceeding a 5% average slope on a 20 meter pace.

In order to get such a trail, the script adopts a repetitive logic (i.e., "recursive process"), allowing to gradually interpolate all points on the surface according to a linear sequence which complies with a series of parametrically controllable criteria: for instance, density of points A and B; the slope of the segment between two points, and that of the ones following; and a series of information on the full-scale path, related in this first scenario to the fastest route.

Fig. 4

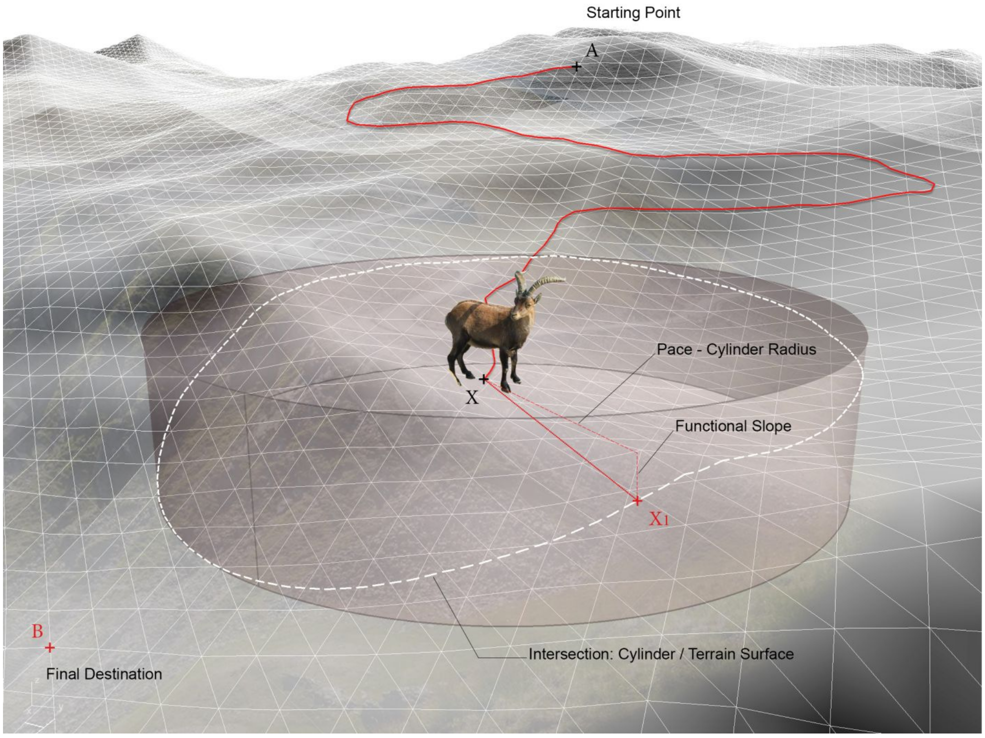


A bundle of paths generated in Grasshopper through the Claghorn script (2015). At the top left, in red, the shortest path between points A and B, and on the right the meshwork obtained by manipulating slope and distance variables; at the bottom, the visual script adopted to generate the different itineraries (images by the authors, 2017).

As illustrated in Image 5, in correspondence of each point of the itinerary this kind of interaction is progressively repeated: a cylinder whose center lays in point X, with variable height and pre-established radius (20 meters, in our case) intersects the ground surface in an infinite number of other points; among those, the ones respecting the *a priori* slope criterion (< 5%) are selected. Subsequently, and applying the logic of defining the fastest connection, point X1 is chosen, namely the closest point to the final point B. Moving from X1 through a loop, the above-cited process starts again, and the following points of the path are located (Xn), finally joined together into a line reaching point B.

For the purpose of this article, it is interesting to stress how the method defined by the script is inspired to an ancient way of tracing paths, empirically implemented for defining trails and routes in hardly accessible rural areas: in fact, farmers often used to identify paths by releasing a domesticated animal on arduous grounds, then following and complying the desire line it chose. Similarly, the script - by following a more efficient and less romantic logic – determines the same path according to incremental steps and simulates, even if in a basic and partial way, an analogous method in tracing the desire path. However, the possibility of choosing a variety of parameters for the generation of such an itinerary also arises a series of speculations on the design potentials of this tool. In fact, the choice of different criteria related to accessibility (i.e., pace and slope) determines as much variations in the path, which might correspond to a variety of users abilities.

