Drawing Imprecision

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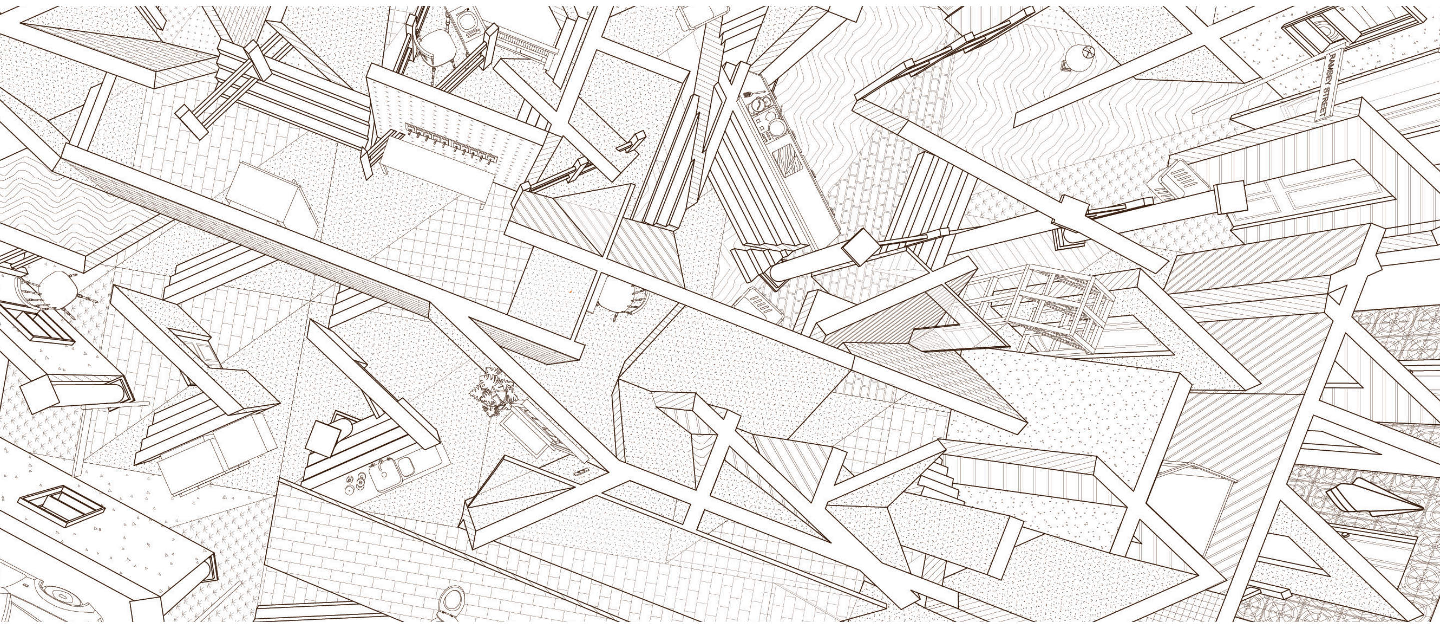
The Digital Drawing as Bits and Pixels



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1 A detail of a domestic architecture designed through the misuse of digital techologies.

ABSTRACT

This paper explores the consequences of digitizing the architectural drawing. It argues that the fundamental unit of drawing has shifted from “the line” to an interactive partnership between bits and pixels. It also reveals how the developmental focus of imaging technology has been to synthesize and imitate the line using bits and pixels, rather than to explore their innate productive value and aesthetic potential.

Referring to variations of the architectural drawing from a domestic typology, the paper uses high-precision digital tools tailored to quantitative image analysis and digital tools that sit outside the remit of architectural production, such as word processing, to present a new range of drawing techniques. By applying a series of traditional analytical procedures to the image, it reveals how these maneuvers can interrogate and dislocate any predetermined formal normalization.

The paper reveals that the interdisciplinary repurposing of precise digital toolsets therefore has explicit disciplinary consequences. These arise as a direct result of the recalibration of scale, the liberation of the bit’s representational capacity, and the pixel’s properties of color and brightness. It concludes by proposing that deliberate instances of translational imprecision are highly productive, because by liberating the fundamental qualitative properties of the fundamental digital units, these techniques shift the disciplinary agency of the architectural drawing.

INTRODUCTION

In her book, Menkman argues that current modes of communication, including the digital technologies upon which the production of architectural drawing relies, have a common ambition of "transparency" (Menkman 2011). Defined in this context as the deliberate suppression of any aberrant function in the iterative processes of data transferal and storage, "transparency" is theoretically not achievable due to the nature of error and noise (Gleick 2011). It can nevertheless be minimized through innovative methods of correction and reduction respectively to provide the illusion of a seamless transaction between measurable space and its digital representation.

The "sanitization" of digital data has explicit consequences for its projective applications as a real-world interface. For the architectural drawing, it means that speculative notations of spatial intervention are normalized by an imposed taxonomy of precise, curated digital algorithms. These interventions are mediated according to highly controlled and predetermined spatial conditions embedded within digital infrastructure. The facility of digital data to be instrumentalized has therefore resulted in the advancement of seamless graphical-user interfaces, while the potential of the same algorithms to deliver diverse, non-standard outcomes has been largely ignored.

