

exploiting the unexpected

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abstract

Contemporary imaging technologies have expanded our ability to view contemporary urban space from many vantage points. The camera's portability has meant a departure from any singular 'ideal' viewing position previously proposed using linear perspective geometry. This visual and technological shift has brought new opportunities for how urban space is understood and conceived for various modes of inhabitation. By fracturing and multiplying its representation, the recording of dynamic space thus destabilises the traditional relationship between image and form and, in so doing, presents previously unconsidered spatial opportunities.

This text-based essay explores the instrumentality of digital image processes in the production of new material and spatial strategies for design and architectural applications. Contextualised within a frame of the digital image and contemporary envisioned space activated by the Internet, it focuses upon the spatial and material properties of three different architectural scales—the residential dwelling, the apartment block, and the public building. The essay demonstrates how repurposed medical imaging software can uncover hidden and unexpected characteristics of different-sized interior spaces by recalibrating image data from captured video footage.

The essay draws on a range of generative digital techniques that transform the temporal visual content of interior space—the image stack and its slices or frames—into diagrammatic abstractions of recalibrated colour and form. The various axes of the stack thus serve as a contemporary extrapolation of the traditional orthographic diagrams that currently define architectural production—the plan, section, and elevation. With the visual content of these axes completely redistributed across different scales according to the shifts of the colour- and contrast-based properties of the digital array, the emerging slippages within each slice compose a new dynamic template or diagram that informs new and uncertain strategies of inhabitation.

keywords

colour; image; digital; viewer; spatial

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digital anamorphosis and architecture

Brunelleschi's 1425 demonstration of linear perspective in Florence changed how the physical world was and still is viewed. While this new technique enabled the viewer to experience an unprecedented projection of the body through a spatial frame indistinguishable from reality, it also meant that its derivative imagery increasingly became a vehicle for marketing the Church's so-called objective and universal ideological truth.⁰¹ Yet the collapse of image and truth provoked a response from those who wanted to draw attention to the representational contrivances underpinning the linear perspective system and its exploitation by the Church. As early as the sixteenth century, Hans Holbein's painting *The Ambassadors* probed the spatial control imposed upon the viewer by linear perspective by introducing an anamorphic element, which interrogated the viewer's spatial relationship with the picture plane by returning their autonomy.⁰² A century later, two Minim monks, Jean-Francois Niceron and Emmanuel Maignan, overturned the rational integrity and reliability of linear perspective by reinstating the subject's viewpoint to one where the viewer is drawn simultaneously into an engagement with the space of the image and the phenomenal space of reality. The viewer is no longer asked to 'see through' the picture plane into a projected and hypothetical space beyond. Maignan's 1640 fresco *San Francesco di Paola* in the church of San Trinità in Rome created both a secondary viewing space and a secondary image offering numerous unexpected, self-contained 'sub-images' that

align with the viewer's various viewpoints along its surface [Fig. 01]. The top two images in the montage show the fresco viewed from the 'correct' oblique viewing position, while the lower images, which are part of the larger image, can only be viewed as the observer passes along the surface of the fresco. As Lyle Massey observes, these unsettling elements are designed to serve as a constant reminder of the actual viewing space and the act of viewing itself: 'Perspective thus becomes a property of man's movement and trajectory in physical space.'⁰³

However, if Niceron and Maignon's intention was to employ the anamorphic technique to set the body in motion in front of the picture plane by denying the viewer a single viewpoint, then the same can be said of Le Corbusier's strategy for architecture. His experiments with a carefully orchestrated building colour system demand a similar immersive engagement with the body as did Maignan's frescoes. Le Corbusier's complex colour system, *Architectural Polychromy*, devised in 1931 and 1959,⁰⁴ comprised sixty-three colours, divided into nine colour groups intended to suppress or amplify architectural volume in tandem with the viewer's experiential journey or 'promenade', as he observes.

At the interior, the first attempts at architectural polychromy, based on specific optical reactions, put into practice the notion of architectural camouflage, i.e., either the affirmation or suppression of certain volumes.⁰⁵

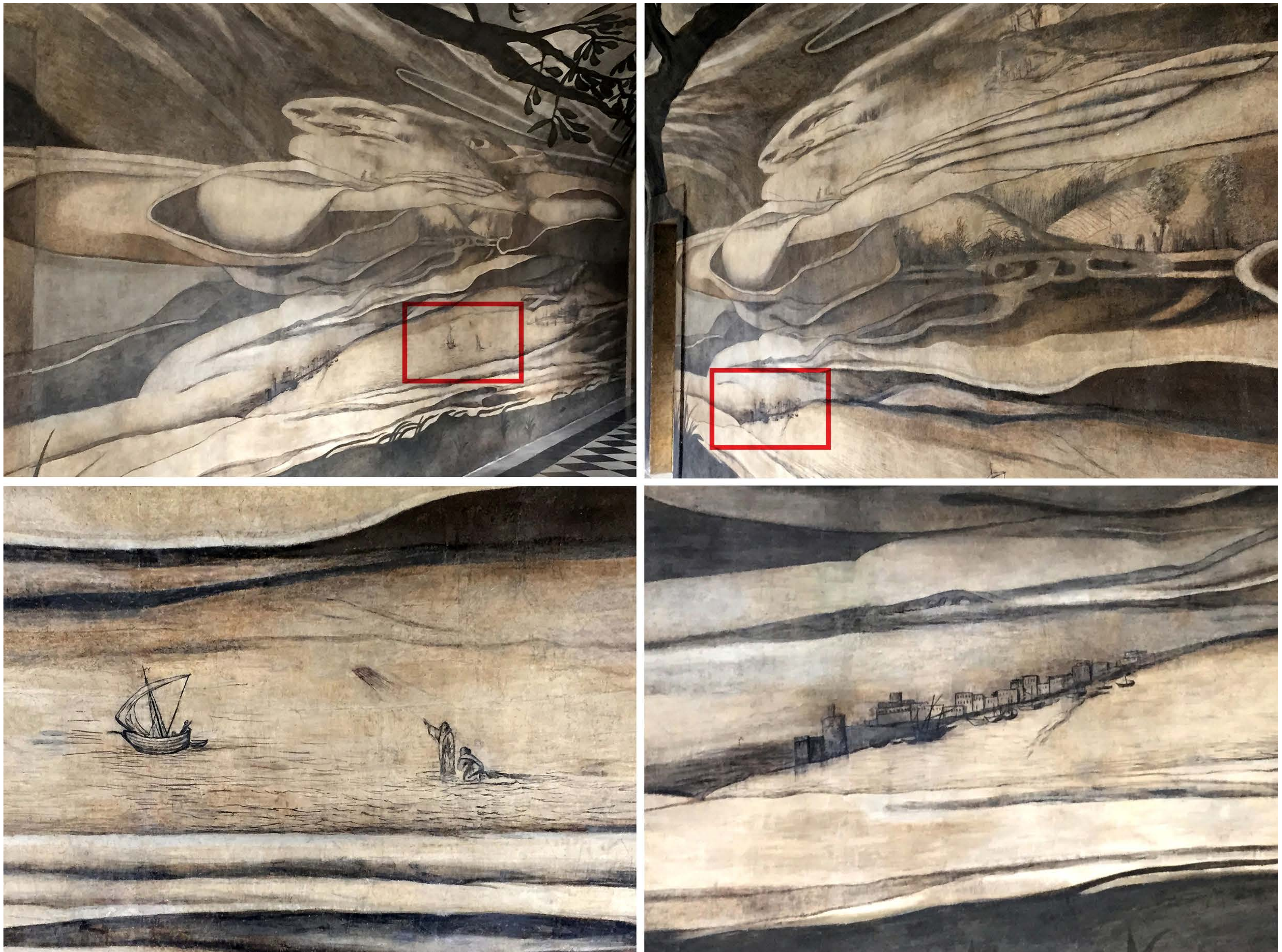


Figure 01. Emmanuel Maignan's fresco *San Francesco di Paola* (1642) in Trinità dei Monti, showing the principal image from an oblique viewing position, with sub-images outlined in red (top); Micro-landscapes embedded within the larger image (bottom). Photographs by author, 2017.

In contrast to the viewing constraints of the linear perspective spatial model, contemporary 'envisioned' urban space is based on a composite of multiple vantage points captured over time. This representation of the world captured by smartphones, internet webcams, unmanned aerial vehicles (UAVs, or camera drones), and high-altitude aircraft cameras for various promotional and surveillance applications is not constrained by the terrestrial coordinates of traditional

global geography.⁰⁶ Instead, it is 'a nowhere, imaginary place' whose aerial vantage points transpose the landscape into an unfamiliar relation of patterns and textures.⁰⁷

Architectural engagement and agency within this new virtual and multi-dimensional digital space also deploy very different tools from the makers of the seventeenth-century anamorphic fresco. Therefore, this essay advances the traditional orthographic

diagrams that presently describe and enable architectural production by aligning them with new digital representational tools.

Creating a digital image involves assigning an integer value to each pixel, the smallest unit of the image, to determine its colour and brightness. Values are assigned to all the pixels on the picture-plane grid to form an entire image. In the case of colour images, pixel values consist of triples of scalar values such as red, blue, and green, or hue, saturation, and intensity. These values dictate the relationships each pixel can have with another.

