typological topologies (workshop robert r. neumayr)

from space to field

robin evans once stated that architects “do not build, but merely draw”, two fundamentally different processes. however, it is interesting to notice that precisely this limitation to the realm of the drawing, in the wake of abstract art which freed the drawing from its purely representational character, has led to the most radical architectural innovations. the move towards digital design processes and the development of new digital tools and parametric techniques, which are characterized by a high level of interactivity and real-time flow control, subjected the field of architecture to further radical changes.

so far architecture and urban design have mostly been relying on formal resources dating back to ancient greece. the classical architecture privileges simple, clear and distinct platonic figures like squares, triangles and circles, symmetries and simple proportions. spatial compositions are always arranged in strictly hierarchical formal systems, following a deterministic design process.
the renunciation of linear and binary systems of perception, which for a long time have been dominating our world view, has only recently opened up new areas of scientific research.
rather than seeing a city as a number of independent entities, we have now come to understand the city as a continuous field of diverse yet interconnected elements, as a spatial organisation that is able to negotiate and interpolate between those elements, which are subjected to the changing forces and currents that guide their use.

as stan allen remarks, “*field conditions move from the one toward the many, from individuals to collectives, from objects to fields.*” (allen, 1999).

urban structures need to be understood as complexly networked field organisations, which are organized primarily around currents and lines of exchange where people, services, ideas and goods are collected, organised and redistributed in a multitude of directions (for an account of these phenomena see: de landa, 2000). these dynamics can be analysed and described using models from various other scientific disciplines.

the concepts and logics in question are mostly drawn from the domains of mathematics, physics or biology and include:

fractal systems: e.g. l-systems, mandelbrot systems.
dynamic systems: e.g. fluid dynamics, particle systems.
crystalisation systems: e.g. diffusion limited aggregation.
self-optimising systems: e.g. voronoi patterns, foams and bubbles.
geometric systems: e.g. triangulations, self-similar subdivisions.
behavioural systems: e.g. flocking, swarming.
cellular automata: e.g. game of life.
network theories: e.g. frei otto’s path optimisations or hillier’s work on urban networks.

all these systems are to a certain extend characterised by the following properties:

modulated field conditions: a system is able to create a modulated field of different yet gradually changing densities and/or other properties that are held in a dynamic equilibrium. emerging and receding patterns (of geometry) resulting from this system are always understood as modulations of an in itself continuous system of changing dependencies, where each modulation becomes an environmental condition (i.e. an agent of change) to their adjacent entities.

complexity: the system builds up complexity out of a series of single components. however, their interaction according to a set of simple rules and their initial condition give rise to a high level of complexity.

emergence: the emergent properties of a system are generated by the recurring iteration and superimposition of interactions of its single components, which add up to the complex state of that system.

consequently, the result of such a non-linear process can – due to its complexity - not be predicted. this is also known as a “bottom-up” process, as opposed to a “top-down” process, in which the overall form is determined first.

gradient transitions: a field is seen as one continuous organisational unit, which organises and modulates a series of entities, that are subjected to the same set of internal and external rules. as the parameters that drive these sets of rules vary gradually across the field, no binary conditions occur, rather gradient transitions from one state to another.

in order to expand the repertoire of urban geometries it is necessary to systematically investigate into what contemporary science can contribute to the field of urbanism beyond the well-known classical canon. the appropriation of complex recurring geometric patterns and their underlying mathematical concepts as well as the understanding of emergent, fractal, chaotic or self-optimising systems and their bottom-up logics of development and proliferation will become a source for the experimental development of gradient urban field patterns with different degrees of densities that are able to host a whole variety of new complex urban geometries.

by taking these processes from their initial context into the domain of urbanism and architecture, urban planning starts to shift towards a new paradigm, whose outcome can later on be compared to the results of conventional urban strategies. however, one needs to observe that the strategies, which one begins to extract from other fields of science, initially have no architectural value per se, as they operate in other scientific domains. their logics need to be analysed, abstracted and appropriated to suit the urban and architectural purposes in question. they can not generate architecture or urbanism but merely serve as a dynamic, changeable, informed pattern of distribution (an abstract machine), establishing different sets of rules that guide the differentiation and proliferation of urban geometries, which in turn are based on the topologies that emerge from the contextualized parametric processes. these topologies need to be analysed and developed for their typological potential at different scales and densities, thus starting to infuse architectural meaning into a process, initially alien to urbanism.
these processes need to be taken beyond the straight-forward application of scientific tools to urbanism or architecture, as the mere control of techniques does not necessarily result in successful architecture or urbanism. research needs to result in the development of a series of different architectural and urban layers that operate within the logics of the techniques applied, yet move past the mere transcription of (semi)scientific algorithms.

