



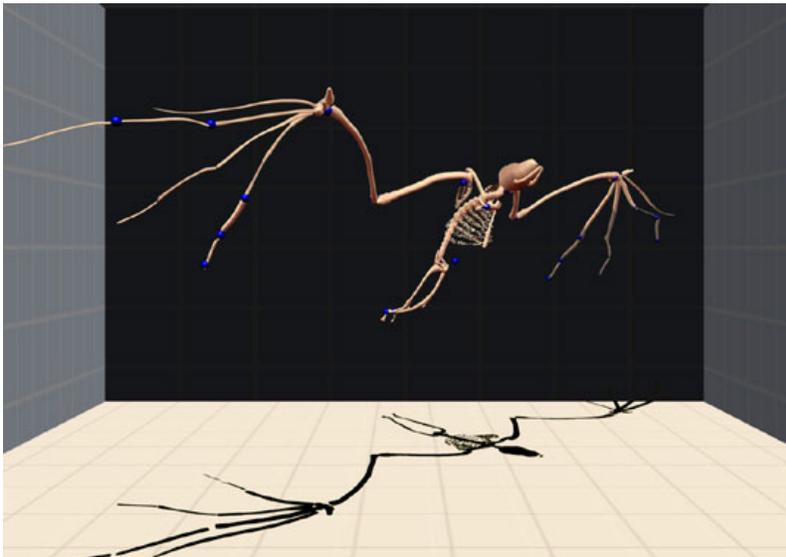
## New Tech Lets You Draw in the Air

Tracy Staedter, Discovery News

**Oct. 1, 2007** — [Three-dimensional](#) drawing programs offer precision, but still require input in two dimensions. Now scientists have developed a software program that trades the keyboard and mouse for virtual reality goggles with feedback to illustrate objects in mid-air.

The program, Drawing on Air, is meant to give scientists a better way to model complex ideas, and could eventually allow doctors to [visualize a surgical procedure](#) before they ever cut into a patient. It could also give artists an intuitive, simple way for moving from traditional freehand methods to computers.

"It's got 'drawing' in the title, but it's very three-dimensional, so in many ways it's more sculptural than it is drawing-based," said Daniel Keefe, post-doctoral research associate in computer science at Brown University in Providence, RI.



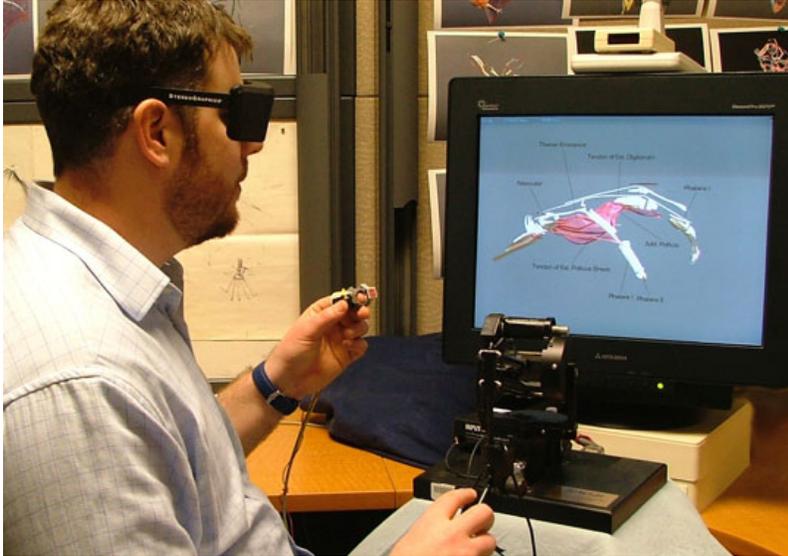
Daniel Keefe/Brown University

### Bat in Flight

Rhode Island School of Design recently used the Drawing on Air program to visualize the flight of bats, which have flexible wing membranes and bones that bend during flight.

Keefe and his team describe the technology in the September/October issue of *IEEE Transactions on Visualization and Computer Graphics*.

To use the program, the sketcher sits in front of a conventional computer monitor and dons a pair of virtual reality goggles. Each lens is equipped with a shutter that opens and closes 100 times a second.



Daniel Keefe/Brown University

### Artist With Goggles

The program helps the sketcher visualize three dimensions through the use of special goggles.

When synched with the computer program, the right lens opens when the appropriate right-eye image is displayed on screen, and vice-versa for the left. The toggling back and forth between right and left eyes tricks the brain and creates an optical illusion that makes the image appear in three dimensions.

But the [goggles](#) are only part of the virtual reality experience. If the person is right-handed, she slides a small tracking device over her left index finger. With her right hand, she manipulates a stylus that is attached to a robotic device designed to provide force feedback. To draw, she leads the line with her left hand, following behind with her right.

The two-handed method is inspired by a technique commonly used in [automotive design](#) called tape drawing. Artists literally sketch on a wall, holding a roll of thin tape in the left hand and sticking it to the wall with the right. By pulling the tape out a little, then securing, pulling and securing, the artist can achieve a precise, smooth curve.

Drawing on Air works the same way: the left hand establishes the drawing direction as well as a guideline and the right hand lays down the final line. The force feedback constrains the stylus to the guideline, so that even if the left hand is a little wobbly, the right hand will follow through smoothly.

Such control is necessary when drawing in three dimensions, said Fritz Drury, professor of illustration at [Rhode Island School of Design](#).

"You might think at first it would be liberating. But in some ways it's like you're suddenly in a cloud, and you don't know what's up or down or forward or backward," he said.

Like other drawing programs, this one allows the user to adjust line color, form, thickness and pattern. For example, by pressing the stylus harder against the force feedback, the artist can achieve a thicker line. And drawn items can be grabbed and rotated as if they were three-dimensional objects floating in space.

Illustration students at the Rhode Island School of Design recently used the program to visualize the flight of bats, which have flexible wing membranes and bones that bend during flight.

Using data from a bat flying in a wind tunnel, the artists were able to illustrate details of the animal's anatomy in motion — a task that would be time-consuming by freehand or would require complex code writing with other computerized drawing programs.

"To use Drawing On Air, you do not need to be able to write digital code. All you got to do is draw," said Drury.

The one thing the program can't do yet, said Drury, is incorporate mathematical data into a model. Imagine being able to flip a switch on the computer to see dynamic air flow and then draw a triangular wing shape in the flow.

"You could observe the flow affecting the plane as it would in real air," said Drury, who says that adding such a feature to Drawing on Air would not be impossible.

For now, the real difficulty may lie in finding the program on a store shelf any time soon. So far, the virtual reality components are too expensive and the program itself is still in the prototype stage.

And Keefe is in no hurry to make this happen.

"My interests are in the research end of things," he said. So for now, that's where the program will stay.

#### **Related Links:**

[Daniel F. Keefe of Brown University](#)

[Advanced Industrial Science and Technology: 3D Images in the Air](#)

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