ABSTRACT
This work in progress paper defines the contours of a new research trajectory that explores architecture as part of a larger encodable surface oriented toward the technologies that image it. This is situated within a conceptual framework that identifies terraforming, geoaesthetics and the composition/recomposition of the Earth (Bratton 2014) as foundational architectural problems manifesting at all terrestrial scales from the microscopic to the geopolitical. In an effort to stake out a more limited territory for imminent future work, the infrastructure of Google Earth is explored so as to understand how it recomposes the surface of the Earth. A small exploration of codified building envelopes provides a glimpse into possible projects that will develop in future work.
INTRODUCTION

For many decades now, cities have experienced an accelerating if not total urbanization of space while the profession of urbanism has been laughed out of existence. Citing an “overwhelming awe for the existing city” and acknowledging the death of the historical discipline of urbanism, Koolhaas (1995) makes a call to architecture to engage the city “not as its makers but as its mere subjects, as its supporters.” It is precisely within this vein that we answer the call to outline the contours of a new research project that aims at augmenting architectural envelopes—more precisely exterior building envelopes—such that they enhance the functionality of the systems that image them such as the aggregation of technologies that constitute Google Earth. We borrow Benjamin Bratton’s Stack (Bratton 2014) as an organizational framework that situates the scope of the research. From Bratton’s Stack, we operate between two layers: Earth and Cloud—Earth as a foundational layer of [ideally] inexhaustible materiality and computation operating as a landscape; Cloud as a conceptual geography made of real infrastructure embedded within and upon planetary landscapes. Specifically we aim at exploiting the “compositional capacities” of Earth so as to augment its ability to interface with Cloud. Toward this end, we examine trompe l’oeil as a method for adding depth to the otherwise flat/layered perspective of Google’s image gathering network. In doing so architecture’s mediation of public and private might be replaced by a new one: mediating exchange between Earth and Cloud. This question is approached through a series of questions that form the structure of the paper itself: How does Google go about imaging the Earth? How does architecture function within this image? And how might architecture be uniquely capable of adding depth to a flattened image of Earth?

EARTH THROUGH GOOGLE’S EYES: DATA COLLECTION AND COMPILATION

Google Earth is a single navigable image of the Earth formed out of an aggregation of images from a variety of sources (Figure 1). These images are not snapshots but rather composite datasets stitched together to create a seamless fluid environment. For example, despite having its logo prominently displayed during the launch of the GeoEye satellite in 2009, Google does not own or task satellites for the retrieval of any specific information but is merely a consumer of images primarily supplied by DigitalGlobe and GeoEye (Chen 2008). It is important to note the functional origin of hi-res satellite images. As Laura Kurgan (2013) writes, Google Earth is built from “GPS, satellite images, databases and geographic information systems (GIS) software; digital spatial technologies originally designed for military and government purpose.” As such the produced maps and corresponding datasets are biased toward the purpose of targeting.

By framing targeting as the identification of objects within a field, architecture functions much like a pixel within urban environments—an individual unit that aggregates to form the city. This analogy can be extended downward, thus adding resolution (pixels) to individual buildings as well as upward where clusters of buildings create delineated territories of their own at the macro scale. But the Cloud has a voracious appetite for information. This is not so much a question of Earth’s supply so much as it is a question of anticipating technologies of extraction that are capable of priming and regenerating the informational capacity of the Earth. The aforementioned DigitalGlobe and GeoEye projects are already evolving toward increased capabilities of resolution, but how might architecture begin to address issues of scale and resolution in an anticipatory way? In other words, how can architecture start to shape the direction in which these image/targeting technologies develop? And what are the lessons that the discipline of architecture might be able to contribute in searching for critical solutions?

LAYERS AS A STRUCTURAL TOPOLOGY

Buildings within Google Earth are defined by their location via a street address, user app generated data via Google Places, tagged user-based images and finally through interpolated satellite and street-view images. These are compiled into a single user environment by layer, thus exacerbating the flatness of each and any individual layer. Layers are designed to order things by being discrete, extractive and explicit. Layers operate as filters. Problems arise when a filter misses information or when layers fail to communicate between one another with the same level of fidelity as they might otherwise in an unlayered state. For example, a lack of fidelity between the physical and virtual environment leading to issues as banal as getting the wrong directions to a restaurant to ones as severe as border disputes between neighboring states (Figure 2).

