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Body, form, material and surface- making of Ruga Interior Skin

Jiangmei Wu

ABSTRACT In design history, the concept of "skin" has been used to refer to the outermost tissue that encloses a physical body. So, if the concept of "skin" can be understood as a generator of ideas for interiors that lie in between the flexible spaces around the body and the rigid spaces within the building, what new form and context can an interior skin take in adding to the contemporary interiority? Borrowing from the metaphor of "skin" in fashion, interior design, and architecture, Ruga Interior Skin (RIS) explores the ambiguous and conceptual realm connecting the act of wearing, inhabiting, and its relationship between body, form, material, and surface-making of a novel interior semi-structural wall and partition. "Ruga" is the Latin word for making wrinkles, creases, pleats, and folds. RIS is inspired by the use of wrinkling and folding to create flexible frameless topological forms that can be suspended in a way that is similar to a piece of cloth or textile. Both flexible and rigid, RIS draws the connection between the body and the interior surface, placing the dichotomy of permanent versus ephemeral, solid versus light, and material versus digital at the center of the concept.

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Introduction

Human skin is the interface between the body and world: it is our outermost organ that protects our physical bodies, it is sensuous to touch and constantly gives us information about our surroundings, and in many cultures around the world it is adorned with colors and designs that stamp on this world the individual's impression of his or her identity. In design history the concept of "skin" has been used as a site for rich metaphors referring to the clothing that wraps around the body or the building walls that enclose and protect our body. In fact, "second skin" is often used as a metaphor for clothing or fashion, while "third skin" is often used as a metaphor for architectural cladding and surface interiority.

In architectural design, skin has its origins in the development of free façade or "curtain wall" in modern building construction, in which the cladding is independent from the structural frame. The architectural skin, referred generically as the cladding zone between exterior and interior, either as thin as a rubber membrane or as thick as a two-meter weathered envelope, has to negotiate with both exterior and interior presences. In fact, it seems that in architectural production much attention and preoccupation has been given to articulating the relationship between the structure and the "skin" that is freed from the structure since the modern era (Leatherbarrow and Mostafavi 2002) and its relationship with the exterior site. In contrast, interior skin, mediated by the architectural skin with its engagement in the exterior, should take on a different literal and visual role in terms of its closer relationship with the human body. Lois Weinthal writes that interior architecture can be understood as a series of layers where our human body is placed at the center (Weinthal 2011). Our skin is the first layer that we "inhabit" and it is the foundation of concepts that have influenced architects, designers, and decorators in creating various forms and surfaces in our interior space. The second layer we "inhabit" is sometimes said to be clothing, the third layer is furniture and objects, the fourth layer is colors and surfaces, and so on and so forth until we reach the last layer where the interior starts to merge into the exterior (Weinthal 2013). Therefore, differentiated from architectural skin with its primary function as the mediator between body and the outdoor environment, interior skin can refer to all layers of interior surface, as found in furniture, finishes and textile sheets that "require active and flexible engagement from the body" (Weinthal 2013). Elaine Scarry has eloquently written about our body's active engagement with the walls in a room:

> Although its walls, for example, mimic the body's attempt to secure for the individual a stable internal space – stabilizing the temperature so the body spends less time in this act; stabilizing the nearness of others so that the body can suspend its rigid and watchful postures; acting in these and other ways like the body so that the body can act less like a wall – the walls are also, throughout all this, independent objects, objects which stand

> apart from and free of the body, objects which realize the human being's impulse to project himself out into a space beyond the boundaries of the body in acts of making, either physical or verbal, that once multiplied, collected, and shared are called civilization. (Scarry 1985)

Scarry argues that the walls, as part of interior surfaces, are not simply objects that enclose the body. The interior walls are also the extension of a body that work in ways that negotiate between the body and indoor temperature, humidity, sound, light, opacity, etc. so that the "body can act less like a wall." Furthermore, for Scarry the walls, as objects, are the projections of the body, which is the subject in the act of making the world, and collectively, the "civilization." In interior design history, much of the esthetic studies have been given to the cultural and visual aspects of decorations and ornaments that are applied onto the planar surface, while little attention has been focused on the relationship between the body, material, surface, and form within the interior space. The site of this contest is the Ruga Interior Skin (RIS) art installation.