In digital images, content is represented by an array of pixels, each having specific numerical relationships with one another. The imaging process also translates complex scenes captured by imaging devices into specific numerical values and positions on the picture grid, allowing reproduction to be easily accomplished using a unique array pattern. Furthermore, these values focus solely on defining shapes and forms through colour and brightness rather than lines. This emphasis on a space's qualitative aspects suggests a transformative approach to spatial documentation and construction.

By establishing the means to document the complex conditions of space as numerical data, this technique creates a reproducible platform that indexes spatial properties according to a new range of qualitative criteria. It also means that the numerical data relating to conditions of colour and light in the image can be transposed into physical

form as a range of material relationships. For the architect, the intrinsic numerical basis of the image thus opens numerous opportunities to incorporate the qualitative aspects of life, revealed in digital images in terms of colour and brightness, into the physical spatial design.

By applying a mechanism traditionally used to track and map the progression or remission of disease—biological and medical imaging software—to the analysis of digitally captured space, new diagrammatic abstractions of recalibrated colour and form extracted from the various axes of the stack serve as a contemporary drawing set.

An open-source digital tool, *ImageJ* software,⁰⁸ allows the viewer to project themselves through orthogonally intersecting X, Y, and Z axes that offer various reconfigurations of the stack's visual content [Fig. 02]. The ability to view spatial change across a temporal frame transforms the stack's structural and material content into an experiential visual journey controlled by the viewer and the flexibility of the digital tool. Depending upon the relative location of the viewer and subject, each image slice disrupts any traditional spatial representation by offering new and unexpected insights into every temporal increment of the journey, just as did Maignon's frescoes. Digital visioning tools, therefore, now allow us to understand the implications of the anamorphic journey virtually and more speculatively. They not only liberate the image's spatiality from



Figure 02.

Public webcam view of Shibuya Crossing. With permission from Tokyo Forrest Brown/Shutterstock.com (left). Image stack of stills extracted from video footage of the same location created using *ImageJ* software (right). Image by author, 2022.

the limitations of a singular viewpoint by extending the structural and material possibilities of the reconfigured subject but provide a methodological framework by which to deliver a series of systematic 'deconstructed' views.⁰⁹

These virtual body movements are represented as diagrammatic abstractions of recalibrated colour and form, mapping the viewer's experiential, immersive journey through interior space. The images are presented in terms of amplified material colour and accelerated cinematic spatial 'jump-cuts' explored across different interior spatial typologies. It proposes that, by releasing hidden properties of these spaces, these new virtual anamorphic snapshots interrogate the more traditional static modes of spatial representation and, in so doing, initiate a new diagrammatic template for architectural production that embraces the uncertainty of the temporal frame.

The conversion of a series of images into a colour- and brightness-based representation achieved using software like *ImageJ* introduces the ability to map qualitative content as visual data corresponding precisely to temporal shifts in materiality and program. For the architect, this introduces the means to design an intervention that responds strategically to its context in terms of its materiality (colour and texture) or changes in its program use (brightness). For example, an interior space might be required to stand in high contrast to its surrounding context, in which case a choice of materials would be selected to work in opposition to a neighbouring space that transforms dynamically across a temporal framework. Similarly, the requirement for low visibility would mean the selection of materials and programs that complement the space's immediate context. This technique would, therefore, be able to deliver the data to make these sorts of design decisions.

the architects of movement

In one of Le Corbusier's early house projects, the La Roche House (1923–25), the changing colour composition of the interior surfaces has a cumulative effect on the viewer, whose journey is no longer prescribed by the need to occupy any fixed viewpoint but instead to occupy many in succession. In this scenario, the viewer becomes autonomous, much like the viewer of the Maignan frescoes [Fig. 03]. Le Corbusier commented:

The second house will be something like an architectural promenade. We enter: the architectural spectacle presents itself to our gaze; we follow an itinerary, and various points of view unfold one after the other; we play with the flood of light illuminating the walls or casting shadows. The window bays open up views onto the exterior, and we rediscover the architectural whole.¹⁰

Le Corbusier's monumental modernist residential housing typology, L'Unité d'Habitation (1952) in Marseilles, is one

of many large-scale housing projects that uses colour to showcase his awareness of the destabilising and shocking effects of Maignan's anamorphic strategy. The Maison du Brésil (1959), in Paris, explored in this essay, is another. A journey along the exterior building façades and interior corridors reveals strikingly similar features. The easily accessed Marseille building in Figure 04 reveals his 'promenade' strategy—an attempt to awaken the viewer through a constantly shifting array of façade and interior colour planes [Fig. 04].

At a public building scale, Zaha Hadid's MAXXI Museum (2010) in Rome uses a series of dynamic suspended walkways rather than colour to destabilise and disorient the viewer. Like Le Corbusier, Hadid explored colour's capacity to express volume through an absence of colour. Colour is used to punctuate volumes as a centring device or marker for the viewer to grasp in an undulating sea of airborne pathways [Fig. 05]. For Hadid, where the viewer must navigate multiple decentring and unstable axes; the anamorphic experience is literally delivered by form in motion.

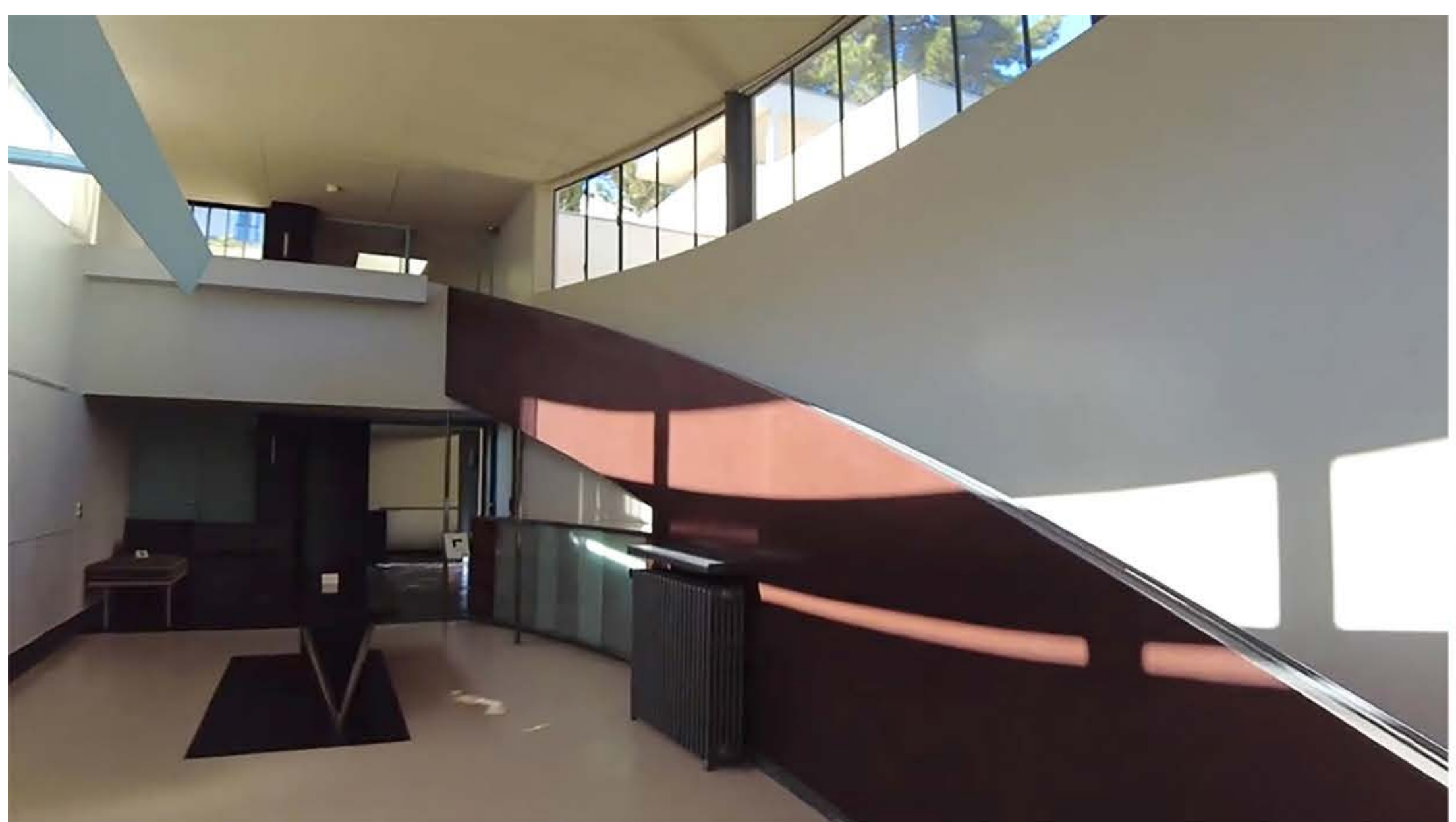


Figure 03. Interior of La Roche House showing 'promenade' ramp. With permission from Heje Yi, 2022.



Figure 04.

Le Corbusier's L'Unité d'Habitation in Marseille showing the changing composition of exterior façades (top) and interior hallways (bottom). Photographs by author, 2022.



Figure 05.

