Urban Cloudification[1] on-demand

"technology is the answer...but what is the question?"
Cedric Price

Statement:
By 2050 urban population will increase with 20%.

Factor 1:

New strategies for inner-urban densification[2] has to be investigated in regard to the persistent global population growth and significant mass migration which is likely to occur in response to climate change.

Factor 2:

While taking all facts, statistics and predictions into consideration it is easy to build up a distopian image of the future. There is a need for the production of a "utopian"[3] yet realistic image which visualises together with the facts as well as the platforms which can provide place for social excitement as proof that new social and urban structures can be beneficial.

Hypothesis:

If architecture would be ephemeral and adaptive, the existing city volume could be programmed more efficiently by the activation of the time dependent snooze-zones. The resulting shift in the city pattern would support the intensification of the city and the establishment of a new social contract.

Proposal:

The project proposes a culture-scripted catalogue for different urban and building typologies where Unmanned Omni-copter Units (Flybries) can help to free buildings from their current static, possibly mobile functions in order to create additional living spaces (residential and related functions), while also improving the qualities of the sorrounding private and public spaces.

Vocabulary:

FLYBRI: intelligent, unmanned, omni-copter aircraft unit
ADSO: attracted, decentralized self organisation
DADSO: Disattracted, decentralized self organisation
VOMCOG: volumetric micro condition generator (gravity dependent- independent

Keywords:

adaptability, mobility, radius = intelligence, quality, time, cloud, active ecology[4], utopia, advanced culture[5], system curating, international language: nature

1 - Cloudyfication:
The conversion and/or migration of data and application programs in order to make use of cloud computing

2- Inner urban densification
Bill Hillier: Theoretical models also show that substantial future savings in transportation energy could be made by densifying cities rather than thinning them out and spreading or dispersing them. These and other arguments suggest that building up densities in existing cities might be a sensible part of a future urban policy.

One aspect of the debate is, however, that a high-density urban policy conflicts with current cultural attitudes built into our planning system, which tends to see density as a bad thing in itself, to be tolerated where necessary but to be minimised as part of an overall policy of bringing order into the 'unplanned chaos' of cities by thinning out, reducing scale, and separating the untidy but continuous city into well-defined zones and identifiable units.

3- Utopia:
Architecture is the platform that enables us to visualise, live and feel those dreams. Dreams like those of Wim Wenders in until the End of The World - and yours too. (Enric Ruiz-Geli) Not utopia. Anticipation. Exploration and foresight. "Adnvanced" (anitcipated) reality.

...Utopist thought, claims Lefebvre, is concerned with abstract utopia and explores the impossible, while utopian thought is concerned with concrete utopia that aims to "liberate" the possible. Lambert places Constant on the side of the utopian;that is to say, on the side of efforts to alter and extend the landscape of the concrete-possible rather than probe the abstract-impossible. (Marcos Novak)

4 - elocogy, active:
"... based no longer upod a timid, merely defensive - resistant - non-intervention, but rather upon a non-impositive, projective and qualifying - restimulating - intervention in synergy with the environment and, also, with technology. Not only possible, but developmental as well.

-an ecology in which sustainability is interaction.

-in which nature is also artificial

-in which landscape is topography

-in which energy is information and technology is vehiclisation

-in which development is recycling and evolution is generic

-in which environment is field

-in which to conserve implies always to intervene"
/Frederic Migayrou

5- Culture, Advanced
In advanced culture, the ultimate aim is the increased quality of life of the individul, seen as an independent entity that participates in a collective. ...In advanced culture, information technologies are not just an instrument for carrying out the same activities as always, but more efficiently (as in the case of electronic mail), they actually transform the very base of the activity they affect.
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density/ den·si·ty n
1: the quality or state of being dense, 2: the quantity per unit volume, unit area, or unit length: as a: the mass of a substance per unit volume, b: the distribution of a quantity (as mass, electricity, or energy) per unit usually of space (as length, area, or volume), c: the average number of individuals or units per space unit <a population density / housing density> 3a: the degree of opacity of a translucent medium, b: the common logarithm of the opacity
-- first known use 1598 -

growth management
- the use of a comprehensive plan to regulate new development, based on constraints such as infrastructure availability, delivery of services and environmental protection.

infill
- housing or other development in an urban area that is designed to fill a void left by vacant property, such as redevelopment land. Generally, the purpose of infill is to revitalize the surrounding area.