"Ruga" is the Latin word for making wrinkle. It has its origin in anatomy and it has been used recently by a group of material scientists in trying to describe the various qualities of wrinkles, crease, pleats, and folds. RIS is inspired by the use of wrinkling and folding to create temporary interior architecture that can be suspended, in a way that is similar to a piece of cloth or textile. Due to the origami folding patterns, RIS is flexible and semi-structural, requiring no additional structural frames. At a small scale, it wraps around the body and allows the body to move with it. At an interior architecture scale, its flexible form mimics the movement of the body, creating intimate enclosures for the body, and allowing the body to move within it. Made from stiffened lightweight sheet material, RIS is digitally cut and patched together into large flat sheets. RIS can be fabricated offsite and shipped to the site in flat packages and then can be installed onsite to create three-dimensional interior structures. Both flexible and rigid, RIS draws the connection between the body and the interior space, placing the dichotomy of permanent versus ephemeral, solid versus light, and materiality versus digital fabrication at the center of the concept (Figure 1).

Figure 1
An art installation of Ruga Interior Skin at Clay Center of Arts and Sciences, Charleston, West Virginia. Photograph by Robert J. Lang.

The concept of "skin" in design

The concept of "skin" in design can be traced back to the mid-nineteenth century. In 1845, Charles Baudelaire, called the black frock coat "the outer skin of the modern hero," thus allowing the word *skin* to first take on a literal role in reference to clothing or fashion (Baudelaire and Charvet 1972). A discussion on "skin" in architecture and interior design, therefore, needs to extend to the discussion of the overlapping relationship between architecture, interior surface and clothing and fashion. It is worth noting the distinction between "fashion" and "clothing" here. The word "fashion" implies a cycle of rapid stylistic and taste changes, while the word "clothing" refers to the covering of the human body with fabric or textile. It might be reasonable to suggest that "fashion" connects to interior surfaces through the choices of applied decoration in interior finishes, while "clothing" relates to interior surface through the engagement of body, the focus of this investigation.

The metaphoric connection between fashion and architecture has been suggested since Vitruvius, and perhaps even earlier. German architect Gottfried Semper, also in the nineteenth century, argued that the origin of the architectural surface came from the textile, hide, or wattle, hung, or stretched between structural posts. Semper confirmed his system of architecture in a Caribbean cottage shown at the Great Exposition in London, which he wrote in *Der Stil* [Style in the Technical and Tectonic Art, or Practical Aesthetics], published in 1860–1863 (Semper et al. 2004). Adolf Loos, in his essay titled "The Principle of Cladding," referred to "covering" as the basic and oldest architecture detail. He wrote, "This is the correct and logical path to be followed in Architecture. It was in this sequence that mankind learned how to build. In the beginning was cladding…Originally it was made out of animal skins and textile products" (Loos 1982). Architects of the modern movement favored functions over forms, rejecting the decoration of the female fashion. Instead, both Otto Wagner and Adolf Loos favored a man's tailored suit with its functional and consistent "non-style" as the model for new architecture of their time. Le Corbusier, inspired by the "non-style" of the male suit, continued a new architecture with white walls, or simply being naked.

While Otto Wagner, Adolf Loos, and Le Corbusier were influenced by Semper, each took on different interpretations. The complexity of this topic is beyond the topic of this investigation; however, it has been thoroughly discussed by McLeod and Wigley in their essays in a book titled *Architecture in Fashion* (Fausch 1994). For Semper, the connections between textile and architecture extend beyond architecture's original connection to textile and the textile design's symbolic role in architecture. Semper argued that architecture can be "dressed" or "worn," like clothing. He not only explained that the German word *Wand* (wall, partition, screen) had the same root and basic meaning as *Gewand* (dress, garment, clothing), but he made dressing, or clothing, and the textile art the focus of his investigation of architectural style (Semper 1851). Semper was not interested in the vagaries and superficiality in fashion, instead, he believed that good adornment, when used

as a visual mask, must work in concert with the material, and "only with complete technical and construction perfection and with proper treatment of the material according to its properties, could the artistic creation transcend the material for its larger social and cultural purpose" (McLeod 1994).

