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Holey wings can improve aerodynamics at bioscales YOHANNA HANNA, GEOFFREY SPEDDING, University of Southern California — The performance of wings at moderate Reynolds numbers ($10^4 \leq \mathrm{Re} \leq 10^5$) is strongly influenced by laminar boundary layer separation, and by the possible reattachment (in the mean sense) of the detached shear layer. Details of these events on both pressure and suction surfaces can lead to unexpected phenomena such as a negative lift slope around zero angle of attack, and abrupt changes in flow state close to the formation of a closed laminar separation bubble. Once understood, one may seek to exploit these sensitivities to find new forms of flow control, either passive or active. Here, we show that small, distributed porosity (porosity ratio, $\phi = 0.003$) on a wing at moderate Re can almost completely remove the nonlinearities in the $C_\ell(\alpha)$ curve, to yield a more robust and predictable lifting device. The flow-through mechanisms of a permeable wing are investigated and provide an alternative explanation for the sometimes-reported benefits in bio-flyers, that would then also apply to engineered equivalents of the same scale.

Yohanna Hanna
University of Southern California

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