FAR (floor area ratio)
- a formula for determining permitted building volume as a multiple of the area of the lot. The FAR is determined by dividing the gross floor area of all buildings on a lot by the area of the lot. For example, a 6 FAR on a 1500 square meter lot would allow a building with gross area of 9000 square meters.

1_Urban Issues

Climate change has been described as the biggest global health threat of the 21st century. World population is projected to reach 9.1 billion by 2050, with most of this growth in developing countries. Significant mass migration is likely to occur in response to climate change and should be regarded as a legitimate response to the effects of climate change. The contribution of population growth, migration, urbanization, ageing and household composition to mitigation and adaptation programmes needs urgent investigation. Climate change and population can be linked through adaptation (reducing vulnerability to the adverse effects of climate change) and, more controversially, through mitigation (reducing the greenhouse gases that cause climate change).

2 Theoretical models By Bill Hillier show that substantial future savings in transportation energy could be made by densifying cities rather than thinning them out and spreading or dispersing them. These and other arguments suggest that building up **densities** in existing cities might be a good solution for preparing to the upcoming population increase.

Vienna's population is expected to increase within the next decades from 1.8 million to over 2 million inhabitants by 2029. The city, with its 19th Century development, served as the case study for investigating alternative urban design strategies to explore the possibilities of undetected spaces for growth in density without acquiring new areas for development.

"There must be alternatives to what we learned to think knowing."

The project 'Urban Cloudification' proposes a hyper-flexible gravity and urban fabric independent infrastructure which is able to detect urban issues- like missing or mis-functioning elements in the city - and is also able to create temporary spatial- and functional configurations as solutions for those. In the current studies the issue is specified as densification.

How to densify?

Throughout history, questions on densification have played a major role in the development of the urban environment. Industrialization, economic growth, building technologies, shifts in labor markets, heavily altered living and working conditions for the majority of society, being governed and organized by a set of best practice solutions corresponding to apparent political and cultural ideologies at certain times.

Planning, urban design, and the architectural disciplines, accordingly offered a variability of possible answers to the apparent problemetatic, which by its very nature adresses the orchestration of flows as much as the presumably static organization of building mass- tightly binding together space and time.

Devastating living conditions at the turn of the century, together with technological advances, evoked a reconsideration of the distribution of building mass towards a vertical development, with the aim to rather occupy the sky and free the ground for the benefit of free circulation of people and goods, ventilation and natural light, towards a maximization of efficiency and functionality. Likewise, for the benefit of hygenic reasons the functional city, proclaimed the separation of functions, allocating specific aereas for living, work (industry) and recreation, expanding the control on the impact of the natural environment in a large scale attempt.

The technological euphoria cummulated in suggestions

such as to “dome” entire city quartes, allowing for potential climate control, to not only supply abounded living amenities but offering large scale solutions for energy related questions. Later examples even free human existence from the technological-spatial correlation of living and labour, freeing society from the ground, from work, as machines do the duties. Grounding back the potential of long-term visions has radically alterated strategic planning, embracing time as the driving factor to allow for thinking a resilient city, planned and designed to adapting to changes over a longer period.

An adaptive system - a cloud- could also become a temporary and fluid building mass and could interact dynamicly with the static and permanent urban tissue in order to bridge its functions with the notion of time. For dynamic issues a dynamic system brings the solution.

1_Urban Strategy / what from, where to, what else?

Densifying by intensifying.
By the integration of the “urban cloud” the project is aiming to re-qualify exterior snoozed zones by providing temporary microclimatic conditions for certain functions to appear.

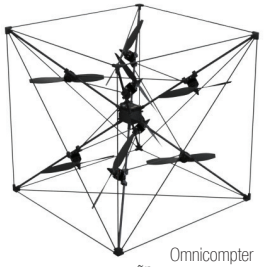
Using the noise maps of Vienna,exterior areas were detected in the inner districts where the daily activity is minimum and could be used as potential locations (sites) for the cloud to spatially operate. These areas - snoozed zones - could be re-inhabited by various functions, once a certain micro-climate is provided. The gross floor area of certain mobile programs could be minimized in the current interior spaces and if there is need for it ,extend them towards the public and semi-public volumes. The exterior would turn into a semi-interior space while keeping the advantages of being exterior. Pop-up functions appearing on the streets could improve safety factors and also enhance neighbouring building qualities.