design methodology and scope of work

a sufficiently large and sufficiently empty site will be given within the city limits of Beirut to allow for the parametric generation of an urban field with gradient densities and to provide enough room to generate a diversified field of urban complexity.

each team will sign up for one generative process, emergent or self-organising system taken from the domains of mathematics, biology or physics, and at first try to establish an urban master plan that defines urban massing (i.e. the distribution of volume across the site and the development of volume-void figurations of different densities) as the primary condition of the urban field:

in a first step we will presume that urban geometries - as opposed to smaller-scale architectural geometries – privilege two out of the three dimensions of space. therefore the first goal is to generate a two-dimensional field of varying densities that reacts and interacts with different internal and external parameters, which are derived from analyses of internal (programme, circulation, …) and external (site conditions, environmental conditions, …) requirements.

typological topologies (workshop robert r. neumayr)

the task is to generate an urban field condition with a high degree of emergent (i.e. unpredictable) complexity through an intricate and intrinsic system of order. the main challenge is to machine complexity, which in its final state can still be understood and recognised based on its initial laws of generation.
to this end the intrinsic properties of a generative process are analysed, abstracted and catalogued at first in order to be able to speculate about their potential to solve architectural and urbanistic problems. in a next step students try to understand and describe the process in a mathematical way, allowing them to simulate and reproduce its results in a scripted or parametric process they set up.
it is strongly recommended that students use their command of grasshopper and other scripting skills that they have already acquired to set up parametric and/or interactive models.

as these generic processes in themselves have arguably no capacities to solve problems outside their own domain, they need to be appropriated, enhanced and transferred into the field of architecture. when transferring the respective process to architecture, students develop an architectural model, indicating which contextual internal and external requirements will then determine the values of the parameters that drive the emergence of these configurations.

the resulting mass distribution, the relation of its volumes and voids and the urban topology they constitute, will be read in terms of their topological potentials, comparing it to existing typological systems (if appropriate), thus developing emergent and surprising typological configurations. this architectural layer, which is added onto and connected with the system and which will vary according to the designer's capacities, should be understood as an integral part of the overall design process.

the possible typological volumes of the differentiated urban field will be read as a swarm formation of many buildings. according to the changing density within the generated urban field these buildings form continuously varying formations with different density figurations, whereby:

every plot of land (every entity) has inscribed the possibility to hold a building.
no two buildings are exactly the same.
there are lawful continuities that cohere this multiplicity of buildings (geno-type/phenol-type).

this process can be described using the notion of geno-type/pheno-type, a concept borrowed from biology, which explains how from one single geno-type a large variety of slightly different but related entities (pheno-types) can be derived, according to varying external and internal parameters and conditions. this can be understood with respect to the diversity of building volumes (according to global and local environmental parameters) and also with respect to the changing internal organisation of the building (according to internal parameters).

required readings:

allen, stan. *field conditions* in *points + lines*. princton architectural press, 1999.
de landa, manuel. *a thousand years of non linear history*. b&t, 2000.
johnson, steven. *emergence.* penguin press, 2001.
kelly, kevin. *out of control.* perseus publishing, 1994.
koenigs, ulrich. *adaptive & selbstorganisierende systeme i.d. architektur* in *gam02*. springer, 2005.
langton, christopher. *artificial life* in *genetische kunst – künstliches leben*. pvs verleger, 1993.
leach, neil. *swarm tectonics* in *latent utopias.* Springer, 2002.
neumayr, robert. g*enerative processes.* in *innovative design and construction technologies.* milano, 2009
neumayr, robert. *associative processe.* in *concepts beyond geometry.* berlin, 2009.
rahim, ali (ed.). *contemporary processes in architecture*. wiley, 2000.
rahim, ali. *catalytic formations*. taylor & francis, 2006.
schumacher, patrik. p*arametricism as a style*. http://www.patrikschumacher.com

essential toolbooks:

aranda, benjamin & lasch, chris. *tooling*. princton architectural press, 2006.
flake, gary william. *the computational beauty of nature*. the mit press, 2001.
wolfram, stephen. *a new kind of science.* wolf media, 2002.

(20110509 / RRN / END)