Division Of Computing Communication Foundations (CCF)

Add Nugget

PI Name: Professor David H. Laidlaw

PI Institution: Brown University

Nugget Title: Collaborating with Artists and Scientists to Create Scientific Visualizations of Bat Flight

Nugget Text:

Bats are energy efficient and highly maneuverable, making the study of bat flight likely to yield insights of use in future technological application, such as the development of unmanned micro-air vehicles. The unique features of bats – their specialized skeletal anatomy, high muscular control over wing conformation, and highly deformable wing-membrane skin – yield complex flight characteristics including wings that undergo large changes in 3D geometry with every wing beat. This method of flight is currently not well understood and challenging to study.

The NSF supports Brown University's multi-disciplinary research effort to capture, visualize, and analyze both experimental and computational data describing bat locomotion. This project spans the disciplines of art, computational fluid dynamics, computer science, and evolutionary biology.

Visualizing the complex data that results from this study is one of the main challenges of the researchers. The data field describing airflow around the bat's wings contains as many as nine quantities of importance at every position in 3D space. Additional data describe the intricate cycle of bone bending, wing deformation, and changes in air pressure near the wings during flight. The visualization process itself is multidisciplinary. Computer scientists at Brown University are working closely with artists, designers, and illustrators to solve the difficult visual problems that arise when trying to represent so much visual information in a single three dimensional space.

Visualization of the data is typically performed in virtual reality (VR), where scientists are immersed in animated, stereoscopic views of their data. Immersive VR has great potential for visualizing highly complex 3D datasets, but creating effective presentations of scientific information in VR remains a difficult challenge. In order to address this challenge researchers at Brown University have formed strong collaborations with visual artists at the Rhode Island School of Design (RISD). Artists, and illustrators in particular, are trained specifically to solve constrained visual problems, and this training can effectively carry over into the VR medium. One of the key challenges in enabling collaboration between artists and scientists has been to provide artists with the right tools for the job. Custom artistic tools for iterative design and refinement of visualizations directly in VR have been developed to support this effort.

In addition, an award winning, multidisciplinary class has been developed and continues to be taught at Brown and RISD. This class trains artists, computer scientists, and domain scientists to work together to make more compelling and insightful visualizations of scientific data utilizing recent advances in computer graphics techniques such as virtual reality. Insights resulting from the bat flight visualization

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have already led the evolutionary biologists involved in the project to change their experimental methodology to lend itself as much as possible to continued visualization efforts.

Directorate/Division:

Program Officer:

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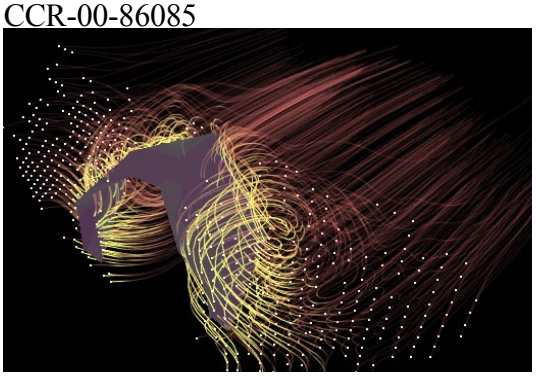
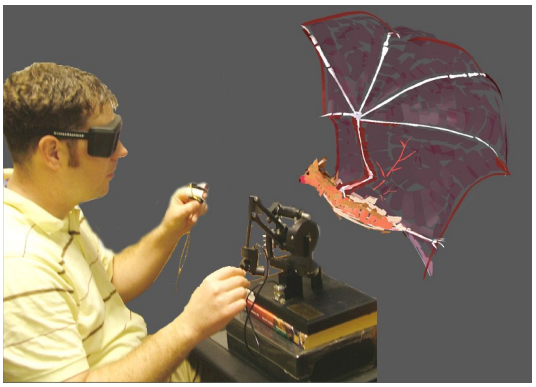
Nugget Image:



Snapshot from an immersive visualization of bat flight highlighting vortical structure, a signature of lift, near the bat wing surface.

An artist using a custom immersive VR tool to develop a visualization design.



Students in a multidisciplinary visualization class prepare for an art class style critique of their designs for a scientific visualization.

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