Aerial walkways in Zaha Hadid's MAXXI Museum. Photographs by author, 2011.

colour amplified in motion

The six image montages in Figures 06–11 reveal the amplification of colour that emerges as the viewer engages in different scales of the architectural ‘promenade.’ In the first instance, the processed images show how the journey through the La Roche House amplifies and extends the existing colour palette created by le Corbusier throughout even a short section of the house. By compressing thousands of stills in the 60-second video motion sequence represented by the top six montage images into a single image (cumulative z-axis projection), it is as if the camera’s capture of the movement emulates the cumulative effect of movement and transforms it into an immersive and unstable condition. This

effect is repeated in the Maison du Brésil as the scale of the building and the diversity of its context expand. The montages unpredictably culminate in the explosive and prismatic colour array of Hadid’s MAXXI Museum, amplified by the vertical movement imposed on the viewer by the walkways and, by extension, embedded in the recorded footage. It is as if the colour emerges from nowhere, describing the spatial volume through diffracted prisms of filtered light mediated by the building’s dynamic form, operating across multiple axes. Colour histograms created using Image Color Summarizer software supporting the empirical evidence of colour amplification in the processed images accompany these and the following montages.¹¹

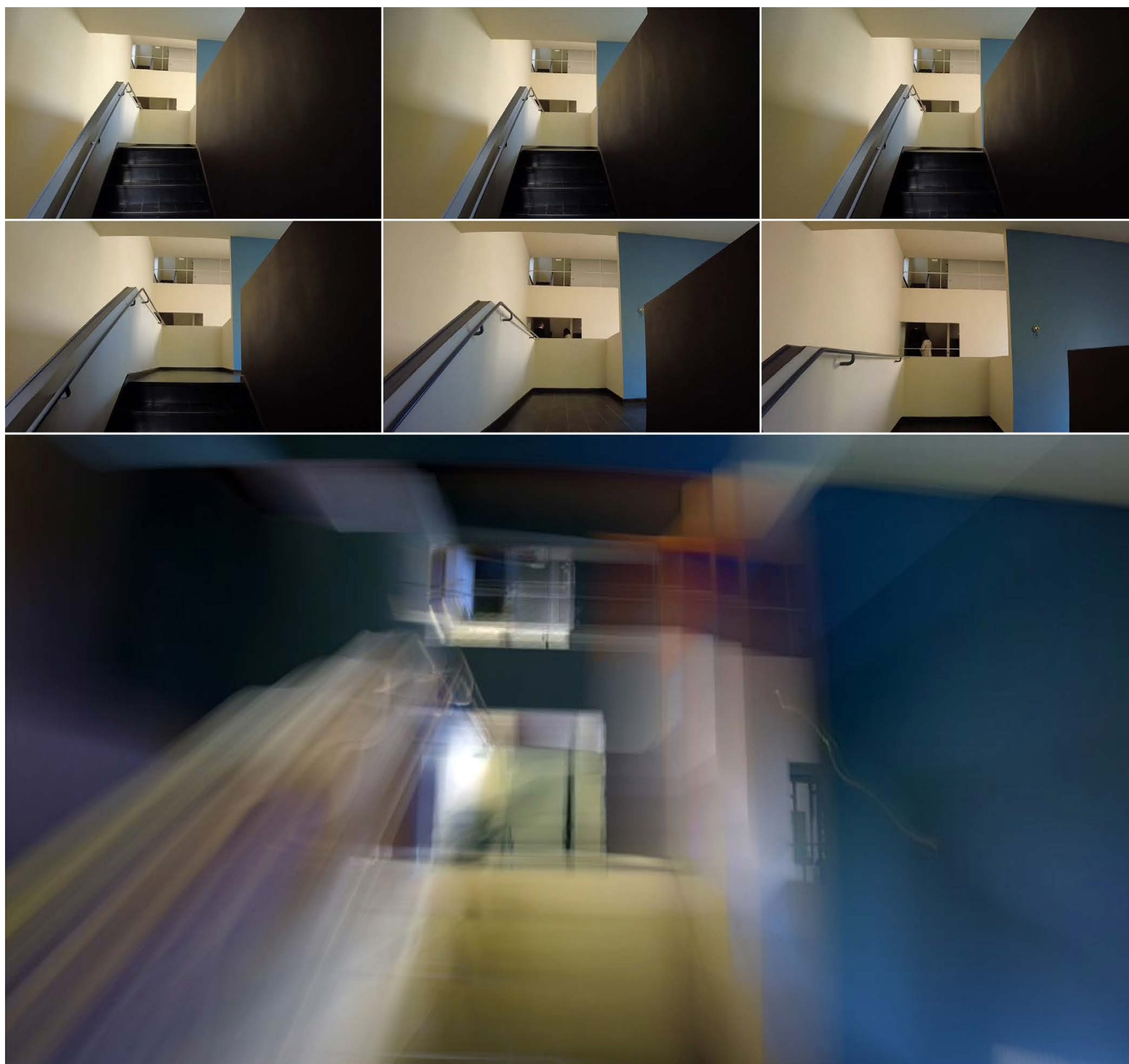


Figure 06.

Montage of unprocessed stills of the interior stairwell in La Roche House (top and centre). With permission from Heje Yi, 2022; Cumulative z-axis projection of the video footage captured at the same location, showing an amplified colour palette (bottom). Image by author, 2023.

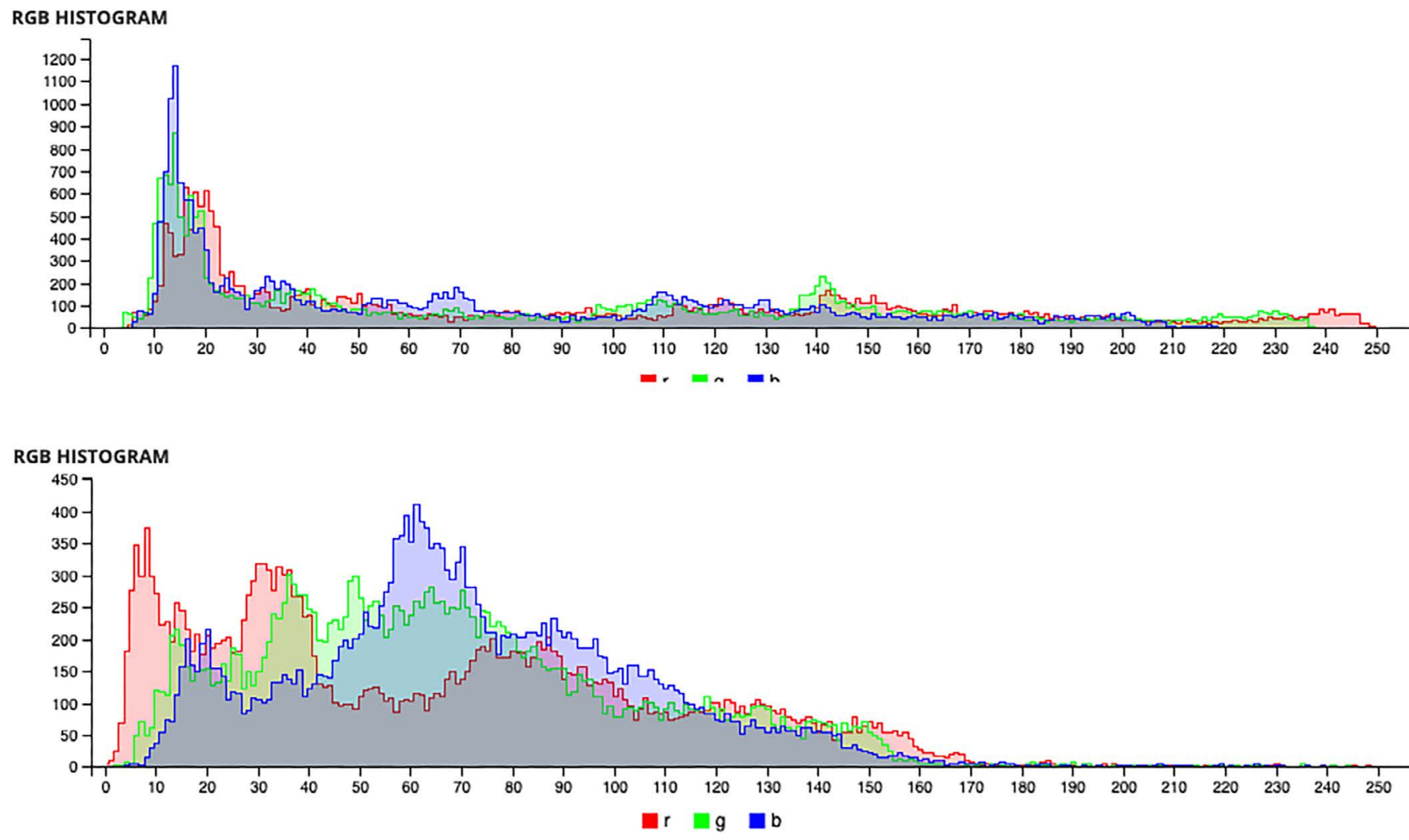


Figure 07.
Colour histograms of an unprocessed still of the La Roche House (top) and of the processed image (bottom), showing a marked increase in colour intensity in the latter. Images by author, 2023.