Perhaps more importantly, Semper's idea, though more than 150 years old, on clothes and body as the origin of architecture or space and his idea of the tectonics of adornment, has direct implication on our increasing preoccupation in generating new and novel forms and surfaces in our contemporary age. Herzog and de Meuron, who have built their entire career on innovative and ingenious surface design, showed strong interests in the "aspect of artificial skin which becomes so much of an intimate part of people" (Herzog 1997). Office dA, another architecture firm, also showed a strong connection in their works to Semper's idea of architecture as cladding. For example, in Weston House, an adaptive reuse project, Office dA used new layers of cladding to cover and mask the original structure, as if they designed a "dress" to cover the body of building. For Office dA, the cladding "is understood and designed as a constitutive spatial elements as much as a vehicle to architectural and cultural signification" (El-Khoury 2001). Meejin Yoon taught an architecture studio at MIT in fall 2001 titled "Between Bodies and Walls," in which students were asked to conceptualize and visualize a new "wall" that "can exist as barriers, dividers, seams, fragments, filters, and gaps," but also at the same time "can be worn – deployed to challenge territory and force new ways of occupation" (Yoon 2002).

When a functional relationship between the body and the wall, or a third skin, is changed from being "inhabited" to being "worn," the space between the body and the enclosed wall, allows the body to act less like a wall and the wall to act more like body. A body not only can move "within" the space, but also move "with" the space, if space is more garment-like. The form of the body projects onto the space beyond the body, just as the body projects its identity on the garment. The wall is no longer just a stand-alone surface, rather its surface, the skin, needs to be felt.

> More precisely, to feel the surface is to enter. Occupying a space does not involve passing through some kind of opening in the surface, like a door, to find an interior. To occupy is to wrap yourself in the sensuous surface. (Wigley 1995)

If the concept of "interior skin" can be understood as a generator of ideas for interiors that lie in between the flexible spaces around the body and the rigid spaces within the building, what new form and context can an interior skin take? Can the interior wall, in its fixed, rigid, upright, and planar forms, like the other interior furnishings, such as a chair, that mimics the movement of the body, become flexible and movable? Can the wall behave and look more like a piece of cloth, or textile, as suggested by Semper, that can be simply hung and unhung?

Can the boundaries and corners between walls, ceilings, and floors be erased so that an entire interior enclosure becomes a total integrated form? Can this interior skin be made of non-structural sheet material and be semi-rigid while fulfilling an important spatial function? What are some design considerations, tools, techniques, and material selections for making an interior skin? And how can a new approach to developing an innovative interior skin contribute to our ongoing search for sustainable design that places the human body at its center? RIS, an ongoing art installation, explores new approaches to these interior skins. RIS explores ways to soften the space between the body and interior walls by the use of origami-inspired design to generate interior spaces that are closer to clothing than to the brick and mortar building.

Folds and interior surfaces

The making of RIS is inspired by origami, the Japanese art of paper folding. The original purpose of origami is to obtain various shapes, ranging from animals figures to objects, both abstract and figurative, by folding a flat sheet of uncut paper. Folded forms have inherently rigid properties and they add structural strength to otherwise flexible material such as paper and stiffen felt sheet. In comparison to other fabrication techniques, folding or bending allows for complex and innovative structures formed with simple and low-cost tools at the point of assembly. In fashion design, folding is also called pleating, and it has not only been used to take up excess fabric, but it also has been used to add structures and forms to soft fabric. Mostly notably, Issey Miyaki, inspired by origami, designed clothes and products that originated from two-dimensional sheet material. From flat sheet material, Miyaki's folded designs can be easily deployed into a three-dimensional volume and then can be collapsed back to a two-dimensional flat shape that is much smaller, for ease of shipping and storage.