Fig. 5



A schematization of the recursive process identifying the optimal route between points A and B – in each point X of the path, mainly according to slope and direction criteria (image by the authors, 2017).

Also, the very length of the path can be controlled: instead of the fastest route, a maximum threshold of linear development could be set; or even, a time limit to cover the path's distance by relating length and slope. The range of possibilities deriving from the variation of the indicators finally describes a bundle of lines, a potential *meshwork* integrating some of the already discussed characteristics of the desire lines together with a series of rules and prescriptions of the planning disciplines.

The above-described example surely represents a simplification, but it also displays the capability of parametric design softwares (in this specific case, the *Grasshopper* application for *Rhinoceros*) to model a variety of statistically predictable users behaviors, then transforming them into measurable and geo-referenced traces in space. In such perspective, our experimentation is a first step towards an even more accurate and well-structured methodology, which is currently being tested in different actual environments for assessing its reliability while expanding possibilities.

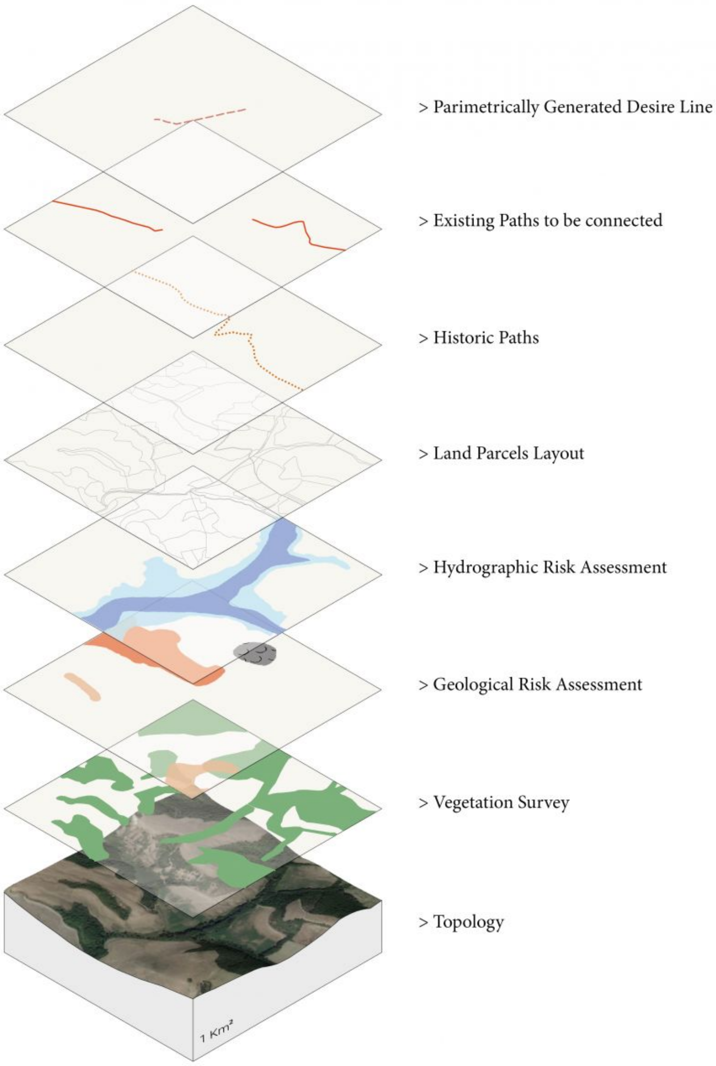
More specifically, this tool is finding the interests of some Italian authorities directly involved in the management of natural parks and protected areas as, for instance, for the case of the Tuscan "Parco della Val'Orcia e Crete Senesi": a cultural heritage site near the city of Siena, protected by the UNESCO. Here, the managing authority has to deal with some important issues as the park's territorial accessibility and recreational use, and the consequent environmental impacts of such activities; at the same time, it is committed to boost local economies, while optimizing the positive effects of these assets on the territory. However, all these purposes - highly interconnecting to the ways of crossing, and therefore experiencing the landscape by visitors and tourists - often do not match the actual spatial organization of the protected site.

