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Performance of a wing with nonuniform deformability in hovering flight[1] KOUROSH SHOELE, RE Vision Consulting, LLC, QIANG ZHU, UC San Diego — The deformability of insect wings are related to the embedded skeleton (venation). In this study, the aerodynamic performance of wings with nonuniform flexibility is computationally investigated. By using a two-dimensional rendition, the underlying veins are modeled as springs, and the membrane is modeled as a flexible plate. The focus is on the effects of the detailed distribution of vein flexibility upon the performance of such a wing in the generation of lift force. Specifically, we are interested to find the importance of leading edge strengthening. Towards this end, the aerodynamic performances of three wings, a rigid wing, a flexible wing with identical veins, and a flexible wing with strengthened leading edge, are studied and compared against each other. It is shown that the flexible wing with leading edge strengthening is capable of producing significantly higher lift force. This is found to be related to the cambering effect at the leading edge, which enhances the leading edge vortices. In addition, in contrast to the other two wings, which show sensitivity to kinematic parameters, the wing with strengthened leading edge perform well over a wide range of parameters.

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Qiang Zhu
UC San Diego

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