In architectural and interior design, folding, both as a theoretical idea and as a means for form and surface generation, has inspired a new generation of architects and designers to create morphogenetic architectural volumes with continuous variations and interpolations that overlap gaps and avoid fracture (Lynn 2004). Morphological architectural structures are starting to make use of one of the main characteristics of folding design – the kinetic ability to deploy and collapse in three-dimensional space (Liapi 2002; Motro 2009). There are many more examples of origami-inspired foldable designs in interior objects and furniture, as well as collapsible interior walls and partitions. However, low-cost interior skins that are deployable, configurable, and that are in large scale continue to be very challenging for architects and designers.

Focusing specifically on one of the most fundamental folding patterns, the Yoshimura pattern (Yoshimura 1955), the RIS project explores its potential for being used to fabricate an interior fabric for temporary use or for an ephemeral interior enclosure. The Yoshimura pattern was discovered by scientist Y. Yoshimura while he was researching

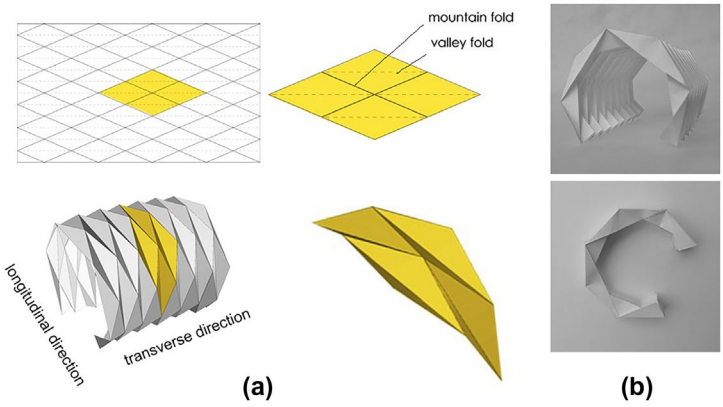


Figure 2
Yoshimura pattern and its deployment. (a) Yoshimura pattern allows the form to reduce the dimensions in all directions when compressed or folded. (b) Paper folded model showing the Yoshimura arch and its flattened form.

the buckling patterns of thin-walled cylinders. One of the most important features of the Yoshimura pattern is its ability to allow the form to reduce the dimensions in all directions when compressed or folded, facilitating easy transportation and storage. A regular deployment of the pattern produces an approximated arc form that has great structural stability (Figure 2).

Two methods are used in the process of topological form finding: small-scale physical models and computer simulations. The digital CAD models generated from computer simulations will then allow us to further our design verification process. The first step of form finding in a small-scale model involves an approach that allows us to start by working with material tactilely. This approach is very different than a typical approach in which CAD programs play central roles. Rather, this approach allows the material, in this case, the paper folds, to be at the center of the morphogenetic process.

In the form finding step with paper folds, two-dimensional Yoshimura crease patterns are able to generate a variety of topologies. Parametric design tools such as Grasshopper and Lunch Box are used to generate many variations of Yoshimura patterns. These crease patterns are then sent to a digital cutter for perforation and cutting so that small-scale paper models can be folded quickly. In this way, two-dimensional paper sheets, embedded with the crease patterns, demonstrate the capability of morphogenesis on its own, in other words, the resulting complex three-dimensional forms came directly from the paper folds rather than from the CAD programs. These paper physical models can shed light upon the structural stability of topologies and their global kinetic properties (Figure 3).

Body, scale, making, and material

RIS has been experimented upon in both the scale of the body and the scale of interior architecture. Transcending the scales from body to interior architecture in terms of tools, assembly details, construction techniques, and material choices, is an attempt to bridge the conceptual as well as the physical space between the flexible spaces around