The architectural capability of the "glitch," or digital malfunction, is an often-neglected field of study because its outcomes are difficult to predict or control. However, the deliberate use of the glitch as a template for drawing procedures has the capacity to circumvent known disciplinary forms through the presentation of new spatial and formal arrangements. In these instances, the invocation of error or malfunction resides principally in the "misuse" of high-precision software, and relies upon the shift from its native or intended use to a seemingly erroneous outcome. By unveiling the hidden properties and behaviors of the digital platform, the potential of the glitch as a generative tool can therefore emerge.

This paper explores the consequences of digitizing architectural drawing through a new lens of the deliberate "misapplication" of software. It presents a series of techniques that draw upon the innate numeric basis of digital geometry to relocate the architectural drawing outside any constructed taxonomy of precision. Furthermore, by releasing the drawing from a predetermined reliance upon "fail-safe" techniques of production, the paper demonstrates that these techniques not only reclaim the drawing"s speculative qualities but allow it to reap the benefits of the diverse and undisclosed capabilities of the digital platform.

BACKGROUND

Traditional notions of architectural drawing position "the line" as its fundamental constructive unit. Just as in other modes of representation, by "replacing" an existing or proposed real-world object, the line acquires meaning analogistically (Evans 1997). Seen through the lens of information theory, the line is an analogy of architectural elements, just as writing is an analogy of language, which allows it to be represented as a series of symbols for the purposes of storage, reproduction, and communication (Shannon 1948; Saussure 1966). The introduction of computation to architectural production has given rise to two new sets of symbols that replace the traditional understanding of the line, and which instead allow it to be stored and reproduced within a digital frame of reference. These sets of symbols are, on the one hand, the binary representation of the drawing on a computer drive (i.e. the bit), and on the other, the pixels of the pixel array onto which the binary representation is "translated" in order to reproduce the image of the drawing.

Referring to Goodman's distinction between autographic (in which the artist produces the final artifact) and allographic (in which the artist produces instructions for the final artifact) work, Mitchell argues that the act of algorithmically translating the architectural drawing between the computer drive and the pixel array is presented as a completely "transparent" process, however, this is done via the use of hidden algorithmic means (Mitchell 1992).

To draw upon Mitchell's quote, the algorithm's role in interpreting how the binary representation of an architectural drawing is rendered is of great significance. First, architectural drawings are stored on a computer's drive in a plethora of different forms. Drawings are not only stored in either vector or raster format, but there are several different file formats within those groups. For example, a vector format may be stored as a .DWG or as a .PDF, and a raster as a .JPG or as a .PNG. Second, the algorithms that read this information may read and interpret it differently. For instance, McNeel's Rhino and Autodesk's AutoCAD may both read the same .DWG file with two different algorithms—seeing as the software has been written by two different companies—that have the potential to import the information into a file differently. Finally, as Mitchell argues "…computer files are open to modification at any time, and mutant versions proliferate rapidly and endlessly" (Mitchell 1992). It becomes evident that the capacity to police the methods by which an architectural drawing is "instantiated" is extremely limited. The creator of a drawing has no ability to control with what software and by what means the drawing is edited and moved to the pixel array. Methods of these kinds are highly orchestrated and reside within art practice under the name of glitch art; however, within a disciplinary context, little research has been done to explore the potential of their application to the architectural drawing.

There have been several explorations into the pure formal qualities of the glitch in architectural production. These range from artworks such as Ratsi's series of collages to !Mediengruppe Bitnik's façade for the House of Electronic Arts to more spatial theoretical attempts such as the work evidenced by Austin and Perin (2015). The problem with the application of these methods to the production of architecture is that they focus upon the formal qualities of the glitch itself, attempting to reproduce them uncritically within physical architecture. Although there are interesting philosophical implications for giving digital artifacts a physical form, the post-human nature of these processes is extremely likely to produce sculptural yet uninhabitable forms.

Drawing upon Imprecision

The production of drawing with software not currently associated with architectural practice has important disciplinary implications. Using these methods to edit or "glitch" an architectural drawing's binary structure, and thus its pixel representation, disrupts the drawing's allographic conventions via the introduction of new symbols, the disruption of existing symbols, and new color information. From Allen's perspective, this disruption of the drawing's allography shifts it from representational to diagrammatic, as the glitch drawing is "…not 'decoded' according to universal conventions, rather the internal relationships are transposed, moved part by part from the graphic to the material or the spatial, by means of operations that are always partial, arbitrary, and incomplete." (Allen 1998).

The introduction of the glitch and the disruptive elements that come with it not only shifts the drawing from an allographic representation of a proposed or real-world object into a diagram, but in so doing, it circumvents known disciplinary forms. The traditional instrumentalized digital methods associated with architectural production constrain the user to known and controllable outcomes. Conversely, the possible architectural applications of the glitch are an often-neglected field of study, because its instrumentalization does not potentially offer either predictable or controllable outcomes for drawing practice. The value of this imprecision is therefore the potential to discover new, and diversify existing, spatial and formal arrangements. By limiting the glitch to the architectural drawing and forcing the designer to shift between the allographic conventions of drawing and the openness of the diagram, the glitch instead offers a rich interpretive space of design potential where formalism is not necessarily the main design driver.