North faced facades cloud configuration

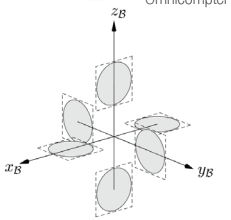
noise exposed facades - cloud configuration

Omnicopter

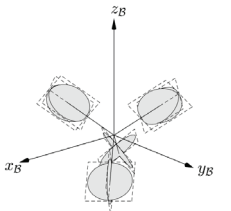
The novel six degrees-of-freedom aerial vehicle is based on a static force and torque analysis for generic actuator configurations,which derive an eight-rotor configuration that maximizes the vehicle's agility in any direction. The proposed vehicle design possesses full force and torque authority in all three dimensions. A control strategy that allows for exploiting the vehicle's decoupled translational and rotational dynamics is introduced. A prototype of the proposed vehicle design is built using reversible motor-propeller actuators and capable of flying at any orientation. Preliminary experimental results demonstrate the feasibility of the novel design and the capabilities of the vehicle.



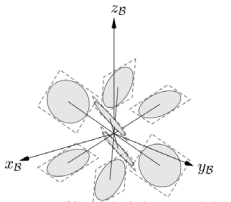
Omnicopter



N = 6, r_{max} = 1.41



N = 6 (two tetrahedra), r_{max} = 2.66



N = 8 (cube), r_{max} = 2.31

During the micro-climatization of the exterior , the cloud could also improve the qualities of the neighbouring interiors. By the use of specific materials and surfaces in the design of the flying cloud elements (reflective panels, pvs, sound isolator materials etc.) there is a potential for natural sunlight supplimentation, sound isolation and also energy production.

As a study, we mapped facades facing the north and those which are exposed to streets with larger than 60 dB noise factor in order to visualise by setting goals the dynamic urban cloud and its behaviour.

2_The Cloud units

The cloud is the new infrastructure. A fluid entity which is built out of small (15cm*15cm*15cm) identical unmanned omni-copter units, called Flibries.
The unit design was borrowed from a research project lead by Raffaello D'Andrea, ETH Zürich.

"With its eight propellers, the Omnicopter is the antithesis of the Monospinner. Its symmetrical design and cube-like shape makes it seem like an unlikely flying machine, yet D'Andrea demonstrated that it can fly in any direction independent of its orientation and rotation."

As an interpretation of the above mentioned prototype, the cloud units are equipped with specific surfaces and materials in order to make them able to create certain micro-climatic conditions.

The design sketch is trying to maximise the usable surface area within the cubic frame while it still allows air to move through the diagonal axises to let the rotors function. In order to make the cloud able to to produce energy, fly, reflect, radiate and shade we applied opaque- and transparent solarcells, reflective panels and for each unit 8 propellers.

The flybries are able to detect highly radiated surfaces and optimize their positions for efficient charging. For energy production, other than the solarcells we could potentially use moisture mill technology which is still under development at the Columbia University (Ozgur Sahin, Ph.D., an associate professor of biological sciences and physics). The technology derives power directly from evaporation.

2_The cloud control and behaviour

The control and the intelligence of the cloud is programmed from two points of view. The combination of the global system with locally decisive elements could be a good approach for detecting urban issues while reducing the risk factor and improving reliability in local and global behavior.
Each unit is equipped with advanced sensory systems which on one hand allows communication with global servers while it also follows its own easy rule set for operation within certain environmental conditions. The basic cloud configurations are defined by the main server which can be controlled by the city while their modification and the movement between those target configurations are solved by selforganization.
The cloud in motion becomes a swarm where each unit by following the rules of cohesion (steer to move toward the average position of local flockmates), separation (steer to avoid crowding local flockmates) and alignment (steer towards the average heading of local flockmates) is able to become part of the collective behaviour, part of the cloud without central coordination. These relatively simple individual rules can produce a large set of complex swarm behaviors. A key-component is the communication between the members of the group that build a system of constant feedback. The swarm behavior involves constant change of individuals in cooperation

Moisture mill

The researchers first glued spores to both sides of a thin, double-sided plastic tape akin to that in cassette tapes, creating a dashed line of spores. When dry air shrinks the spores, the spore-covered dashes curve. This transforms the tape from straight to wavy, shortening the tape. If one or both ends of the tape are anchored, the tape tugs on whatever it's attached to. Conversely, when the air is moist, the tape extends, releasing the force. The result is a new type of artificial muscle that is controlled by changing humidity.