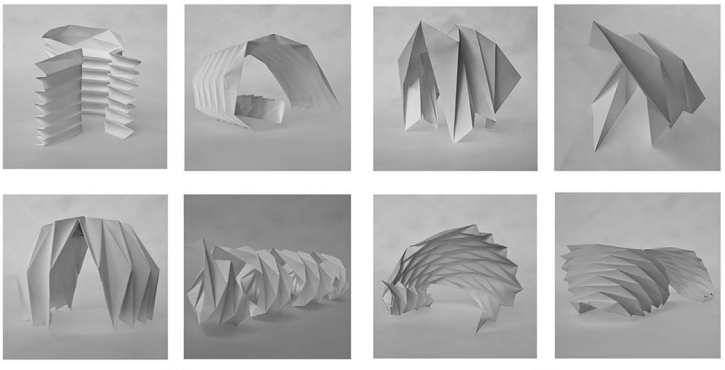


Figure 3
Folded paper model showing Yoshimura deployments resulting in a variety of topologies that can be applied to interior surfaces. (a) Regular deployment of the Yoshimura pattern. (b) Irregular deployment of the Yoshimura Pattern.

(a) (b)

the body and the rigid space within the building, namely the possibility of enclosing and wrapping around the body at various human scales. Working at the body scale, the folding adds flexibility and springiness to the otherwise flat and rigid material, allowing RIS to wrap around the wrist like a piece of jewelry, or around the torso like a piece of cloth. Here, the gap between the body and the "skin" is very tight, the body fits within the "skin" and moves with the "skin," as in a piece of garment. Working within a rigid architectural structure, RIS can be scaled up and can be applied in both horizontal and vertical applications in architectural interiors, such as ceiling clouds, stand-alone partitions, paneling systems. At the architectural scale, the gap between the body and the "skin" becomes loose and spatial, allowing the body to move "within" the "skin," as in space enclosure (Figure 4).

At the scale of the body, RIS can be designed and fabricated very similar to a piece of clothing. The silhouettes of the patterns can be digitally cut using a laser cutter or a digital cutter and crease lines of the patterns can be etched or perforated, again using a laser cutter or a digital cutter. These patterns can then be sewn or stitched together using a sewing machine or by hand. The material choices for RIS at

Figure 4
Flexible deployments of Yoshimura pattern in various proximities to the body.

the scale of the body include textile and paper. The soft textile can be stiffened using starch or glue to allow easy pleating and shaping. In comparison to textile, paper is more stiff and it is more ideal for making folded forms. However, paper is often not durable and washable. Due to recent advances in the material science of paper development, paper that is water- and weather-proof, tear-proof, and chemical-resistant has started to be used for three-dimensional products in fashion, interior design, and in other industries (Schmidt 2009). On the other hand, traditional Washi, a type of Japanese paper that is made from the long inner fibers of kozo (mulberry tree), mitsumata, and gampi, can also be considered for RIS application at the scale of body. Due to these raw materials and the traditional craft techniques, Washi papermaking has no negative environmental impact. More recently, this traditional paper has been updated with new technologies, resulting in a material that has paper-like quality, yet is durable and washable like a piece of textile, and therefore becomes a suitable material for applications in fashion, interior lighting, and interior furnishing.

In order for RIS to transcend the scale from body to interior architecture, it is important to consider the structural impact of an architectural interior skin. Small paper folded models can't be easily transformed into architectural structure. Instead, material choices, jointed details, construction techniques, and fabrication tools all need to be carefully considered. A folded interior skin is similar to a thin shell structure such as a folded plate structure. Due to the increasing interests in origami-inspired architecture, researchers and engineers have been conducting structural analysis for various origami patterns at architectural scales (Lebée 2015). According to these studies, the structural stresses work differently in folded architecture between hinged connections and fixed connections at the fold lines. For a folded plate structure with hinged connections, there is a lot of tension across the plate, while for the structure with stiff connections the compression over the connection, over the fold line, is large (Samuelsson and Vestlund 2015). This finding has implications for material choices as well as joint details for RIS at the scale of the interior skin. Since RIS is conceptualized and designed as a flexible interior surface, it would be contradictory to make all the fold joints as fixed joints. Rather, RIS used hinged connections at the fold lines. While these hinged connections can be designed in future iterations with active design by incorporating automatic actuations and active materials (Wu and Anwar 2016), it is also important to design prototypes using non-active folding mechanisms such as piano hinges. Because of the flexible hinges in RIS, the structural stress will concentrate on the folded plates instead of on the hinge connections. Therefore, the material criteria for RIS should be thin, light, and rigid, similar to the material properties found in corrugated cardboard or plastic board. If the material is foldable, like a piece of paper or stiffen textile, then the flexible hinges can be formed without using additional piano hinges.