In addition to a lack of fidelity inherent within any system of superimposed layers, there is also the challenge posed through the sheer magnitude of information that can be placed into a virtually
layered system. For example, municipalities have a particularly difficult time quantifying the built environment as their only image of it comes in the form of permit drawings and census data. But the prospect of organizing that data into a broadly accessible and searchable model is difficult at best. Further, even if a city attempted to superimpose information such as square footage, zoning or demographic data over top existing Google-based maps on a per-building basis, it would have to assume that the records accurately correspond to the actual built environment. These problems reveal a significant weakness in Google’s image of Earth: it is inherently flat because it is always (and wants it to be) reduced to a single seamless image layer. But what if information (whether layered or layer-resistant) could be physically embedded within the environment in more legible or accessible ways rather than virtually superimposed over them?

LAYERING IN ARCHITECTURE

Architecture is already showing signs of moving away from layers. While the discipline has long subscribed to layers in a multitude of ways (software layers, building assembly layers, orthographic layers, etc.), layers can be expensive—compromising quality requiring additional systems and labor to connect them; and separate in terms of performance and durability thus creating assemblies that are only as viable as their weakest component. As an alternative, the work of Tom Wiscombe is aggressively approaching composites as a way of circumventing layer-based practices.

A useful, albeit over-simplified, definition of composites are assemblies that have been smushed together so as to perform greater than the sum of its parts. We think there is promise in framing the Earth as both a composite and a layered system, freely fluctuating back and forth between one another as Earth and Cloud interface with one another. We anticipate that the sustainability of this fluctuation will rely on synthetically regenerating a composite depth within the flat-layered image of the Earth.

FROM TROMPE L’OEIL TO INFORME L’OEIL

The premise of playing with a building’s image through perspective in order to augment their perceived image is not a new one—with an exemplary instance being the technique of trompe l’oeil, a painterly technique used to generate the illusion of dimensional depth to otherwise flat surfaces. When applied to the exterior of buildings, it often depicts the extension of public space where there is otherwise none. The technique itself is metric in nature, using the mathematics of perspective drawing to augment the human perception of space. It also relies on orienting itself toward a particular user, in this case an individual’s visual perception of space. The ubiquity of images of three-dimensional space represented as two-dimensional has begun to create a cultural inversion whereby three-dimensional objects are represented as editable two-dimensional surfaces.

In both the cases of Street Eraser and Pierre Delavie, the building envelope has been augmented such that it produces a skewed sense of physical spaces that have been contaminated by their susceptibility to being imaged. But what if the condition were inverted? What if rather than sensing this susceptibility to editing, it was instead hidden in plain sight? What if buildings were visually communicating explicit information to a non-human user, the Cloud? And could trompe l’oeil provide a mechanism to do so? Would informe l’oeil then become a viable alternative means of adding dimension to any layer of Google’s flat Earth?

REPROJECTING SULLIVAN’S FACADES TOWARD A NEW USER/OBSERVER

The work of Louis Sullivan serves as a valuable precedent that may offer a solution to the challenge of non-human aesthetics and communication. Kevin Murphy (1988) explores the influence of poet Walt Whitman’s use of reader-oriented poetics on Louis Sullivan’s “functional” application of ornament. For Sullivan the use of façade ornamentation creates an interface for buildings to participate with his “user/observer-oriented theory of architecture.”

Sullivan, in his work Kindergarten Chats, declared the primary function of an architectural entity was to establish a connection with the observer and that this can be communicated through the façade of a building. If modern architecture’s (and by extension Sullivan’s) ideal user was the liberal human subject, the Cloud’s user is rather something that likely resembles a state or corporation. What is at stake within the digitally constructed environment of things like Google Earth is not only that humans are not the primary observer of the built environment but also that questions surrounding program, information exchange and aesthetics would likely aim at mainlining into the cloud by deliberately bypassing human perception altogether—posing another fundamental challenge to the research: how can architecture disguise its communication with the cloud in plain sight of the human user?

What Sullivan uniquely brings to the discussion is the façade’s uniquely independent position away from both a building’s plan and section, thus fundamentally remaining on the exterior. By allowing a building to “tells it story” through façade augmentation, or ornament, an architecture is capitalizing on its potential to express information to an “outside.” But between architecture
and its outside, between the envelope and its image, there must exist a medium for exchange. Presently Google Earth is incapable of reading the composite architectural surfaces of the Earth because they have not been encoded with a universal language through which complex information can be transferred. And so we see this as an opportunity for architecture to establish a means of communication between its outward-facing surfaces and the aggregation of image-targeting technologies that have situated themselves as user/observers.

A SMALL INITIAL EXPERIMENT

Given our hunch toward the importance of building facades, we undertook a small initial experiment that focused on embedding images generated through Google Street View with composite data. This was done in an attempt to realize the kind of project that this broader research territory might yield. Toward this end, we developed a scripted definition that would encode (inform) a virtual instance of a building façade. We then fabricated and photographed that assembly. A second piece of code was then developed that would decode (read) that surface with the intention of accurately extracting the information back out of the image and into code once again.