Self-organization

a process where some form of overall order or coordination arises out of the local interactions between smaller component parts of an initially disordered system. The process of self-organization can be spontaneous, and it is not necessarily controlled by any auxiliary agent outside of the system.

with others, as well as the behavior of the whole group.

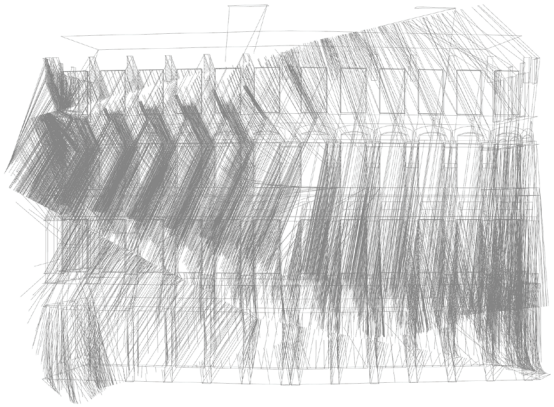
3_ Cloud Configuration

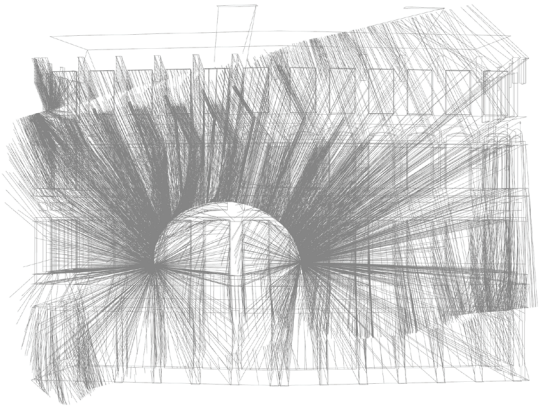
The use of flight assembled architecture, ie drones to lay bricks, has been a topic of research since many years. The concept of the Flybri combines the two into one single element which is able to perform independently as well as a collective in the form of one structural entity. Unlike the standard brick element that is fixed in place once assembled, the Flybri offers flexibility as one function is completed, it reconfigures for alternate purposes.

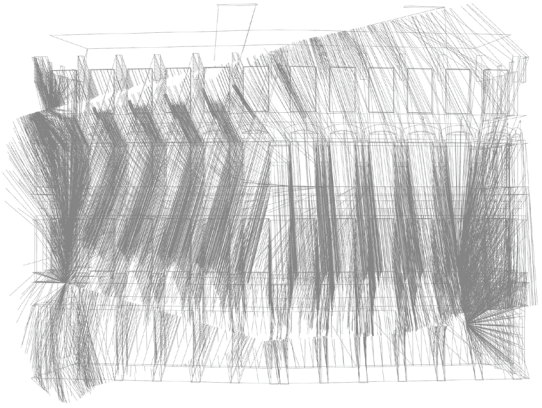
It can improve building-physical properties while also can create spatial configurations. The latter could be designed or “curated” by combining certain algorythmic formations and meantime including the aesthetic aspect of the local environment for behavior. The result is a multi-dimensional coordinate system which defines locations for the flybries to occupy. Once the copters distributed themselves and got attached to the designed coordinates they are capable to adjust themselves as a reaction to structural, or environmental performances. The city becomes an interface for the the new soft-scape and the existing hard-scape to combine.

3_ Gravity independent configurations

Each flybri can rely on itself wihout dependencies. Its failure never affects the group. When the elements of the system are independent from gravity, the system itself also becomes. The ability for creating flying architecture redefines the notion of structure. It is not anymore a physically interconnected selfsupportive system but a communication based, pixelized, porose and fluid entity. The cloud has the potential to perform without following the rules of the extisting urban fabric while also is able to form infinite surfaces, real time changing porosities and densities.