A wide range of materials can be appropriate for interior surfaces, from rigid ones such as wood, glass, and metal, to flexible ones, such as wool, leather, and paper. The selection is often limited by material

performance characteristics, codes, and regulations that are intended to ensure interior functions, public health, and safety, and is less limited by structural constraints. One of the potential materials being considered to replace cardboard panels or plastic boards in RIS is polyester felt, made of recycled plastic bottles using needle punch non-woven techniques. This felt has superior acoustic qualities because of its porous characteristic, and it is currently being used in interior carpets and wall panels. While it is non-rigid, folding adds rigidity to the material. Figure 5 shows an initial test conducted with stiffened polyester felt that is about 5/8 inch thick. The material can be easily cut and scored using a laser cutter and CNC router using a drag knife. If the material is not completely cut through, it can then be folded easily by hand to create a simple mechanical hinge.

Other potential materials include HDPE, composite resin, fiberglass, and polycarbonate. One such material is Kraftplex, a type of paneling that is made entirely of pure cellulose. Kraftplex, hundred percent recyclable, is produced using only water, pressure, and heat, with no chemical additives, bleach, or adhesive agents. Though it is made of cellulose fiber-like paper, Kraftplex has material and shaping properties similar to those of sheet metal and plastic. Further, it can be compression molded and deep-drawn into shape, thus allowing folded hinges to be formed. Further studies need to be conducted in order to test the feasibility of these different sheet materials.

It is also important to note that each of the folds in RIS, at both small scale for clothing and large scale for interior surfaces, is a transformation of surface and it behaves more like a mechanism than a structure. Therefore, the resulting folded form, either as a garment or an interior skin, is somewhat non-structural and exhibits certain degrees of freedom in movement. While this flexibility resulting from folding mechanisms is highly desirable for a piece of garment or jewelry which needs to move with the body, these movements would present certain challenges when making RIS as a large, interior, semi-structural surface. This problem can be solved by closing the folding mechanism so that a folded surface at an architectural scale can be structural (Lebée 2015; Samuelsson and Vestlund 2015). Figure 6 shows the details for adding bracing plates to the edges of folded surfaces in order to prevent movements from the folding mechanism. These bracing plates should be added after the RIS is deployed on site to its final three-dimensional

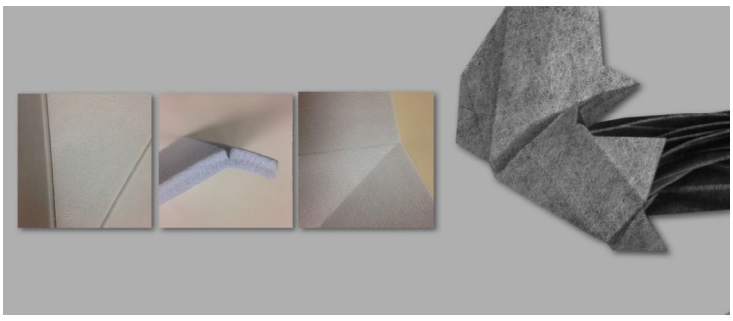
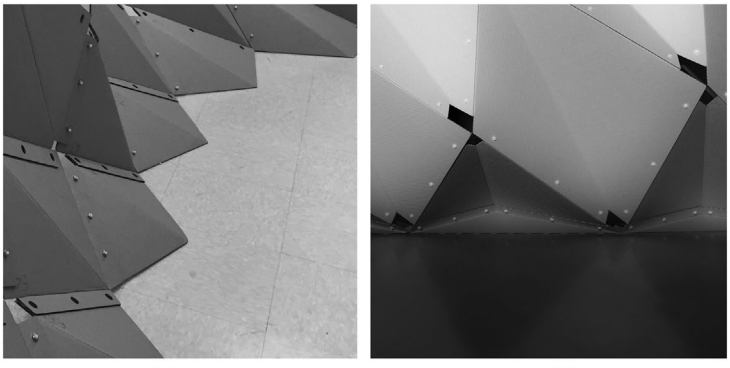


Figure 5
Cutting, scoring, and folding of stiffened polyester felt panels of various thicknesses.