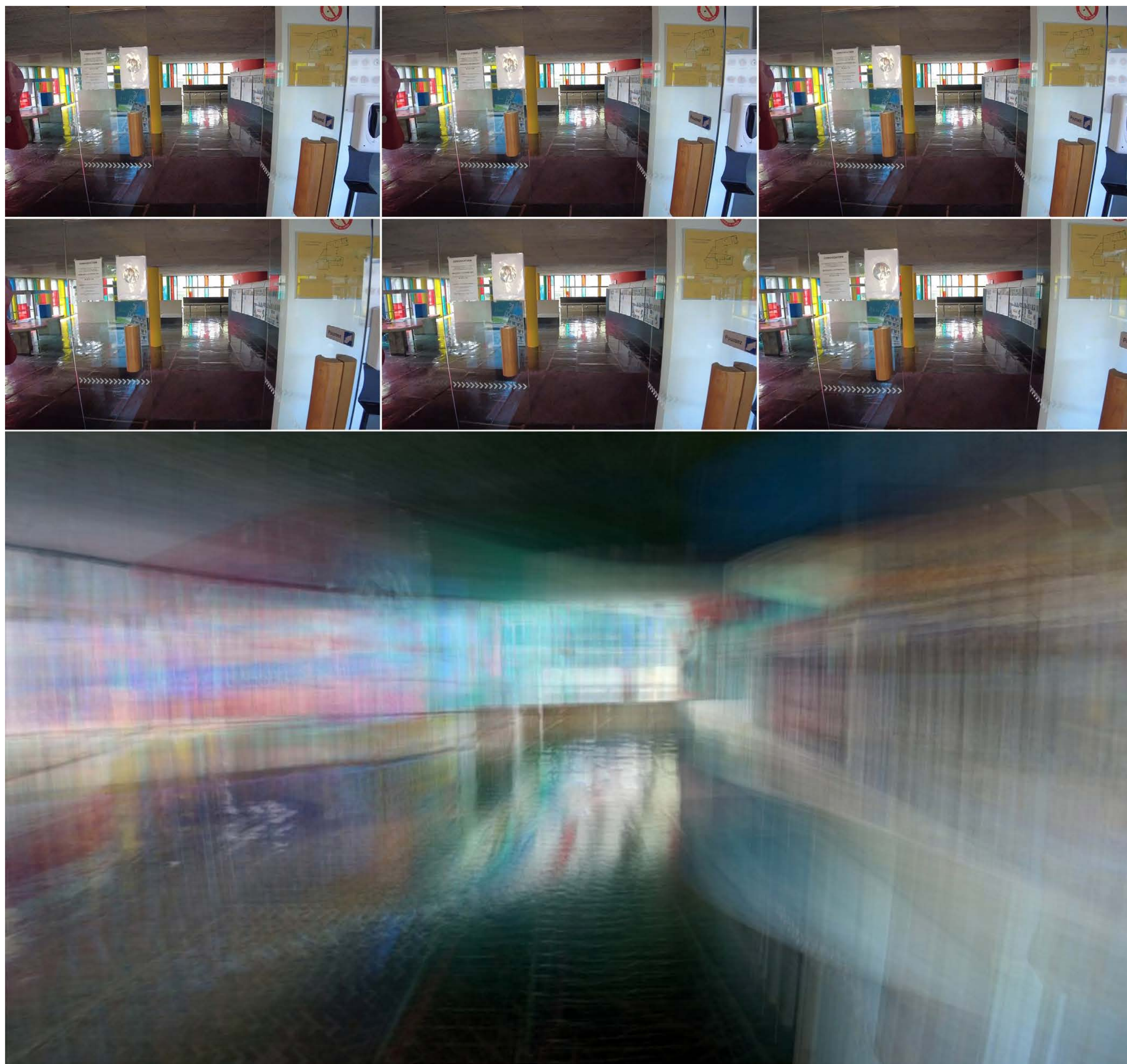


Figure 08.
Montage of unprocessed stills of the interior circulation space in the Maison du Brésil (top and centre). With permission from Heje Yi, 2022; Cumulative z-axis projection of the video footage captured at the same location, showing an amplified colour palette (bottom). Image by author, 2023.

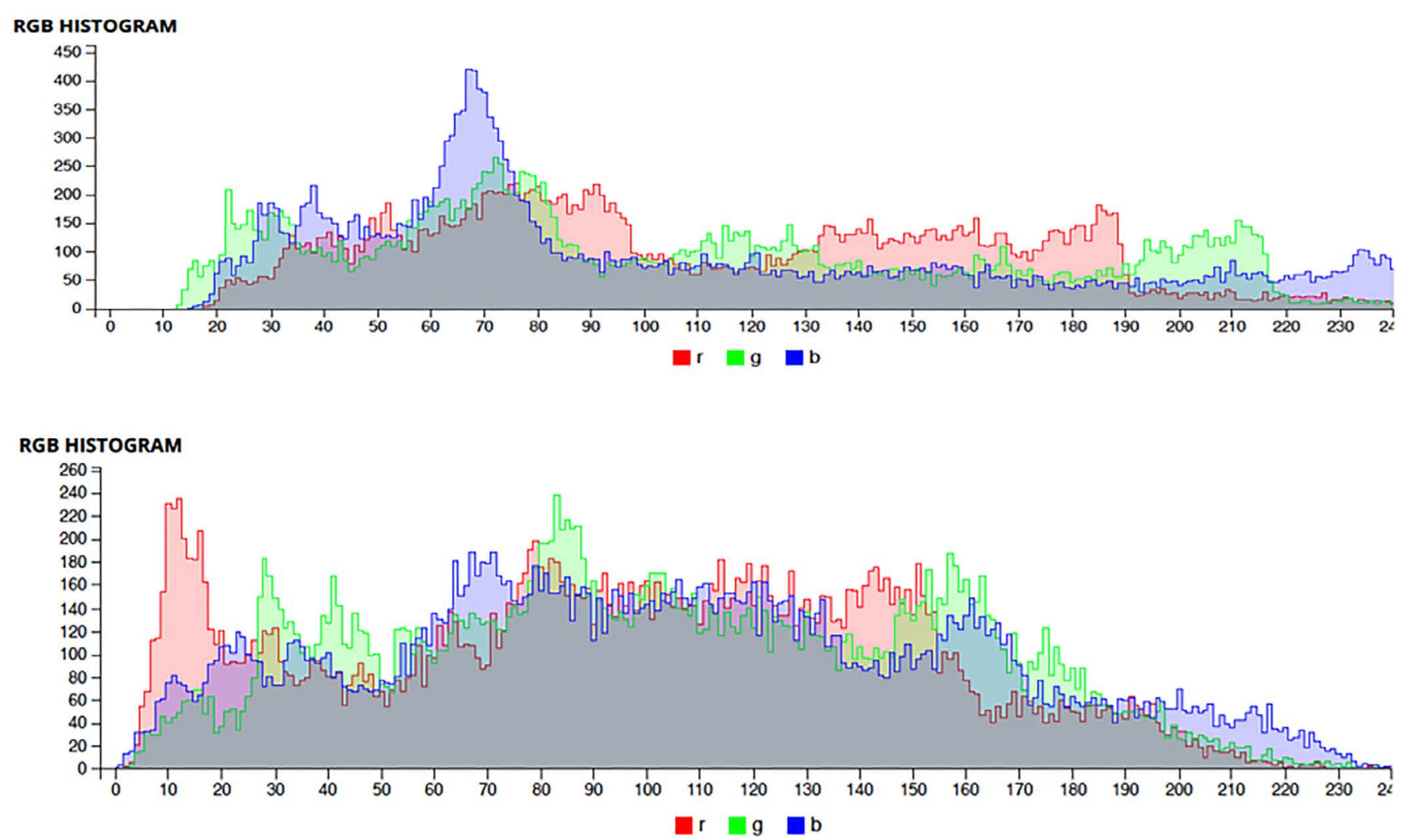


Figure 09.
Colour histograms of an unprocessed still of the Maison du Brésil (top) and of the processed image (bottom), showing a marked increase in colour intensity in the latter. Images by author, 2023.