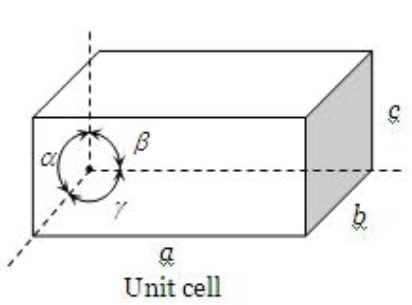




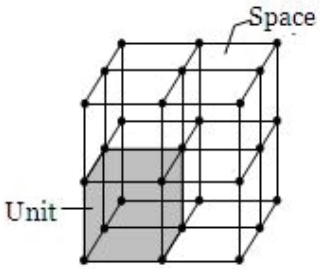
3_Gravity Dependent configurations

Once the configuration reduces its real-time changing factor it is able to modify itself to a static semi gravity dependent system.

1. Main idea of bricks and drones
2. Structural logic- bricks and space frame
3. Optimisation



Unit cell

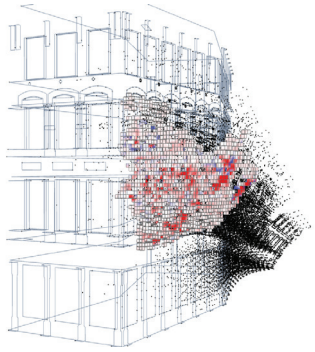


Space lattice & unit cell

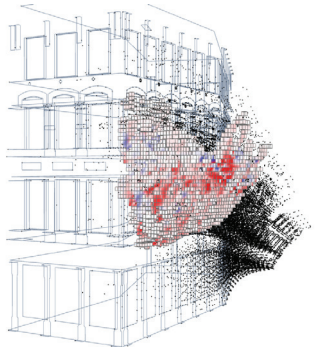
The unit itself functions as a basic brick which can be assembled and reassembled to suit various needs. If the configuration sees potential in resting, its core becomes a spaceframe structure, and once assembled with other units in its static position is able to achieve very a strong and self loading structure. The distribution of the tensile and compressive forces, the rigidity and the ability of the structure to deform locally makes it safe even under extreme conditions such as earthquakes or sudden impacts. Loads are also equally distributed well throughout the assembly process. Much unlike masonry structures, the assembled Flybries are able to reduce the internal inertia forces, and is much stronger against tension forces and shear.

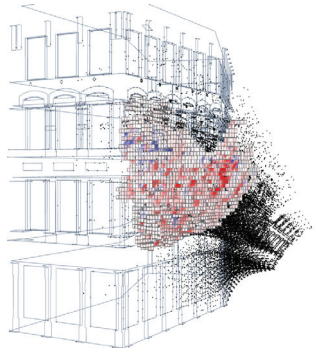
The geometry of the assembled space lattice is not dependent on gravity for strength or integrity and is therefore suitable for employment in ground and in air applications. Once the swarm of Flybries recognise a required function, systems in place are able to determine the shape and assembly process needed. Each Flybri unit recognises its position within the overall geometry and will maneuver to its set position. During the assembly process, the units are able to analyze the global structural performance and calibrates itself accordingly to optimise the units and structural performance. It can recognise any changes in the environment and react by adding or subtracting units at weak points.

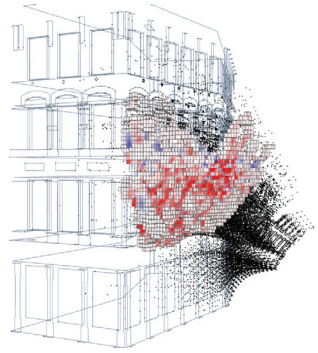
num of units:4000
displacement: 3,9cm



num of units:6000
displacement: 2,5 cm







num of units: 5400
displacement: 2,4cm

num of units:9000
displacement: 2,1 cm

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The idea of flying architecture at the first glimps can easily sound naive and make the audience question its several aspects. Although the vision of a realtime-adaptive and fluid environment - which can create gradial changes between extreme environmental conditions while also has the ability to detect and self-repair the urban space itself - hopefully is provocative enough to be discussed. Once there is a good reason detected in the narrative we belive it creates space for further urban and architectural imaginations to appear.

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