(a) (b)

Figure 6
(a) No bracing plates are added to the edges of a folded surface. (b) Bracing plates are added to the edges of folded surfaces to prevent movements from the folding mechanism.

configuration. They can be removed to bring flexibility back to the RIS and allow RIS to be reconfigured into a different three-dimensional form in case of needed flexibility in an interior space. They can also be substituted for a different set of braces of different designs and dimensions so that the RIS can be stabilized in its new configurations.

Ruga Interior Skin in 1:1 architectural scale prototypes

The large-scale installation in the RIS project measures about 15–20 feet in width and 9 feet in height. Corrugated cardboard was chosen for 1:1 architectural scale prototypes, due to its economic, lightweight, and environmental qualities. In addition, the rigid corrugated cardboard panels can easily be folded and layered to add thickness to mimic the real interior skin. The creased and folded cardboard hinges store some kinetic energy so that folded kinematics and mechanical responses of the 1:1 scale structure can be studied. Large cardboard panels were laser cut. Some panels were glued together to add strength and thickness. Because of the added thickness, careful design decisions regarding folding thick origami were considered by offsetting panels and cutting away the corners. These panels were then scored using a simple scoring tool, folded by hand, and then connected together into large flat sheets with plastic rivets. These rivets are removable and reusable, thus allowing the structure to be easily modified. Once the individual patterns were all connected together into large flat sheets, the structure of the interior skin could be formed by folding the panels simultaneously in either mountain or valley folds. During the making of 1:1 scale RIS, it was soon discovered that hand folding was impossible, therefore, the 1:1 scale interior skin was suspended to allow the folds, or pleats, to work simultaneously in order to create the semi-rigid space. Changing the suspension points also resulted in changing the three-dimensional forms. Figure 7 shows the making of one version of RIS in 1:1 scale cardboard models and its various configurations when suspended differently, while Figure 8 shows another version of RIS in1:1 scale cardboard models in a design workshop taught by the author, and how the body interacts and moves through the enclosure.

Figure 7
The making of a 1:1 scale RIS in corrugated cardboard.

Figure 8
The making of a second 1:1 scale RIS in corrugated cardboard.

When the RIS project was invited to be part of a large-scale traveling exhibition in the United States, one of the challenges was to propose a method for shipping and safe handling of the large, full-scale, interior skin. This RIS project was made of two, almost identical, sheets that are connected in the middle. Each sheet, when lying flat, measures about 22 feet by 9 feet. Each of these two flat sheets was folded flat in simple accordion folds so that they would fit into a 20 feet by 3 feet wooden crate for safe storing and shipping. Once they arrived at the site, these large sheets were then suspended and configured using a

Figure 9
Installation of an artistic form of RIS at Hermitage Museum and Gardens, Norfolk, Virginia, 2015.

simple pulley system. Figure 9 shows the shipping container and the installation of the RIS project in an exhibition at the Hermitage Museum and Gardens in Norfolk, Virginia.

Conclusion

This article has introduced the concept, form, making, and material for a prototype of a novel interior skin. While clothing, or the "second skin," is often non-rigid and flexible, and can move and adapt to the body, a series of discrete layers within interiors, or the third skin (referring to all interior surfaces, from walls, ceilings, and floors to upholstery and curtains), can be either rigid or non-rigid. There are interior surfaces that are configurable and semi-rigid, such as the movable screens or walls that fold up like an accordion. RIS focuses on generating a new type of semi-rigid interior surface by crossing the boundary between clothes making and interior space making, using patterning, folding (or pleating), hanging (or suspending). Both flexible and rigid, RIS thus draws the connection between the body and the building, placing the dichotomy of permanent versus ephemeral, solid versus light, and material versus digital at the center of the concept. RIS is an ongoing research project that aims to arrive at more robust and functional prototypes in the future.