By reflecting on how to reconfigure the existing mobility networks crossing the landscape, the aim is to promote a territorial use as much sustainable as possible, socially inclusive, and cost-effective. In this sense, our research[3] is focusing on how to efficiently reconnect a number of existing rural trails, known as "white routes", which are for long segments interrupted. By doing so, and pursuing objectives of territorial valorization for touristic and recreational uses, and for a sustainable cultural and environmental experience of these landscapes, new large-scale paths are being designed, determining new itineraries based on alternative uses and ways of traveling (Emanueli & Lobosco, 2015). As shown in Image 6, starting from the identification of all those heritage and landscape emergencies which need to be promoted and reconnected, and with a special attention to the interruptions in the existing white routes network, the aim is to apply the parametric model for generating potential desire lines in order to define a new meshwork for crossing and enjoying the site. Even though at an early stage of implementation, we are also experimenting the integration of the above-described model with additional parameters, especially analyzing two aspects.

The first one, concerning a more accurate definition of potential desire paths: for instance, by applying further variables deriving from the study of landscape views and landmarks which could act as route's catalysts; or also, micro-environmental indicators related to comfort – i.e., studying slopes exposure to solar radiations – using plugins for the inquiry of geo-referred data, such as *GRASS* on the *Qgis* software.

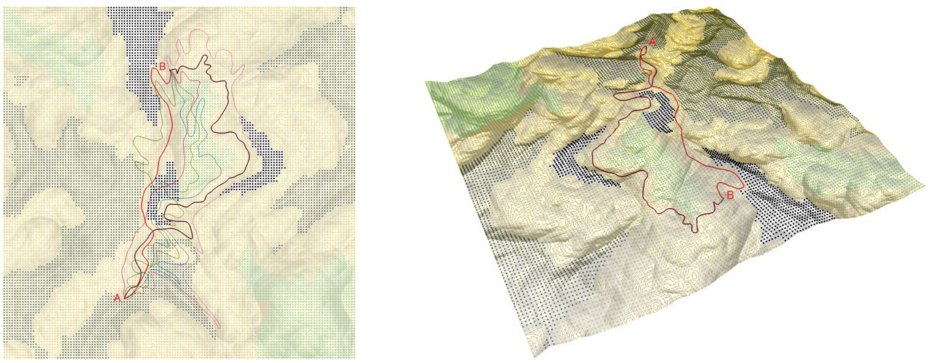
On the other hand, the second aspect refers to the specific, strategic goals of the investigated context, and to the scale of intervention. These might pertain to the analysis of eco-systemic fragmentation induced by alternative paths in the landscape (trough the use of softwares as *FRAGSTATS*), or to the exam of hydro-geologic issues which, overlapping with the meshwork, are able to give the risk exposure of each potential path (as illustreted in Image 7). The totality of these information, together with other functional considerations (e.g., maximum walkable lengths, location of rest areas, etc.) might be included in the script generating the bundle of paths: constraining its degrees of freedom, and operating that additional control on the potential desire lines which has already been mentioned.

Fig. 6



A layered representation of some territorial elements which have been taken into account when modeling a sample of the new road network in the "Parco della Val'Orcia e Crete Senesi", Tuscany - Italy (image by G. Engelke, 2016).

Fig. 7



The meshwork of potential paths shown in image 4 is overlapped with the environmental local patchwork, identifying – on the right - the two less impacting paths on the eco-systemic fragmentation (images by the authors, 2017).

5. Conclusions

Broadly speaking, both nature and consistence of the above-cited additional filters are key-elements within the design process, also closely related to the context of intervention and its strategic needs. Basically, the *meshwork* configures itself as an operative tool supporting the planning and design processes; a framework within which to implement design choices that are not necessarily permanent, and might adapt to several conditions.

In fact, the many lines which compose it represent all the alternative paths: "customized" according to the different users abilities, or to the environmental features of a site (as, for the case of natural parks, depending on reproduction cycles and/or the presence of determined animals). Also, these lines might correspond to the different implementation phases of a broader territorial network, adapting over time according to – among others – climate changes and surrounding conditions. Therefore, the possibility of visualizing how the meshwork may vary by manipulating some pre-determined parameters on the evolution of ground morphology (either for "natural" or artificial events) allows to dynamically interpret the project, and to define a one-to-one relation between paths and landscape.