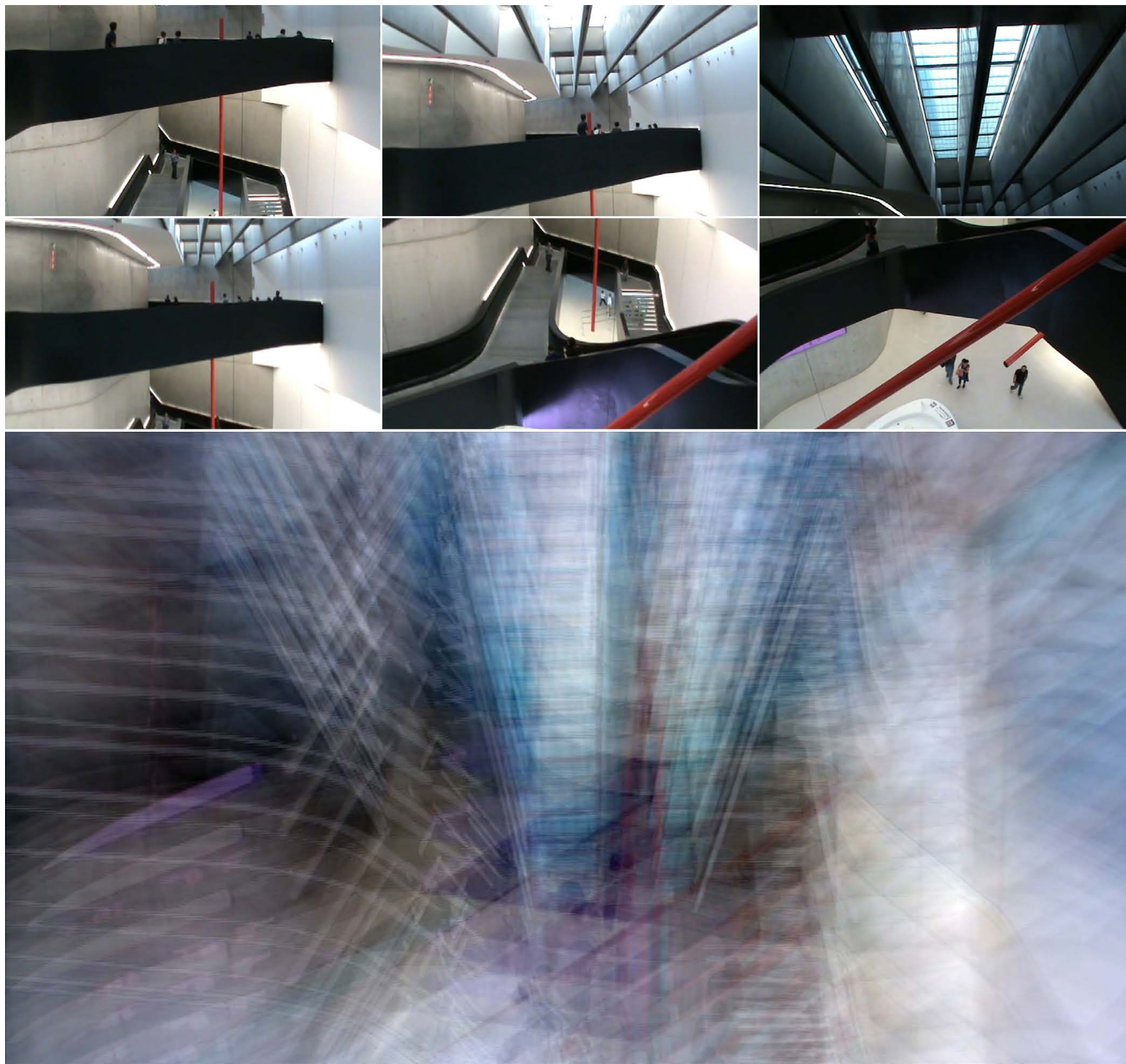


Figure 10.

Montage of unprocessed stills of the interior aerial walkways in the MAXXI Museum (top and centre). Photographs by author, 2011; Cumulative z-axis projection of the video footage captured at the same location, showing an amplified colour palette (bottom). Image by author, 2023.

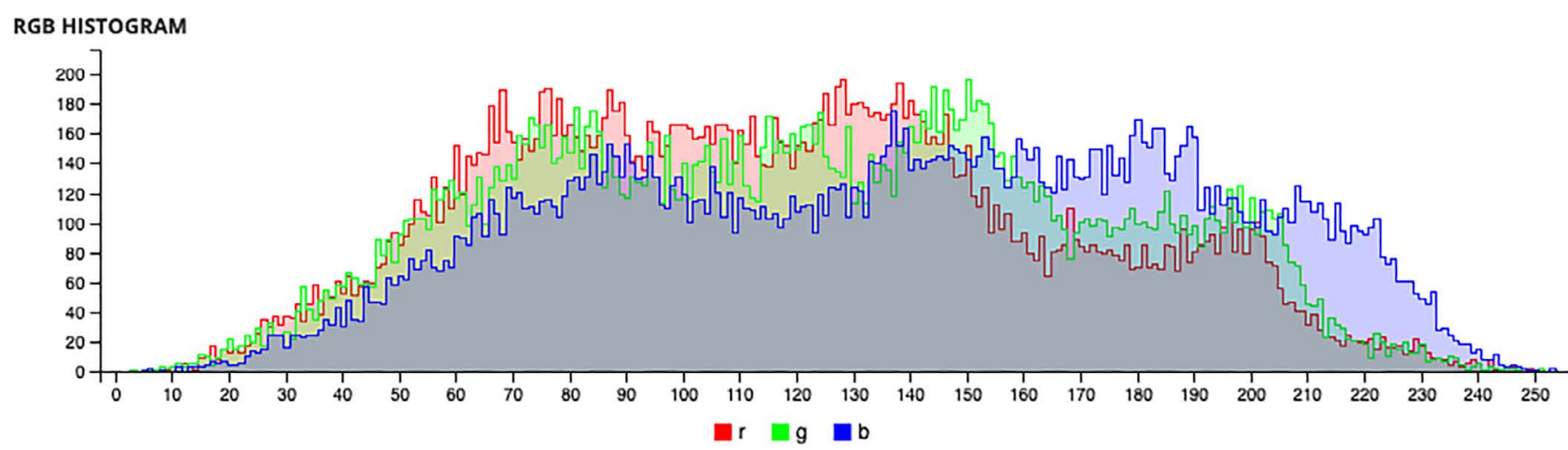
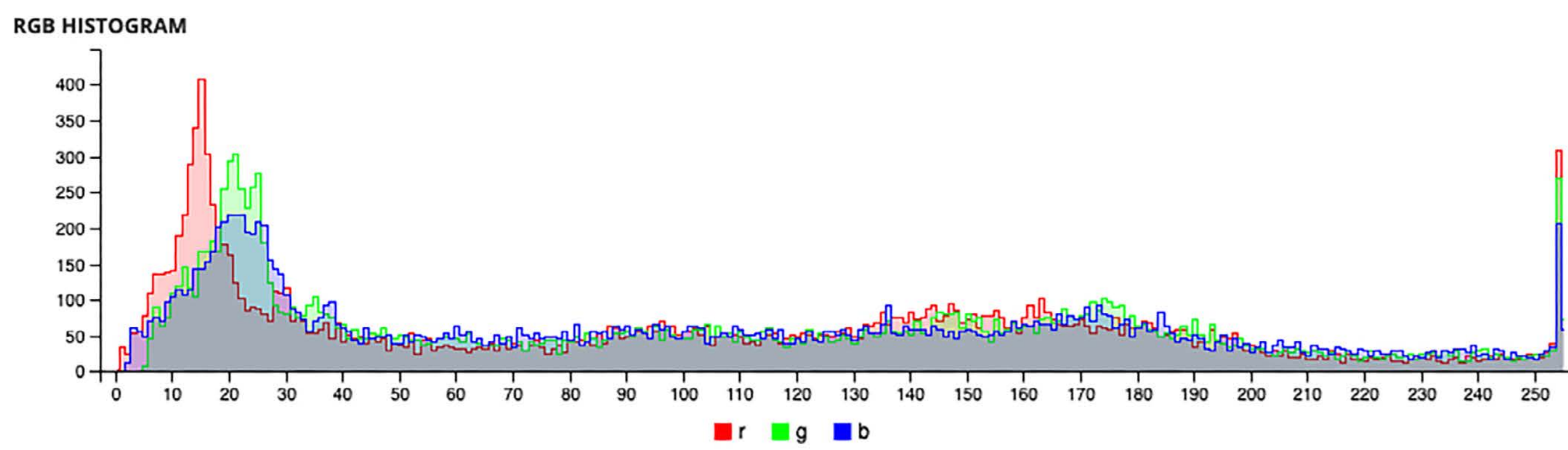


Figure 11.

Colour histograms of an unprocessed still of the aerial walkways in the MAXXI Museum (top) and of the processed image (bottom), showing a marked increase in colour intensity in the latter. Images by author, 2023.

navigating unstable space

The cumulative effect of the body's trajectory through space produces yet another anamorphic uncertainty, in this case, one that describes collective motion as a visual dynamic. By compressing all visual data in the image stack into a series of individual compositions, the form of the interior building spaces becomes visible as paths of light. The progressive instances of compression achievable using *ImageJ* software provide insights into not only the destabilising effect of motion on the perception of the interior space but also its extensive permeation by light not otherwise recorded.

While the dynamic human trajectory tends to flatten urban space, at the same time, it can also be said to expand it, as Leonard Schlain observes: 'Spatial representations also merge at high speeds. As space is compressed, multiple views of objects are possible from a single perspective because planes and volumes become one.'¹² This paradoxical condition is evidenced by the montages in Figures 12–14, in which multiple views are simultaneously compressed into a single image and yet describe the spatial properties of the building interiors as the embedded dynamic of light and colour.