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References

Baudelaire, C. and P.E. Charvet. 1972. *Selected Writings on Art and Artists [of] Baudelaire*. Harmondsworth: Penguin.

El-Khoury, R. 2001. "Office DA's House Dressing." *Thresholds*, 22: 48–53.

Fausch, D. 1994. *Architecture, in Fashion*, 1st ed. New York: Princeton Architectural Press.

Herzog, J.K. and J. Kipnis. 1997. "A Conversation with Jacques Herzog (H&DeM)." *El Croquis. Herzog & De Meuron 1993–1997*, 84: 7–21.

Leatherbarrow, D. and M. Mostafavi. 2002. *Surface Architecture*. Cambridge, MA: MIT Press.

Lebée, A. 2015. "From Folds to Structures, a Review." *International Journal of Space Structures*, 30(2): 55–74.

Liapi, K.A. 2002. "Transformable Architecture Inspired by the Origami Art: Computer Visualization as a Tool for Form Exploration." Paper presented at the 2002 Annual Conference of the Association for Computer Aided Design in Architecture, Pomona, CA, 24–27 October 2002.

Loos, A. 1982. *Spoken into the Void: Collected Essays, 1897–1900*. Cambridge, MA: Published for the Graham Foundation for Advanced Studies in the Fine Arts, Chicago, IL, and the Institute for Architecture and Urban Studies, New York, by MIT Press.

Lynn, G. 2004. *Folding in Architecture*, Rev. ed. Chichester: Wiley-Academy.

McLeod, M. 1994. "Undressing Architecture: Fashion, Gender and Modernity." In D. Fausch, et al. (eds.), *Architecture in Fashion*, 38–123. Princeton Architectural Press.

Motro, R. 2009. *An Anthology of Structural Morphology*. Singapore: World Scientific.

Samuelsson, C. and B. Vestlund. 2015. "Structural Folding: A Parametric Design Method for Origami Architecture." Master's thesis, Chalmers University of Technology, Sweden.

Scarry, E. 1985. *The Body in Pain: The Making and Unmaking of the World*. New York: Oxford University Press.

Schmidt, P. 2009. *Unfolded: Paper in Design, Art and Industry*. Boston, MA: Birkhauser.

Semper, G. 1851. *The Four Elements of Architecture and Other Writings*. Cambridge: Cambridge University Press.

Semper, G., H.F. Mallgrave, M. Robinson and G.R. Institute. 2004. *Style in the Technical and Tectonic Arts, or Practical Aesthetics*. Los Angeles, CA: Getty Research Institute.

Weinthal, L. 2011. *Toward a New Interior: An Anthology of Interior Design Theory*, 1st ed. New York: Princeton Architectural Press.

Weinthal, L. 2013. "Interior Skins." *International Journal of Interior Architecture and Spatial Design,* 2: 64–71.

Wigley, M. 1995. *White Walls, Designer Dresses: The Fashioning of Modern Architecture*. Cambridge, MA: MIT Press.

Wu, J. and S. Anwar. 2016. "Ruga Architectural Skin (RAS): Towards Building Smart Self-Deployable Structures." *International Journal of the Constructed Environment*, 7(3): 17–30.
Yoon, J.M. 2002. "Between Bodies and Walls." *Thresholds*, 23: 86–89.
Yoshimura, Y. 1955. "On the Mechanism of a Circular Cylindrical Shell under Axial Compression." Technical report, NACA TM 1390.

Biography

Jiangmei Wu is an interdisciplinary scholar, artist/designer, and interior design educator. She has been investigating the relationship between geometry, surface texture, computational algorithms, and making techniques in the art and science of paper folding. Her origami-inspired, spatial installations have been exhibited across the United States, as well as in Italy, the Netherlands, Canada, Japan, and Thailand, and they have been funded through the Indiana University College Arts and Humanities Institute and the National Science Foundation. Email: jiawu@indiana.edu