METHODS

The transferal of the processes of drawing production to the digital platform introduces new contingencies to its role as a disciplinary tool. Nevertheless, the toolsets that mediate the bit and pixel's intrinsic geometric properties to the viewer in highly precise and quantifiable terms demonstrate moments of imprecision offering alternative, affective reinterpretations of space. The paper will thus explore a set of software that due to its strategic misuse introduces imprecision into architectural production.

The first of these is the misuse or application of software not traditionally associated with architectural production. These processes, rather than focus on architectural drawing as an act of attempting to precisely manipulate the pixel array, rely on "misinterpreting" the underlying information structures of the drawing in order to introduce methods that are not inherently visual. For example, the digital architectural drawing can be interpreted as text, given a "spell check," and then reinterpreted as an image to finally be presented on a pixel array. The second of these is scientific image analysis software. The specificity of scientific image analysis software makes it a highly efficient toolset targeted to quantify the behavior of captured visual data for the validation of speculative scientific theses. Medical imaging software, in particular, is a diagnostic tool that demands a high degree of infrastructural precision to produce an accurate index of reality that avoids figural ambiguity.

However, the reapplication of these softwares and the capacity of their internal algorithmic processes to delineate formal and spatial conditions provokes a new set of diagrammatic constraints governed by the properties of digital geometry. At the same time, the automated and transformative capacities of this platform offer the architect an accelerated volume of diagrammatic possibilities that are situated outside the traditional limits of diagrammatic architectural precision. It is in these spaces of imprecision or glitch that the opportunities for speculation and ambiguity reside.

Data-Bending

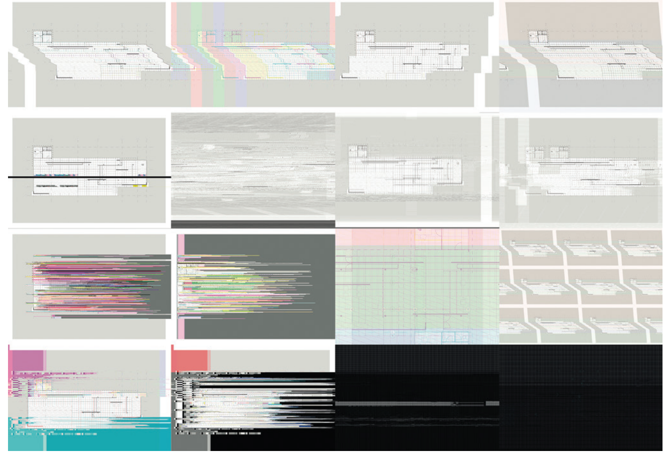
The architectural drawing is stored as files on a computer drive by storing two sets of instructions. The first set of instructions, known as "the header," is read by an algorithm to let the computer know information such as file type, width, and number of channels.* The second set of instructions, known as "the body," is the actual information that constitutes the visual component of the architectural drawing (Davis 2011). The header and body structure of digital image files implies that the digital architectural drawing can be stored in a multitude of different file formats that have unique headers and ways of storing the digital information associated with the body of the file. As a consequence, manipulations of the byte structure of a digital file, known as "digital data-bending," have drastically different effects on the final visual output of the drawing depending not only upon the drawing itself but also the file format in which it is stored.

A common form of data-bending interprets the image as text via the use of text or hex editors such as Microsoft Word or Notepad++. Forced glitches are then created via operations native to word processing before reinterpreting the information as an image, as shown in Figure 2. The importance of these processes is that there is no precise mechanism for predicting what visual disruptions and aberrations that a spell-check or a character-replace algorithm will cause in the reopened image file.

Similarly, for drawings stored within a .RAW file format, acoustic software such as Audacity allows formal manipulation and distortion of a drawing's representation of physical elements. While the previously discussed operations have the capacity to deform drawings in coherent ways, temporally based tools can also distort a drawing into a similarly coherent form. Examples of these are effects such as reverberation and echo, which have a clear potential to reorganize and reinterpret a drawing's spatial capacity, as shown in Figure 3.

The Medical Imaging Toolset

The numeric basis of digital geometry implies the capacity to assign highly specific and layered data to its base structural unit, the pixel, forming a finite, dynamic data structure that is able to be reassembled in a variety of combinations. To quantify this data, high-precision medical imaging toolsets allow captured image data to be organized into manageable image sets or "stacks" of multiple spatially and temporally related image slices (Figure 4). These can be easily manipulated, rotated, and reassembled according to the user"s specifications. Supported by the visioning capabilities of the digital platform, these three-dimensional data mappings exceed the analytical scope of traditional numerical assessments previously relied upon for scientific scrutiny by providing unprecedented architectural insights into the viewed subject through multiple image axes.