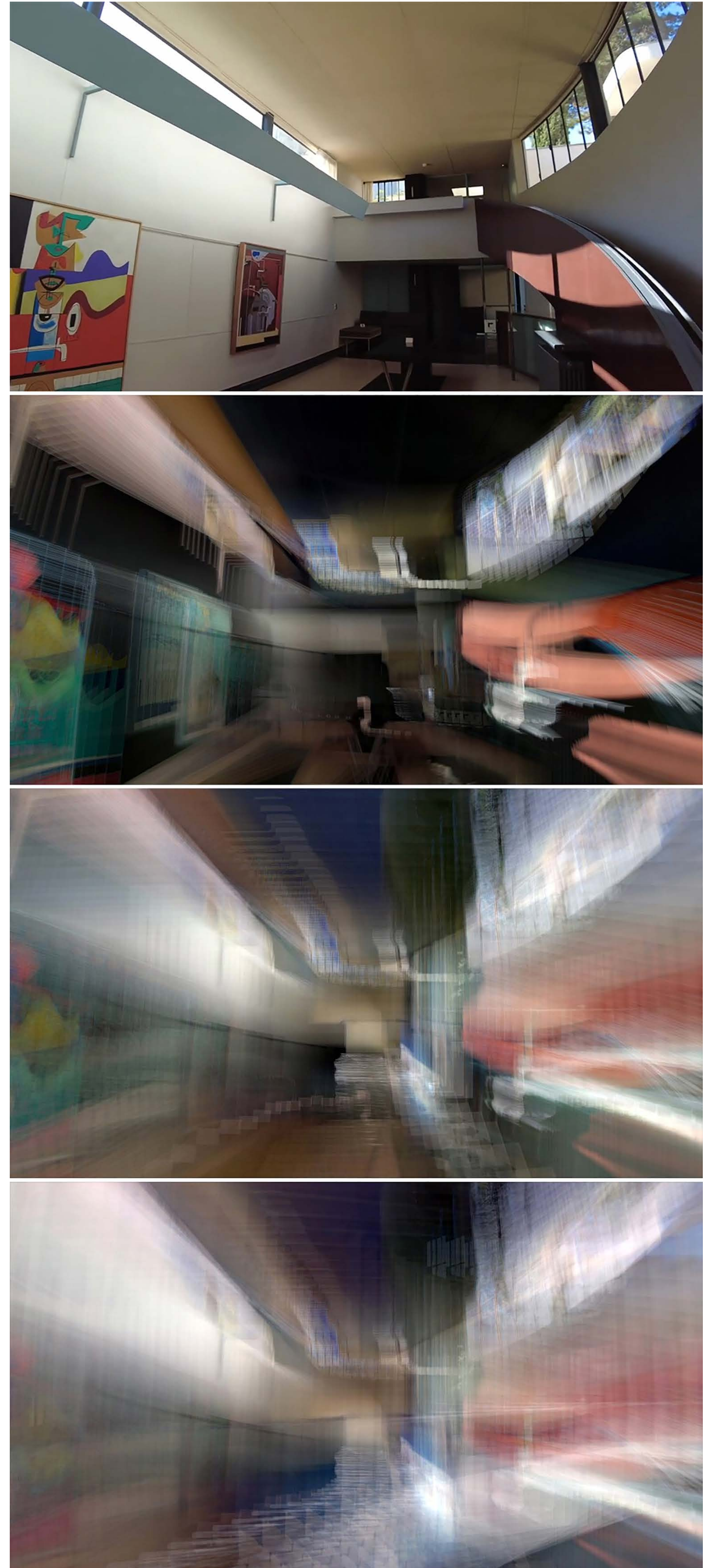


Figure 12.

Montage of unprocessed still of the interior ramp in La Roche House (top). With permission from Heje Yi, 2022; Cumulative z-axis projection stills of the video footage captured at the same location, showing the progressively dynamic composition of light and colour arising from the body's motion in space (other images). Images by author, 2023.

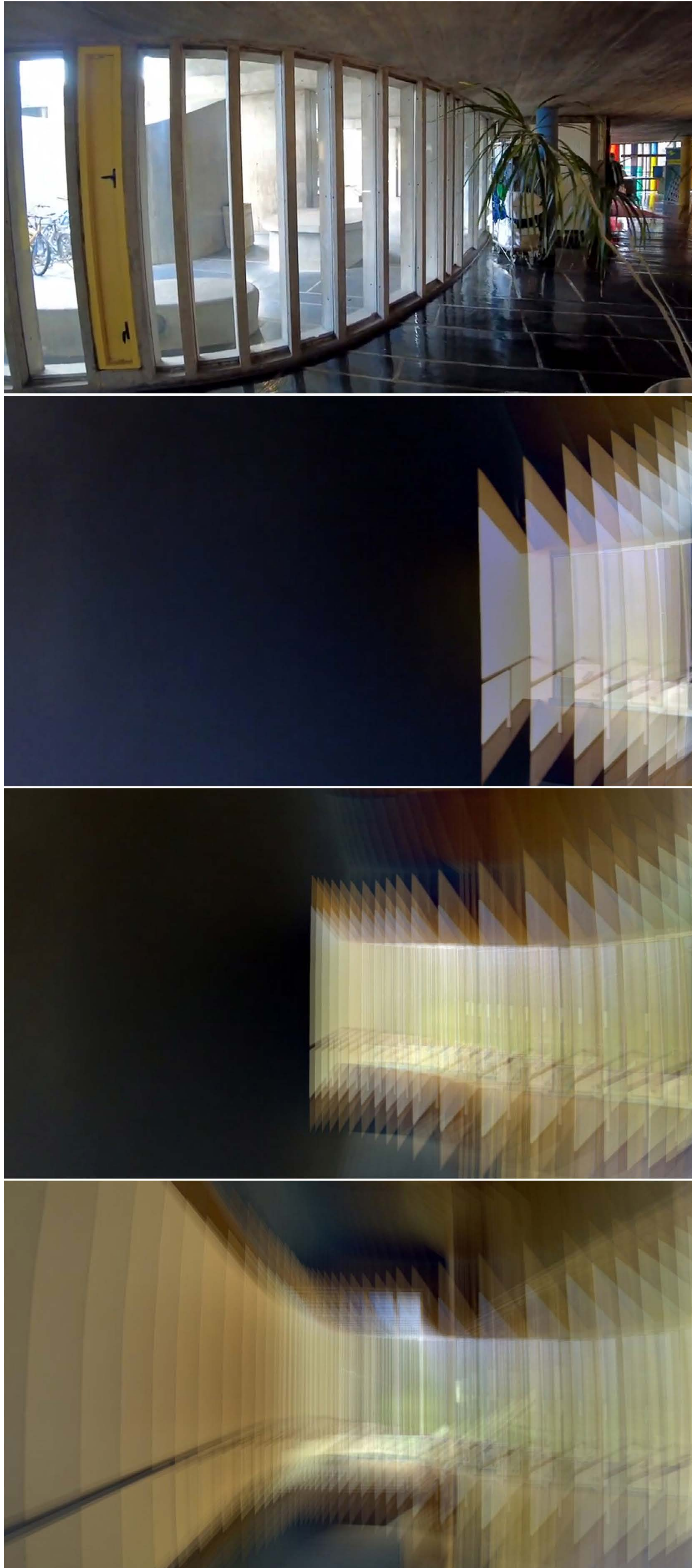


Figure 13. Montage of unprocessed stills of the interior circulation space in the Maison du Brésil (top). With permission from Heje Yi, 2022; Cumulative z-axis projection stills of the video footage captured at the same location (other images). Images by author, 2023.

