

# Biomimetic Spatial Designs based on the Venation System of Insect Wings

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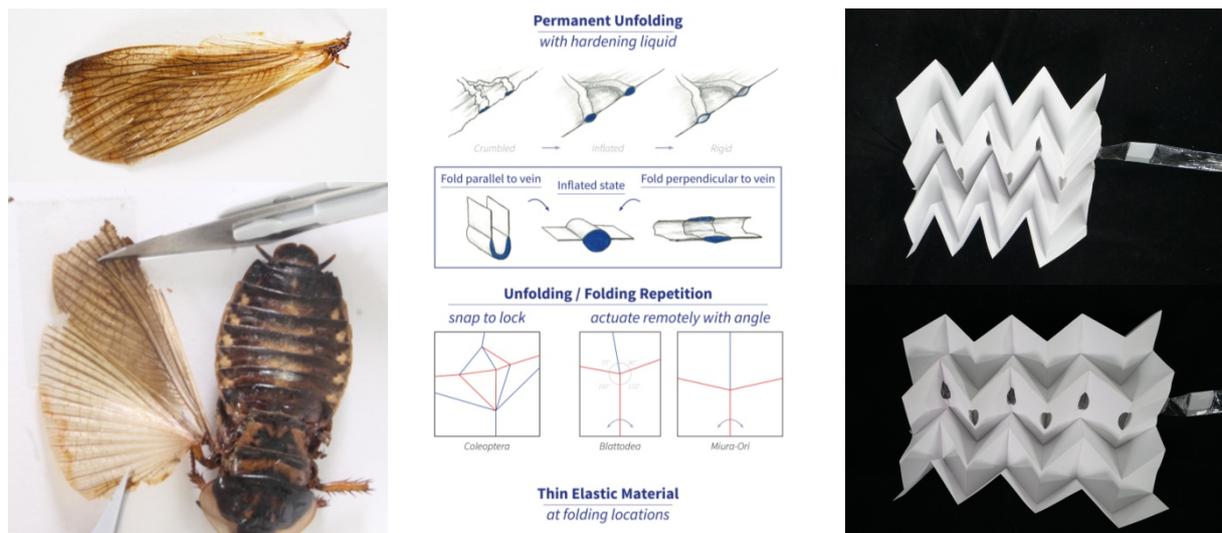
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## Abstract

In response to the need for adaptive designs, folding structures are increasingly implemented in architectural concepts based on their packing and shape change capabilities. On the other hand, difficulties in the manufacturing process and maintenance of such systems limits their implementation in realized projects. Numerous folding patterns and actuation mechanisms are being discovered by biologists studying biological role models such as insect wings and leaves. These models are designed to perform specific functions using the least amount of resources possible. As some of these functions are similar to the ones required in human systems, folding patterns and their actuation mechanisms can be abstracted and applied to adaptive designs for example facade systems. Implementing moving facade elements in a design usually requires many actuators controlled by a centralized system which is prone to failure. The venation system of insect wings, that enable unfolding due to hydraulic pressure, could serve as a biomimetic role model for continuous actuation system. Instead of using numerous mechanical actuators, a venation system could be implemented to allow facade elements to adapt to their environment. The discovered principles could also be applied to the design of outer space structures, such as satellites. Biomimicry was used as a framework to translate biological principles to design resource efficient folding constructions (Figure 1). By simplifying the actuation mechanism to a single venation system, the application of adaptive designs will be easier and require less resources.



**Figure 1.** presents the biomimetic process employed in this study from the venation system investigation in biological role models (left), to the abstraction of the actuation principles (center), to the prototyping stage with experimental models prior to design conceptualizations (right).