IMAGE AGGREGATION

Using Google Earth and Street View as a case study, we test the viability of our façade images against its image stitching technology. Google creates its 3D environment through a composition of multiple images stitched together creating a texture map or Google’s own Universal Texture applied to a 3D mesh generated through laser scanning and isometric aerial images. Façade codification must anticipate agents of intended communication and establish protocols for language exchange. As this research explores the interface between the built environment and Google, we have developed techniques that account for the focal length and perspectival overlaps of the images generated by the Dodeca 2360 camera along with the depth and accuracy of the SICK LMS 200 laser scanner (Figure 3).
Google’s environments are never captured from truly orthogonal perspectives, therefore it is important to encode the surface with geometric relationships that remain legible from oblique angles. The research develops a number of different mapping strategies based on binary and trinary codification and surface depth relief. In all cases there must be a quantifiable and consistent understanding of distinguishable geometric shapes comprised of categorical areas when viewed as a 2D digital image. Further explorations intend to explore the potential flexibility afforded by encoding the same surface with different information manifested as oscillating geometries representative of different data, legibly deciphered from specific viewpoints.

ENCODING SURFACE ARTICULATION

While we anticipate incrementally moving toward more complex geometries, we simply used bricks with two codification logics. In the first instance brick length varied to correspond with letters of the alphabet (Figure 4). In a later instance a single brick size was used, varying its orientation by ninety degrees such that it expressed Morse code.

Morse code is considered a trinary language, made up of three unique geometries. The inclusion of a space marker is necessary to denote the start and end of letters and words. The pattern of dots, dashes and spaces are assigned a numeric signifier associated with a corresponding grid. According to the numeric signifier, the grid is irregularly altered to account for input geometries that coincide with the trinary language. Geometry can be parametrically linked at each point of a grid and associated with its related call out. As such the language is not limited to only dashes, dots and space as geometric expressions but any discrete geometric assembly consisting of distinct edges and translatable areas when interpreted in a 2D photograph.

DECODING LOGICS AND PROCEDURES

Decodification takes an input digital image adjusts for contrasts and performs an edge detection algorithm to identify and separate the spatial forms of a surface. The unique geometries are sorted relative to their occupied area in the 2D image and listed according to variable thresholds. Fields of geometry are ordered relative to their x, y coordinates of the image and relocated in digital space so the algorithm can in effect read the input geometries from left to right and top to bottom. The geometry is then translated back into a dash, dot or space and translated back into text (Figure 5).

CONCLUSIONS

The premise of adding dimensional depth to flattened surfaces by codifying material surfaces seems a rich and underexplored territory for investigation. We anticipate these methods will be of particular interest to city planners and developers alike who might be looking for ways to accurately understand the built environment and its embedded metrics. While the geometric language we have developed could be applied to any component-based surface articulation including bricks, shingles, stucco patterning, billboard vinyl or even applied paint schemes, the larger importance of the research territory lies in critically approaching the interface between Earth and Cloud in both layered and composite ways. By cloaking informed patterns amidst ordinary material organizations, the built environment might feel the same to human users while the entities concerned with observing and evaluating those spaces can more easily access crucial metrics. As such, traditional ways of evaluating problems and solutions may not lie in conventional visual terms or techniques. However, borrowing historical techniques and reorienting them toward non-human users will likely be a necessary practice moving forward. Critical questions as to what metrics might be of use and to whom will remain, but evolving communicative technologies will most certainly play a central role. Developing those technologies as well as encoding the imaged surface of the Earth establishes a new and explicit territory for architecture to operate within.

The control and accuracy of our own methods of digital codification and data extraction developed has been encouraging for future research—merely operating on binary and trinary codification of alphanumeric values. As the algorithm evolves, we anticipate easily expanding its capability to accommodate a wide range of unique codified languages. Although the project is only in its initial stages, we are encouraged by the fact that we were able to produce a high fidelity loop between encoded physical surfaces and decoded virtual images.

We anticipate an important role for excessive surfaces as they will likely yield more dynamic feedback systems provided fidelity can be maintained. In particular, it is our hope that we will be able to embed surfaces with multiple layers and composite sets of infor-
mation in communication with one another without losing fidelity. Surface volume, depth, fractal geometric variation and color will likely play a large role in such investigations. We have already started work on an image processing algorithm that generates a depth and color map of surface variations; extracting pixel brightness values and charging a corresponding UV coordinate of a 3D surface with a directional vector. And while we have emphasized fidelity, we do see complexity and excess as both desirable and useful attributes (Scott 2010) that provide a corollary to the messy, indiscrète and indeterminate composite surface that is the Earth.

REFERENCES


IMAGE CREDITS

All image credits to Taron and Parker (2014) with the exception of Figure 2 as noted in the caption.

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