Compliant mechanisms and its application

A common understanding toward the word “mechanism” is a system of parts working together in a machine or a piece of machinery. And its prefix adjective “compliant” emphasizes the function of complying with a certain command. In other words, different from the traditional mechanisms consisting of multiple rigid components and a joint structure to accomplish some certain functions, compliant mechanisms prefer to monolithically complete the same task through its flexible elastic body deformation.

According to above definition, it can be easily implied that compliant mechanisms will perform well in compact machine with high requirement in efficient energy transformation and endurance. Since there is no need in joints or other connective structures, a large space, materials and energy loss during transmission among connective structures will be saved. And with the help of its flexibility, any lubrication or energy storage mechanisms like spring are not necessary any more. There still remain some limitations while using compliant mechanisms such as a higher predesign effort. Besides, it might not suitable for the machine required multiple functions and those with easily replaceable components like auto-body.

Most of the applications with compliant mechanisms are in the field of Micro Electro mechanical Systems (MEMS) design and robotics. As the assignment required, some application proposals are listed below after considering the advantages and characteristics of compliant mechanisms. The first one is the skeleton of eyeglasses. Besides, inspired by its application in robotics, garage kit or some other modular toys can be used this kind of design method as well. Even though those replaceable components in auto-body might be not suitable to apply, others part like piston and suspension within automotive system seems promising. At last, the structure of building is also a suitable applying bed for compliant mechanisms. Noted that with a complex elastic body so a high requirement in production, current approaches like rapid prototyping might not possible to produce such huge mechanism, which one of the disadvantages of the compliant mechanisms.

There are several kinds of design method within compliant mechanisms, pseudo-rigid body model and topology optimization and inverse method. With a brief understanding in this field, it is difficult to select a suitable for each proposed application above. But I would like to take the simple case of the skeleton of eyeglasses as an example, where the common structure can be seen as a pseudo-rigid body model of its compliant mechanisms.

Reference:
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[2] Alejandro E. Albanesi et al., A Review on Design Methods for Compliant Mechanisms, Asociación Argentina de Mecánica Computacional.
[3] Intro to Compliant Mechanisms, Brigham Young University, England