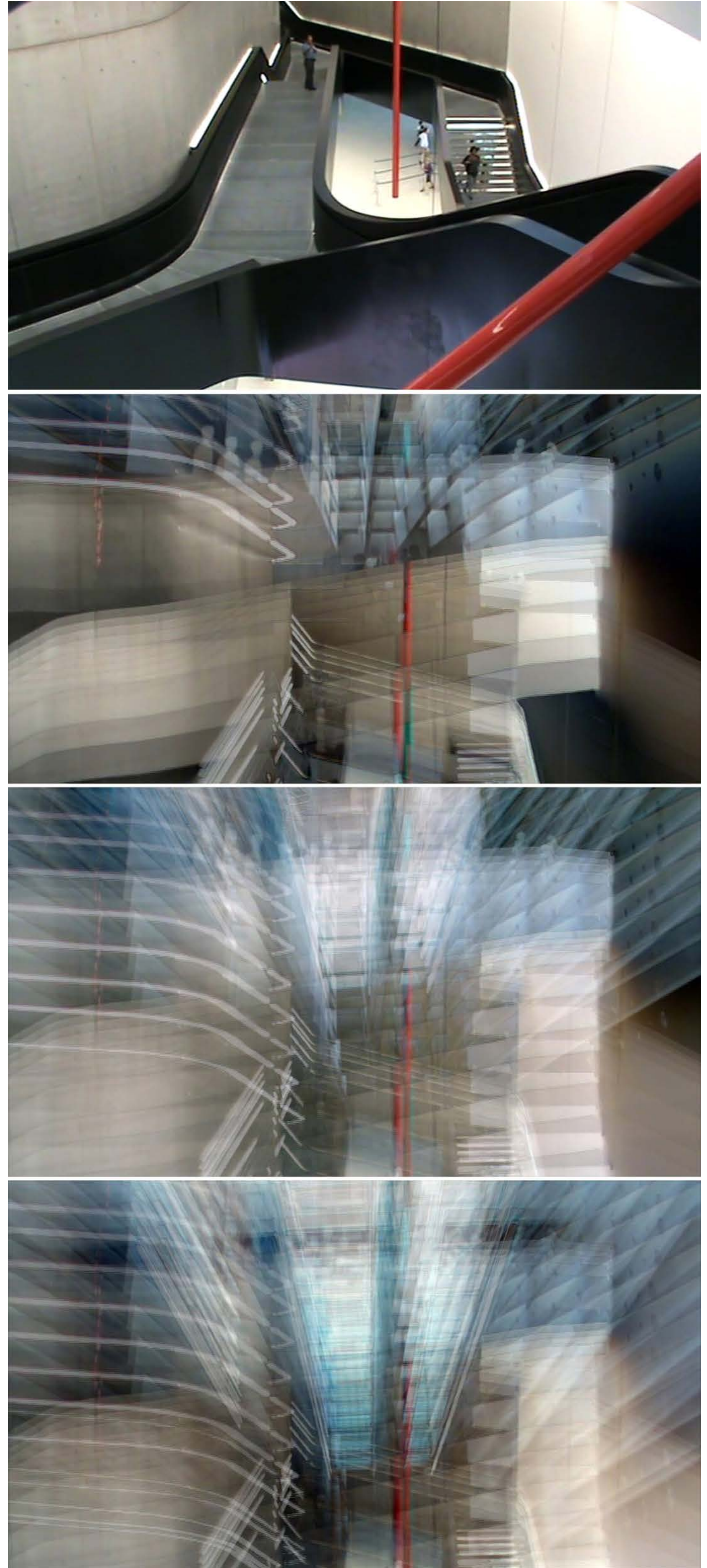


Figure 14. Montage of unprocessed stills of the interior aerial walkways in the MAXXI Museum (top). Photograph by author, 2011; Cumulative z-axis projection stills of the video footage captured at the same location (other images). Images by author, 2023.

On a residential scale, we see the dynamic of the La Roche House extend the notion of Le Corbusier's 'architectural promenade' with fluid formal shifts merged and blurred with light. The images truly support his theory of motion embedded within form: 'Everything, especially in architecture, is a question of circulation.'¹³

At the larger apartment and public building scales, nothing attests to the prioritising of motion embedded in form more than the fractured prismatic space of the Maison du Brésil and Hadid's MAXXI Museum. Both montages defer to the combined effects of the body's motion in space and, almost to the exclusion of recognisable landmarks, present a complex, exciting, and nevertheless, potentially unnavigable space to the viewer.

uncertain strategies of inhabitation

The montages in Figures 15–17 show how spatial modification is expressed across the simultaneously evolving X, Y, and Z axes of the image stack over a given timeframe (see Figure 02 for an explanation of image stack axes). These axial representations or 'elevations' of space-time can be understood as this location's unseen, anamorphic views. By making the space 'behind' the primary camera view visible, these seemingly illegible representations not only subvert the stability of the primary image but also introduce the uncertainty of temporality through the constantly shifting ground of the image.

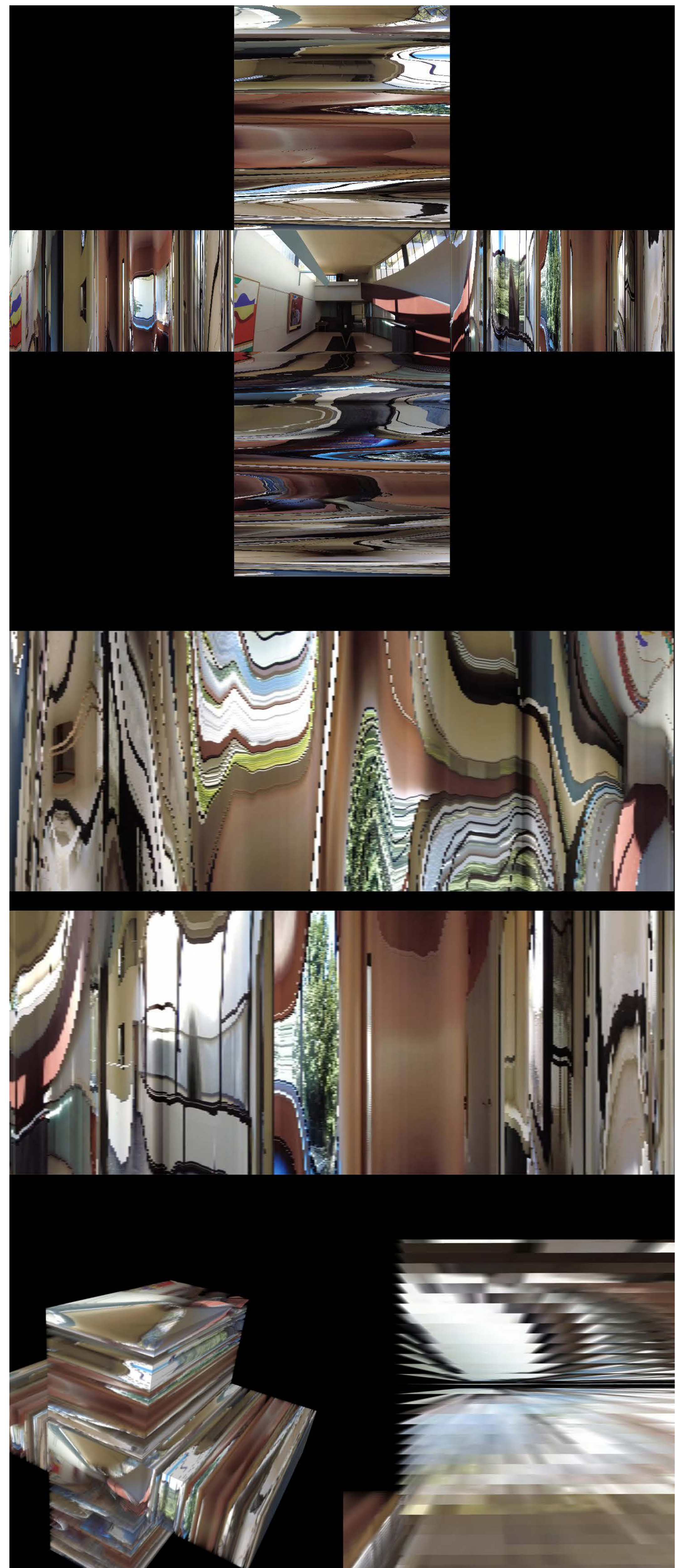


Figure 15.

Montage of a single slice from an image stack of the interior of La Roche House, showing combined orthogonal views of the image stack's X, Y, and Z axes (top); Stills of XZ and YZ axes showing a complete reconfiguration of visual content (centre rows); 3D view of a rotated image stack showing the temporal progression of image content along the image stack axes (bottom left); Close-up 3D view of image stack showing unexpected forms and colours emerging along the temporal axis (bottom right). Original photographs with permission from Heje Yi, 2022. Images by author, 2023.

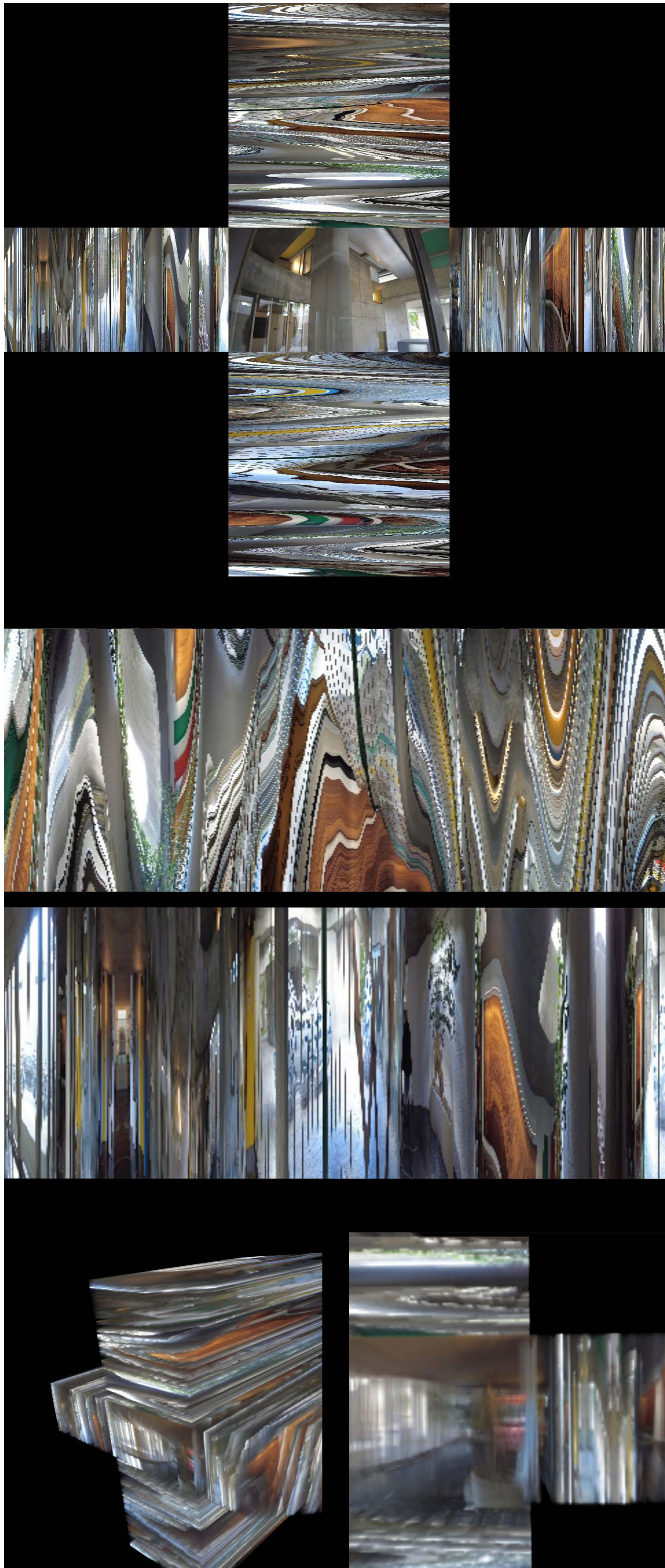


Figure 16.