As a support to the planning process, the meshwork is a tool capable of going beyond the "planned vs used" dichotomy, while integrating social, behavioral, and informal components – typical of desire lines, and embodying the so-defined "social signifiers" recalled by Norman (2011) - within the generative process of new paths, and therefore of new landscapes.

Especially at territorial scale, modeling the indicators deriving from the direct observation of such phenomena, and crossing them with further data characterizing the topology of the investigated context, would allow to visualize and analyze beforehand the potential consequences and repercussions of design choices, according to different evolutionary scenarios of both the landscape and the forms and elements (i.e. the meshwork of paths) which will create it.

Notes

[1] Space Syntax represents a set of theories and techniques providing a configurational description of an urban structure by using a connectivity graph representation, and attempts to explain human behaviors and social activities from a spatial configuration point of view (Jiang et al., 2000). First conceived by Bill Hillier and Julienne Hanson at The Bartlett University College of London, it is a tool supporting urban planners to simulate the likely social, economic and physical effects of their designs, seeking to analyze the ways in which the built environment constructs and constrains space; how this construction of space can be described using a "standardized lexicon"; and finally represented through a series of standardized visual conventions (Hillier & Hanson, 1984; Hillier, 1996).

[2] LIDAR (acronym for *Light Detection and Ranging or Laser Imaging Detection and Ranging*) is a remote sensing technique that allows to determine the distance of an object or of a surface using a laser pulse, in addition to determining the concentration of chemical species in the atmosphere and in the water.

[3] Part of these technical experimentations have been also developed by the Graduate Thesis of G. Engelke, titling: "Le strade bianche delle Crete Senesi. Porgetto di rigenerazione del territorio e dei percorsi dimenticati" (supervisors: Prof. L. Emanueli, Prof. G. Lobosco; co-supervisor: Prof. D. Moderini), University of Ferrara – Department of Architecture, academic year 2015-16.

Bibliographic References

Alexander, C., Silverstein, M., Angel, S., Ishikawa, S. & Abrams D. (1975). *The Oregon Experiment*. New York: Oxford University Press.

Alkheder, S., Wang, J. & Shan, J. (2008). *Fuzzy inference guided cellular automata urban-growth modeling using multitemporal satellite images*, in *International Journal of GIS*, vol.22(11-12), pp. 1271-1293.

Bachelard, G. (1964). *The Poetics of Space*. Boston, MA: Beacon.

Barlow Rogers, E. (1987). *Rebuilding Central Park: A Management and Restoration Plan.* Cambridge, MA: The MIT Press.

Bates, C. (2017). *Desire Lines: walking in Woolwich*, in Bates, C. e Rhys-Taylor, A. (eds.), Walking through social research. New York e Londra: Routledge.

Batty, M. (*2009*). *Urban Modeling*, in Thrif, N. & Kitchin, R. (eds.), "*International Encyclopedia of Human Geography"*, *Oxford*, *UK: Elsevier,* pp. 51- 58.

Chicago Area Transportation Study (1959). *Final Report in three parts*. Chicago, IL: Western Engraving & Embossing Co.

Claghorn, J. (2015, February 17). Path Finder Using a Recursive Process – Example 8.5. [Blog post] GENERATIVE LANDSCAPES by Joseph Claghorn. Retrieved from https://generativelandscapes.wordpress.com/2015/02/17/path-finder-using-a-recursive-process-example-8-5/ (Accessed 09/02/2017).

Copenhagenize Design Company (2013, October 8). *Islands Brygge: Application of the "Desire lines"*, [Blog post] THE BLOG by Copenhagenize Design Co. Retrieved from http://www.copenhagenize.com/search?q=desire+lines (Accessed 10/03/2017).

Dorato, E. (2016). *Landscape project / Large-scale project. A reflection on green-structures and territorial networks as key-elements for the development of a sustainable Southern Albanian Riviera*, in Aliaj, B. & Rossi, L. (eds.), *Albanian Riviera: an alternative model of progress and development for a Next Generation Albania*, Tirana: Mali Pleshiti Printing House, pp. 124-131.

Emanueli, L. & Lobosco, G. (2015). *Infrastrutture e Turismo: nuove relazioni e strategie di riconversione*, in *Atti della XVIII Conferenza Nazionale SIU. Italia '45 – '45. Radici, Condizioni, Prospettive*. Venice, 11-13 June 2015, Rome - Milan: Planum Publisher, pp. 1572-1579.