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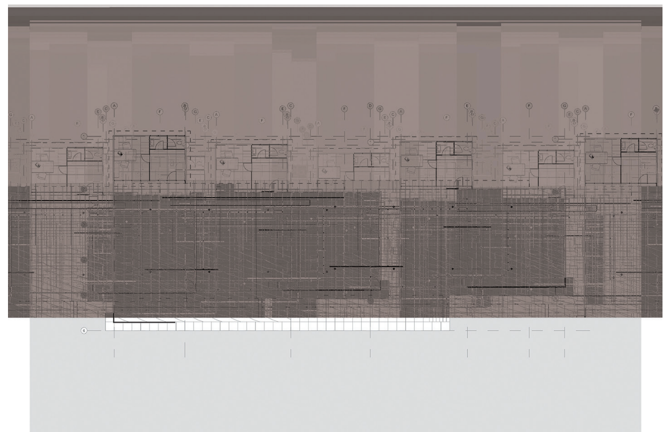

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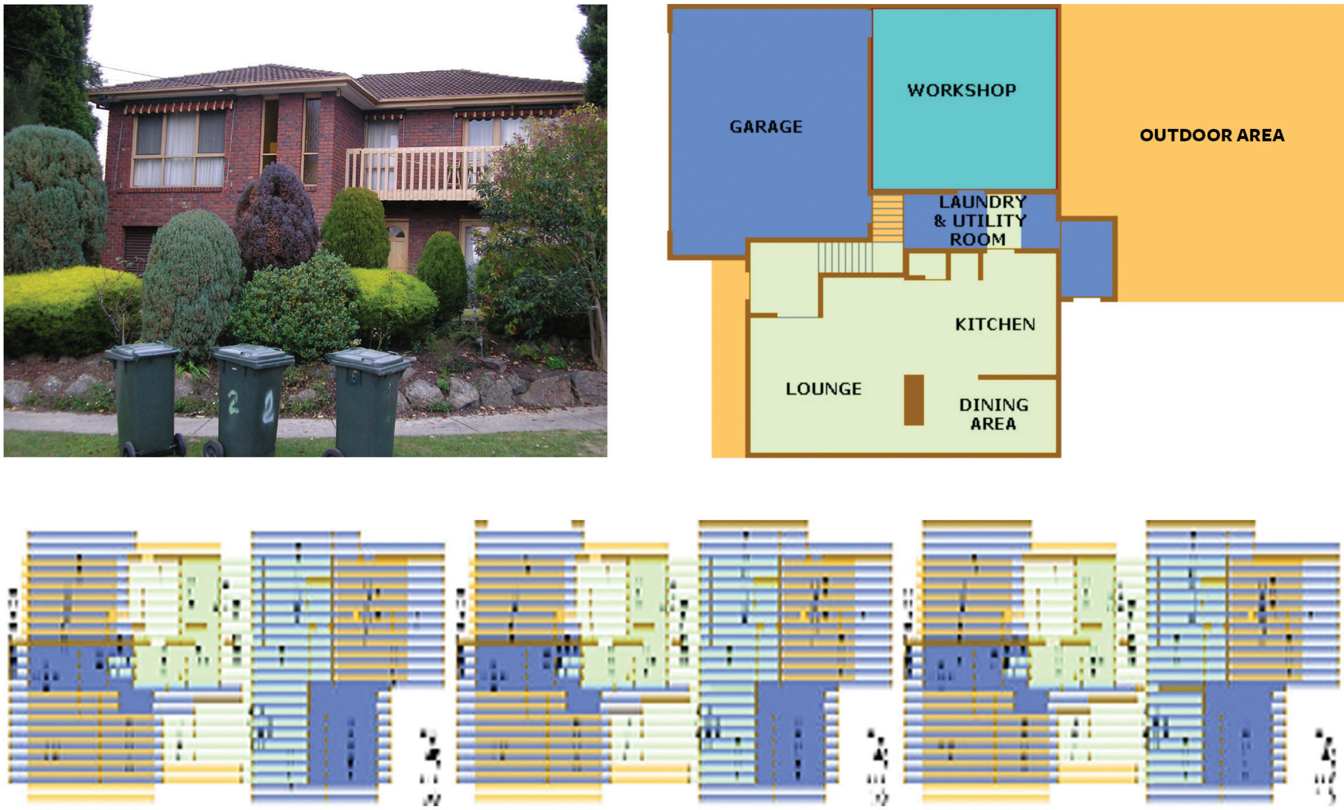
2 A series of different data-bent Barcelona Pavilion plans exploring the difference in image file formats and the types of disruptions and artifacts that are produced.

3 A drawing of a Barcelona Pavilion saved out in .RAW file format and opened as a single channel using the A-Law Codex in Audacity. An echo transformation was then applied before reconstructing the original drawing.