Montage of a single slice from an image stack of the interior of the Maison du Brésil, showing combined orthogonal views of the image stack's X, Y, and Z axes (top); Stills of XZ and YZ axes showing a complete reconfiguration of visual content (centre rows); 3D view of a rotated image stack showing the temporal progression of image content along the image stack axes (bottom left); Close-up 3D view of image stack showing unexpected spatial conditions emerging along the temporal axis (bottom right). Original photographs with permission from Heje Yi, 2022. Images by author, 2023.

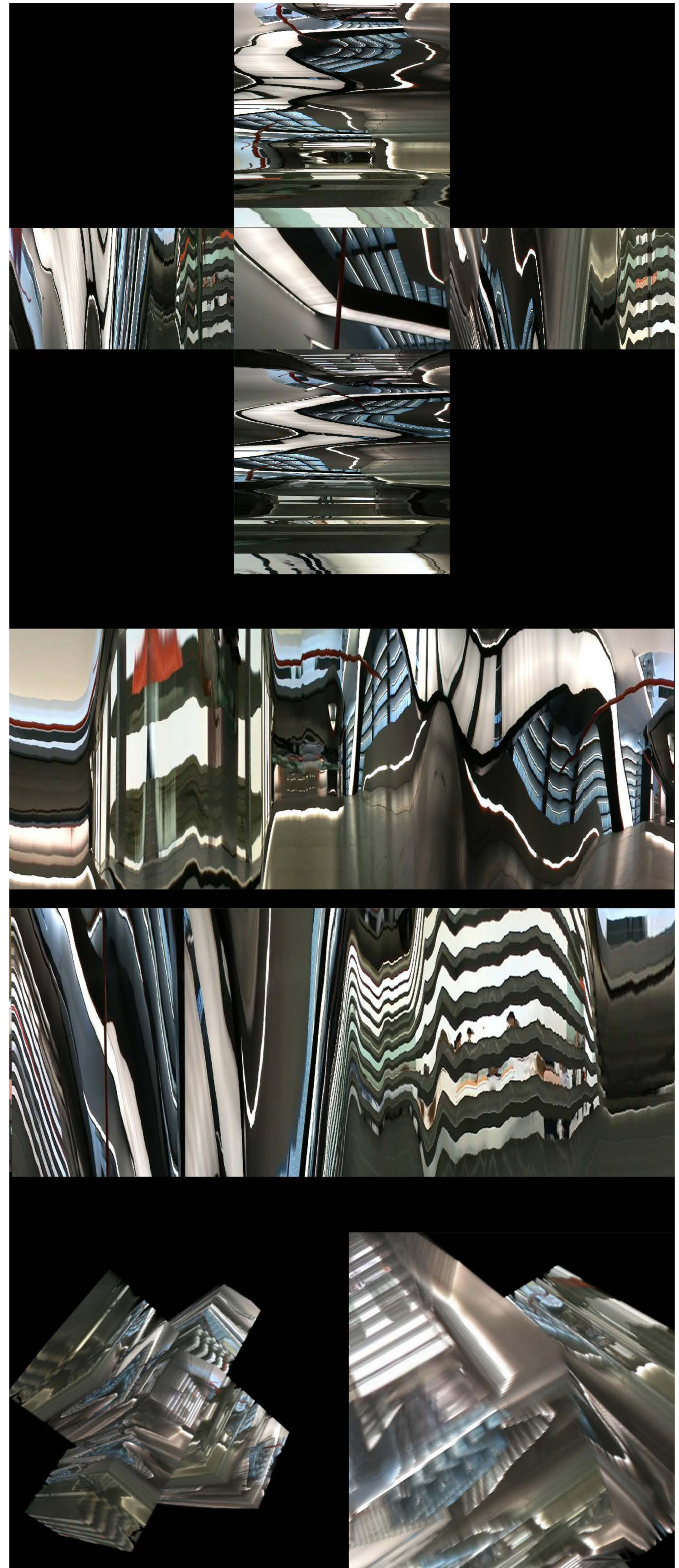


Figure 17.

Montage of a single slice from an image stack of the interior of the MAXXI Museum, showing combined orthogonal views of the image stack's X, Y, and Z axes (top); Stills of XZ and YZ axes showing a complete reconfiguration of visual content (centre rows); 3D view of a rotated image stack showing the temporal progression of image content along the image stack axes (bottom left); Close-up 3D view of image stack showing unexpected spatial conditions emerging along the temporal axis (bottom right). Original photographs by author, 2011. Images by author, 2023.

So, what is the procedural value of these anamorphic micro-scenes? The abstraction of image content seen in the axes removes the visual distraction of traditional, stable arrangements and presentations of form within a scene. With the viewer's response to form sublimated, the scene's new composition can offer insights into the operation of the space or even call it into question.

the qualitative image and affective space

A consequence of deconstructing conventional methods of spatial representation and established experiential contexts is the emergence of affect. In the realm of visual perception, affect is unsettling, triggering a response to the disruption of familiar receptive pathways, making the subject disoriented and incapable of exhibiting a controlled or predictable reaction. Seigworth and Gregg describe this phenomenon as both complex and immanent: 'the name we give to those forces—visceral forces beneath, alongside, or generally *other than* conscious knowing, vital forces insisting beyond emotion—that can serve to drive us toward movement, toward thought and extension.'¹⁴ Brian Massumi draws on scenarios in which perceptual inconsistencies produce an affective and complex outcome within the observer, arguing in favour of the idea that it is not possible to extract simplicity from multifaceted experience. In the essay *Too Blue*, Massumi indicates how colour's complex properties resist quantification by any reductive procedure.

The remembered colour exceeds the testable meaning of the word [...] Between 'blue' used as the trigger for the production of memory, and 'blue' used to test the identity of that memory, something extra has slipped in, which the color-word, as the common property of the experimenter and the subject, does not designate.¹⁵

When considering the relationship between digital images and the surfaces of the urban spaces they depict, a re-presentation occurs of potentially affective conditions characterised by the dominance of qualitative attributes such as colour and brightness as the primary drivers of spatial representation. Significantly, the visual ambiguities associated with these attributes, as described by Massumi, are also present in digital imaging.

This occurs because the fundamental unit of the digital image, the pixel, assigns numerical values to perceptual qualities such as colour and brightness (also shape when considering groupings of pixels within a two-dimensional grid). As a result, conditions of variability and ambiguity related to these attributes are automatically translated into numerical image values and seamlessly integrated into the image. In this way, the ambiguities Massumi discusses, where colour and brightness boundaries blur, become inherent data within the image and constitute a fundamental component of its content. Importantly, this also means that the digital image has the potential to be highly affective because it is not bound to a single, normative visual experience.

With urban space presented by digital imaging devices in terms of qualitative visual properties readily translatable into data, a new approach to its design and construction also becomes possible. Because there is an indexical relationship between the image and digitally 'viewed' space, form can affect the numerical values within the image. However, for affect to be genuinely affective, or unconscious, then it is the capacity of these spaces to disrupt any traditional visual narrative that makes the presence of affect possible.

The ability to index a physical surface to the qualitative properties of the image and, in turn, to the ambiguities of the Human Visual System is thus fundamental to a departure from a predetermined visual narrative. In this respect, both the pixel's numerical basis and camera technology's anamorphic capacity ensure the conditions to produce affect are present.

drawings for digital space

This essay shows how digital platforms and their associated modes of visual representation extend both the viewing experience and representational techniques beyond the constraints of the current practices defining architectural production. It reveals how digital technology activates a new type of embodiment, projecting the body along newly visible axes of space/time to engage with previously unexplored atmospheric properties of the building's interior worlds.

It also proposes that these digital anamorphic representations enter the architectural arena as the new atmospheric 'drawing set' to sit alongside its traditional orthographic counterpart. These digital compositions connect the architect to unique formal and material assemblies informed by atmospherics and ambiguity rather than traditionally recognisable form. The images compose an experiential visual language underpinned by the unknown eventualities of temporal space and, in this respect, provide a new generative agency as working drawings for the digital city.

author biography

Linda Matthews is the Co-Director of the UTS Visualisation Institute and a Senior Lecturer in the School of Architecture at the University of Technology Sydney. Her area of interest is the history, politics, and techniques of representation. Her current research explores new architectural and urban design methodologies that utilise the optics of digital visioning systems to reconfigure and generate non-traditional modes of architectural and urban form.

notes

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