Girot, C., Bernhard, M., Ebnöther, Y., Fricker, P., Kapellos, A. & Melsom, J. (2010). *Towards a Meaningful Usage of Digital CNC Tools Within the field of large-scale landscape architecture*, in "*Future Cities: proceedings of the 28th Conference on Education in Computer Aided Architectural Design in Europe"*, September 15-18 2010, ETH Zurich, Switzerland, pp. 371-378.

Girot, C., Freytag, A., Kirchengast, A. & Richter, D. (eds.) (2013). *Topology: Topical Thoughts on the Contemporary Landscape*. Berlin: Jovis.

Hays, D.L. (2015). *Book Review of Topology: Topical Thoughts on the Contemporary Landscape*, in *Journal of Landscape Architecture*, vol.10(2), pp. 92-94.

Hillier, B. & Hanson, J. (1984). *The Social Logic of Space*. Cambridge, MA: Cambridge University Press.

Hillier, B. (1996). *Space is the Machine: A Configurational Theory of Architecture*. Cambridge, MA: Cambridge University Press.

Ingold, T. (2007). *Lines: A Brief History*. London: Routledge.

Ingold, T. (2011). *Being Alive: Essays on movement, knowledge and description*. London: Routledge.

Jiang, B., Claramunt, C. & Klarqvist, B. (2000). *Integration of Space Syntax into GIS for Modeling Urban Spaces*, in *International Journal of Applied Earth*

Observation and Geoinformation, vol.2(3-4), pp. 161-171.

Lefebvre, H. (1991). *The Production of Space.* (trans. D. Nicholson-Smith), Oxford: Blackwell.

Lidwell, W., Holden K. & Butler, J. (2010). *Universal Principles of Design.* Beverly, MA: Rockport Publisher.

Lin, E.S. & Girot, C. (2014). *Point cloud components: Tools for the representation of large scale landscape architectural projects*, in Wissen Hayek, U., Fricker, P. & Buhmann, E. (eds.), "*Peer Reviewed Proceedings of Digital Landscape Architecture 2014 at ETH Zurich*". Wichmann, Berlin: Offenbach, pp. 208-218.

Luckert, E. (2012). *Drawings We Have Lived: Mapping Desire Lines in* Edmonton, in *Constellations*, vol.4(1), pp. 318-327. Retrieved from https://journals.library.ualberta.ca/constellations/index.php/constellations/article/view/18871/14659 (Accessed 09/26/2017).

Myhill, C. (2004). *Commercial Success by looking for Desire Lines*, in Masoodian M., Jones S., Rogers B. (eds), "*Computer Human Interaction. APCHI 2004. Lecture Notes in Computer Science*", vol 3101, Berlin, Heidelberg: Springer, pp.293-304.

Nichols, L. (2014). *Social Desire Paths: an applied sociology of interests*, in *Social Currents* vol.1(2), pp. 166-172.

Norman, D.A. (2011). *Living with Complexity*. Cambridge, MA: The MIT Press.

Solnit, R. (2001). *Wanderlust: A History of Walking*. New York: Viking.

Vanegas, C.A., Aliaga, D.G., Benes, B. & Waddell, P.A. (2009). *Interactive Design of Urban Spaces Using Geometrical and Behavioral Modeling*, in "*Proceedings of SIGGRAPH Asia '09*", vol. 28(5), New York, NY: ACM, pp. 111-120.

Vanegas, C.A., Aliaga, D.G., Wonka, P., Müller, P., Waddel, P. & Watson, B. (2010). *Modelling the Appearance and Behaviour of Urban Spaces*, in *Computer Graphics Forum*, vol.29(1), pp. 25-42.

Waddell, P. (2002). *UrbanSim: Modeling Urban Development for Land Use, Transportation and Environmental Planning*, in *Journal of the American Planning Association*, vol.68(3), pp. 297-314.

Reference According to APA Style, 5th edition:
Dorato, E. Lobosco, G. ; (2017) Designing Desire. A Parametric Approach to the Planning of Landscape Paths. Convergências - Revista de Investigação e Ensino das Artes , VOL X (20) Retrieved from journal URL: http://convergencias.ipcb.pt