4 Image stack produced in Fiji captured from a webcam in Times Square, New York.



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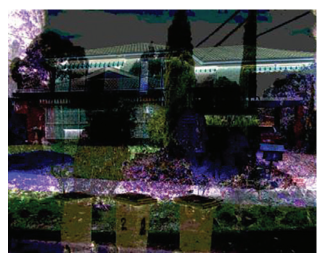

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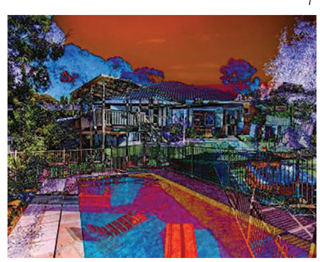

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5 Top: Photograph of domestic house with floorplan. Bottom: Fiji-resliced floorplans showing redistributed color data and program.

6 Top: Photograph of two domestic houses and floorplans. Bottom: Fiji-resliced floorplans showing the dominance of one color set.

7 Transformations produced by data merging using Fiji's "Image Calculator" function of division.

8 Image transformations produced by data merging using Fiji's "Image Calculator" function of subtraction.

Fiji is part of a comprehensive medical imaging toolset that is a distribution of the open source software ImageJ, which is focused on biological image analysis. It enables rapid prototyping of image processing algorithms, facilitating the transformation of novel algorithms into Fiji plugins that can be shared with end-users through an integrated update system. Fiji therefore operates as a high-precision software platform for productive collaboration between computer science and biology research communities.

The interdisciplinary repurposing of the mapping capabilities of this type of imaging toolset therefore has very diverse consequences. This is not only because it introduces a new representational language to architectural drawing, but because the reapplication of its many precise analytical and visualizing functions to objects of a much greater scale than originally intended produces unexpected results.

Data Redistribution and Proliferation

The first example of this productive misalignment can be seen in the application of Fiji's capacity to assemble multiple images into a "stack" or volume along three-dimensional axes, as seen in Figure 5. When applied at an urban rather than a human scale, this function permits all content within the volume to be addressed simultaneously across multiple axes. It also allows the data content of the volume to be seen as redistributed visual data along these temporal axes.

As an extension of this, Fiji"s "reslice" function transects the data content along a preselected axis that is traditionally applied to the volume or stack to isolate a significant moment of change. However, this function instead produces a range of redistributed data outcomes when applied to conditions of a higher order of magnitude.

In architectural terms, multiple redistributed variants of an original are produced when the floor plan of a traditional domestic home containing color data assigned to represent programmatic function is transformed into a Fiji image volume and resliced along a chosen axis. Significantly, the redistributed color data is both an aberration of the tool's precise function applied at an imprecise scale and a recalibrated variant of the original drawing that offers new formal options. The colored program mapping, shown in Figure 5, redistributes color data in unsolicited ways according to the selected axis. Even the simple assignation of color to program seen here, in which the program of the house's lower level is divided into three broad functional areas of outdoor, living, and garage/workshop, offers profoundly different planning options from those seen in the existing floor plan. When applied to an architectural drawing, the procedure of reslicing the image stack through its different axes thus redistributes assigned color data in unexpected ways, where even the most improbable outcomes merit consideration. As seen in Figure 5, the insertion and merging of seemingly incompatible adjacent programs—such as lounge and outdoor or garage and lounge—is perhaps an option that would be traditionally discarded from consideration, but these are combinations that could offer potentially rich and diverse dwelling outcomes.

Another variation of the application of this function can be seen in Figure 6, in which two domestic floor plans have been combined in Fiji into a single image stack and then resliced to produce strikingly different variations of the original drawing. What can be seen to emerge here, which is not quite so evident in Figure 5, is both the domination of one color set by another, and the emergence of a new third set of colors that is the combined result of the reslicing process. A hybridized program that results from this combination, while situated outside the traditional boundaries of the normalized domestic drawing, nevertheless presents new and viable alternatives to the traditional architectural drawing. This generative procedure thus begins to suggest an unprecedented, emergent program that is the unsolicited yet productive outcome of applying a precise toolset to an undesignated task.

An important outcome of this data redistribution process is that its original purpose of isolating precise instances of data is now supplanted by one that stochastically multiplies design outcomes, thus liberating the drawing from the constraints of traditional conceptions of domestic space. In this transformational drawing, the misalignment of the toolset and the recalibration of visual content, together with the automation of the digital platform, all multiply design opportunity.

