

Abstract Submitted  
for the DFD15 Meeting of  
The American Physical Society

**Low Dimensional Analysis of Wing Surface Morphology in Hummingbird Free Flight**<sup>1</sup> GREGORY SHALLCROSS, YAN REN, GENG LIU, HAIBO DONG, University of Virginia, BRET TOBALSKE, University of Montana — Surface morphing in flapping wings is a hallmark of bird flight. In current work, the role of dynamic wing morphing of a free flying hummingbird is studied in detail. A 3D image-based surface reconstruction method is used to obtain the kinematics and deformation of hummingbird wings from high-quality high-speed videos. The observed wing surface morphing is highly complex and a number of modeling methods including singular value decomposition (SVD) are used to obtain the fundamental kinematical modes with distinct motion features. Their aerodynamic roles are investigated by conducting immersed-boundary-method based flow simulations. The results show that the chord-wise deformation modes play key roles in the attachment of leading-edge vortex, thus improve the performance of the flapping wings.

<sup>1</sup>This work is supported by NSF CBET-1313217 and AFOSR FA9550-12-1-0071

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Date submitted: 02 Aug 2015

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