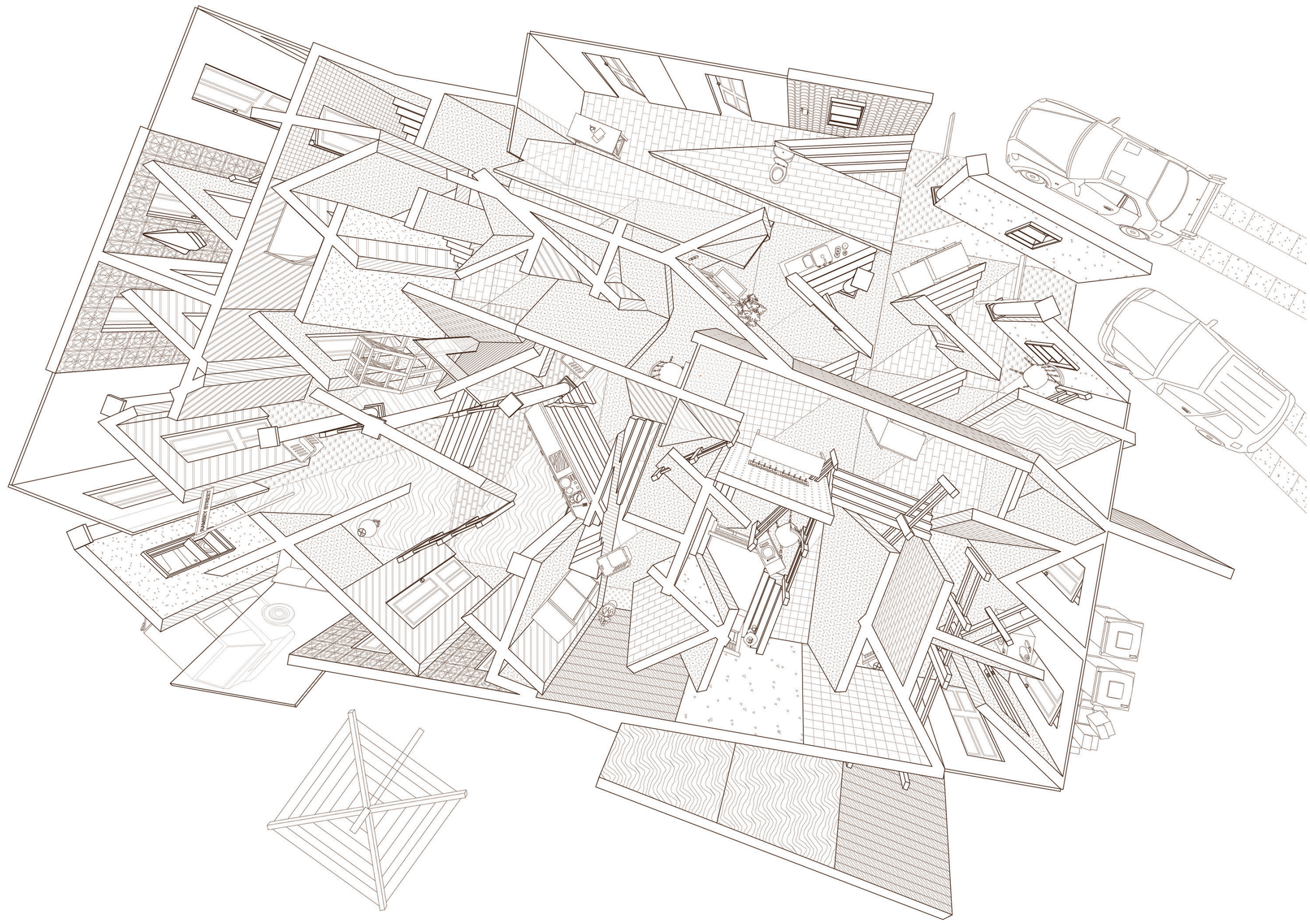
Captured Data Merging

The precision of digital imaging–based toolsets such as Fiji can also be "misapplied" productively to another form of architectural image, the digital photograph, to extend and diversify its representational and functional roles.

The traditional task of Fiji's "Image Calculator" function is to perform arithmetic and logical operations between two images or sets of images, using thirteen available operators with a high degree of exactitude. The repurposing of this tool to architectural representation therefore recalibrates these arithmetic functions to explore not only the possible diagrammatic assets of its improbable outcomes, but also the formal possibilities generated by the merging of two datasets.

The process of performing various arithmetic functions upon photographic elevations of two homes that typify the domestic vernacular has two distinct outcomes. The first is to deliver new formal and spatial arrangements that maximize the domestic footprint through the blending of data (Figures 7 and 8). This can be extended and made more comprehensive by repeating the process across the other elevations of the buildings.

The second shows that the comprehensive addition and subtraction transformation of Fiji's functions (one of many other possible transformations) to the digital image, is a complete recalibration of its color palette. If the many variations of digital image are to be included in the diverse array of representational material that composes digital architectural drawing, then this transformation not only has profound consequences for the physical and material properties of the building, but it shifts the digital image's disciplinary agency.



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9 Domestic floorplan resulting from the distortion of the underlying geometry by interpreted JPEG.

RESULTS AND REFLECTION

Taking these methodologies and iteratively disrupting the architectural drawing's meaning is constantly dislocated from the intentions and desires of the designer. After each glitch the designer reconfigures an allographic interpretation into a workable architecture to then glitch again, thus allowing the designer to drift away from known disciplinary forms and arrangements.

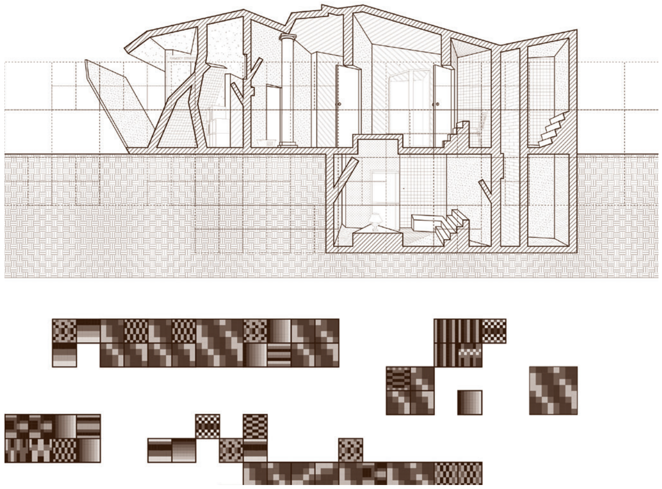
The interpretive act of translating the glitched generative diagram back into standard architectural allography forces the designer to reconsider the relationship between architectural symbols and glitch artefacts in a generative way. As a consequence of these transformations, the architectural expertise of the designer is required to translate the glitched drawing not only back into the allography of the architectural drawing, but into a sensical and workable architectural proposition. The value of this translation is that it enables the designer to "…step outside her/his established habits of thought and reconsider what would otherwise have taken for granted"(Harfield 2014).

For the sake of consistency, the research has focused upon applying the glitch to domestic architecture in order to limit and frame the study. The value of this is twofold. First, it limits the number of input colored program information, making the results of the study clearer. Second, the traditional domestic diagram offers a clear mechanism of qualitative comparison with the diagrammatically glitched drawing in order to address notions of how "dislocated" (a term used by Eisenman) the architecture is from pre-existing notions of dwelling (Eisenman 1987).

This paper focuses on two particular integrations of the methods expressed previously to explore the potential of the domestic diagram. These results all investigate the reslice as a method of merging and manipulating the base program types of the domestic diagram. Secondary methods have then been introduced to further dislocate or formalize the diagram.

Reslicing + Text Transforms

After the act of reslicing to reorganize the internal programmatic information, the implied form of the resultant plan



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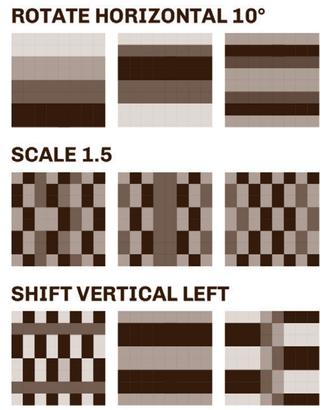

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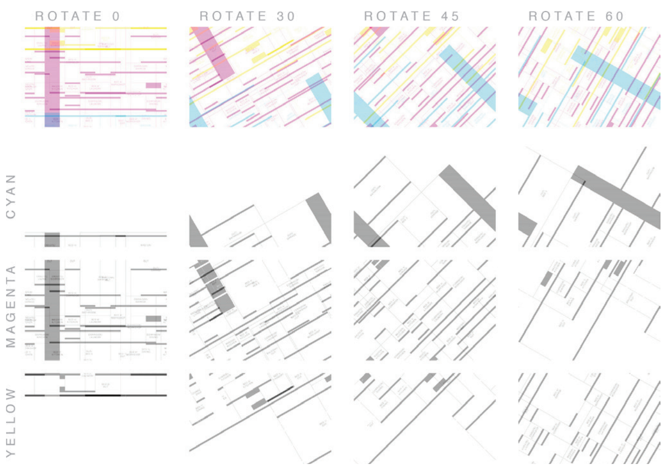
10 The JPEG artifacts that are used to distort the section (bottom), and the resultant formal outcome (top).

11 Example of Euclidian transforms associated with specific JPEG glitch artifacts used to transform a sectional drawing.

12 The application of three architectural drawings being stored in the Cyan, Magenta, and Yellow channels of a CMYK image



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can be sectioned multiple times, and each section can be manipulated by text to further disrupt and dislocate the implied domestic diagram. This act of disruption forces the designer to give meaning to aberrations that belong to the nature of the file format that is being data-bent within the context of architectural drawing. Figure 10 reveals how this can be done via data-bending a section saved as a JPEG by performing a "find and replace" algorithm upon the image and recursively changing the scale of the section. As the program of the architecture is predefined by the reslicing process, each JPEG compression artifact that is introduced into the drawing by the act of data-bending needs to be attributed with a formal material or structural maneuver within the design process. These maneuvers are dictated by the designer, and their design value is therefore dependent upon his or her critical aims. Figure 11 shows one such maneuver set being attributed to Euclidian transformations to the architectural form represented by the section.

The act of text-oriented data-bending means that where the symbols occur and what symbols occur are imprecise and difficult to predict due to the complexity of the JPEG compression algorithm that is being applied. Stitching these sections together into the resulting plan (Figure 9) shows the generative potential of such a process. Although the drawing has large elements of post-humanism, due to the direct application of the system of attributing formal maneuvers to JPEG artifacts, the underlying plan logic derived via the reslicing process is maintained.

Reslicing + Acoustic Transforms

As a direct consequence of drawings being stored as an image file, grayscale drawings are stored independently in each of the image's color channels. From a digital storage perspective, an image file can store as many grayscale drawings as the image has channels. Conversely, as is the case in Figure 12, a single grayscale drawing can be subdivided and stored within the image's color channels in a more digitally efficient way. Considering that the original process of reslicing was introduced in order to reorganize the distribution of the program, the overlaying of channels allows for an overlaying of the structure associated with those programs. This permits the amount of symbols representing structure within the drawing to be mediated as required.

As a consequence of this method, each color channel, and thus each third of the building, can be imported into Audacity as separate audio channels and acoustically operated separately to create differing effects in each color channel, as shown in Figure 13. This process allows for the amount of structure represented by the channels to be manipulated separately, allowing for a degree of disruption and thickening dependent upon a critical engagement with the information being represented by the acoustic channel.

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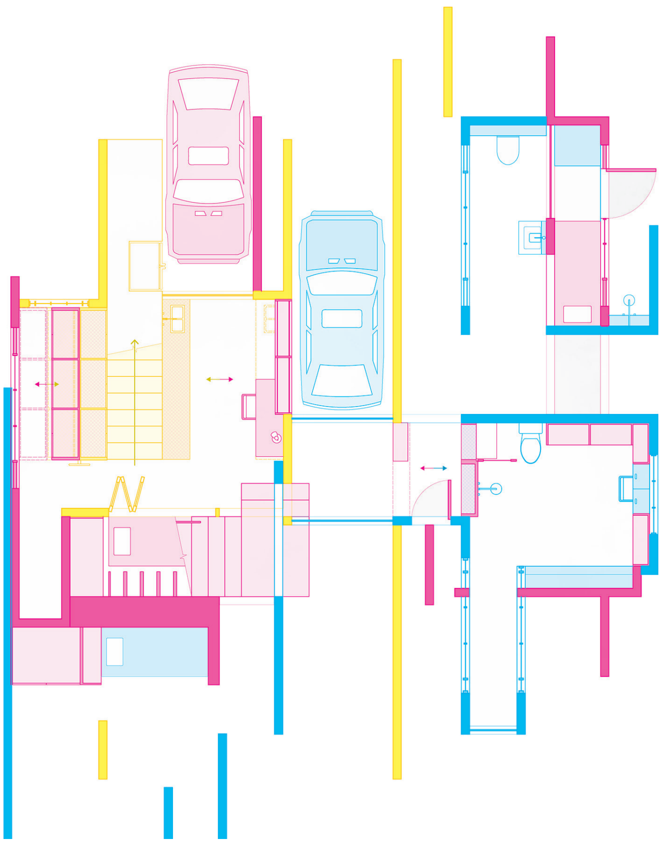

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13 The effect of allowing an echo transformation onto an architectural drawing.

14 Domestic floorplan resulting from the interpretation from three separate interleaved architectural drawings intersecting.

The act of interpreting the diagram exhibited above as a structure results in three interleaved houses (Figure 14) in which program is shared between particular houses, and where there are large and meaningful overlaps between the color channels of the image.

Reflection

Further research is required to understand the differences, changes, and implied potentials that result when manipulating the order in which these methods are applied. This additional research into new methods and how they are integrated has the latent possibility to generate new mechanisms for not only formal manipulations, but dislocating the arrangements of architectural spaces.

The previous two projects both exhibit strengths in challenging and manipulating the domestic diagram into new and novel forms. Although the first project has a degree of associated post-human formalism, the general interrelationship of programs and internal structure suggests and manipulates traditional modes of dwelling.

CONCLUSION

By liberating the architectural drawing from its predetermined reliance upon precise tools and techniques of production, the techniques outlined in this paper not only demonstrate the means of reclaiming the drawing's speculative qualities, but they also multiply design opportunity. They reveal that the introduction of the operational duo—the bit and pixel—as the fundamental unit of the digital platform brings with it the qualitative properties of color and brightness, rather than the line, as the principal determinant of spatial measurement.

The paper shows that the issues of precision that are raised though the deliberate "misapplication" of software present a new disciplinary challenge. This is because architectural production is shifted into a role of interpreting and understanding symbols that are alien to the overarching language of architecture. However, this very disciplinary challenge is what implies the potential for the dislocation of disciplinary architectural space. The value of this is that the glitch has the capacity to imprecisely disrupt the allographic conventions of architectural production to become a generative digital tool rather than a literal disruption of the represented architecture itself.

The original promotion of the animated diagram by Lynn was persued because the process was instrumental and generative before it was representational (Lynn 1999). While early digital production persued digital mechanisms to avoid known disciplinary forms, the glitch has the potential to not only produce unknown disciplinary forms, but also to dislocate the underlying assumptions of how architectural spaces are related and defined.

The tools and techniques presented here therefore suggest the practical terms by which the reinstatement of architectural agency might occur within the new digital frame. They reveal that by releasing the qualitative and reinforcing the ambiguous, the trajectory of the discipline can be realigned with this frame. Furthermore, it is the discipline's capacity to acknowledge the increasing status of the image and to engage with the contemporary mechanisms of representation that will allow it to respond to the challenges presented by future visual paradigms.

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Figures cited at the end of the paper come from a design studio run at the University of Technology Sydney. The authors wish to acknowledge the work of the students participating in the studio.

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