Edwin Chang
Joseph Hocking
Jane Kernan
He Zhu

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Final Project Proposal: Team Ottoman

The focus of Team Ottoman's final project will be *comfort* and *control* for the scientist user. We have improved the current visualization to end frustrations including, but not limited to, the lack of comprehensive and easily accessible animation controls, focusable flow visualizations, and seating.

Interaction:

Armband menu device

The main menu system consists of a wrist mounted menu device. This interactive menu device consists of an arm mounted set of four selection buttons mounted on an armband that can either be strapped to the forearm of the user or docked to the cave chair for user convenience. The selection buttons consist of the main interaction feature of the armband menu device, allowing the user to summon various menus functions, and is the main method in which to call the three data analysis functions currently incorporated within our visualization, the Scalar and Cilia Planes and the smoke emitter tool. For each function of data analysis, the user, by repeatedly pressing the same button, can scroll through the list of displayable variables, such as Vorticity, Velocity, and Pressure. The wrist mounted menu option has been designed to not only give the user maximum flexibility and options, but to make the interaction convenient as well, as it not only leaves both hands free for other options but also requires only intuitive motion for use.

Animation Control

As part of our team's priority of building a convenient to operate visualization, we have built a special device for controlling the animation. In the previous visualization, flow data is fairly effectively visualized by particles moving. However, the user has little and difficult control over the movement. The current controls are hard to reach, buried under a series of menus, presenting serious impediment to the usefulness of the visualization for making scientific observations. In order to closely examine the movements depicted, the user must be provided with intuitive yet powerful control over the animation playback.

Team Ottoman has introduced the video-editing concept of 'scrubbing' to the visualization via an animation scrubber. The top face of the puck, held in the users hand, is a dial for scrubbing the animation.

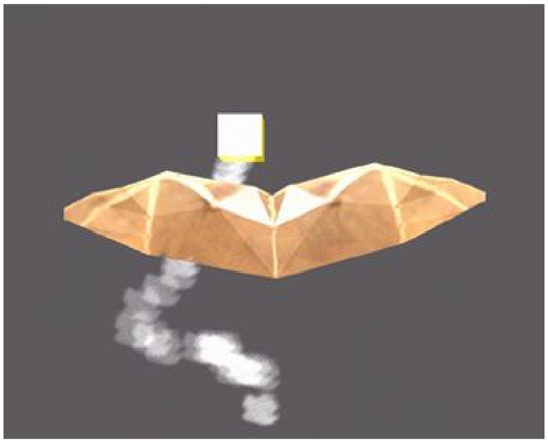
. When a video editor scrubs a timeline, they can move the playback head forwards and backwards in order to quickly see different moments along the timeline. This function allows scientists to examine moments frozen in time and rapidly switch what moment they are looking at. Scrubbing has introduced a new visualization paradigm to the cave, with the scientist now scrutinizing the details of movement, as opposed to simply taking in everything in a general way or examining closely only static images. The latter approach is particularly problematic and often misleading since the entire scene is in motion all the time.

Cave Chair

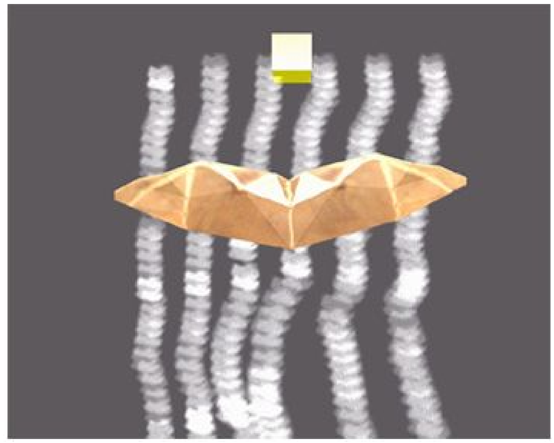
In order to combat the former inhospitability of the cave for long sessions of use, we have introduced a “cave chair” that will provide comfort and convenience to the user without damaging the cave environment. The base is cushioned to soften the impact of the chair with the floor display screen and prevent scratching; it also makes the chair easy to reposition. Our other interaction devices can be docked to the arms of the chair with Velcro attachments or worn as armbands, as the user prefers. The visualization will track the wired goggles as in the current interaction set-up, but if the user desires, the tracking goggles can be placed on the chair as well. This frees the user to walk around independent from wires.

Visualization:

Hose and Plane



(i. Smoke hose)



(ii. Smoke plane)

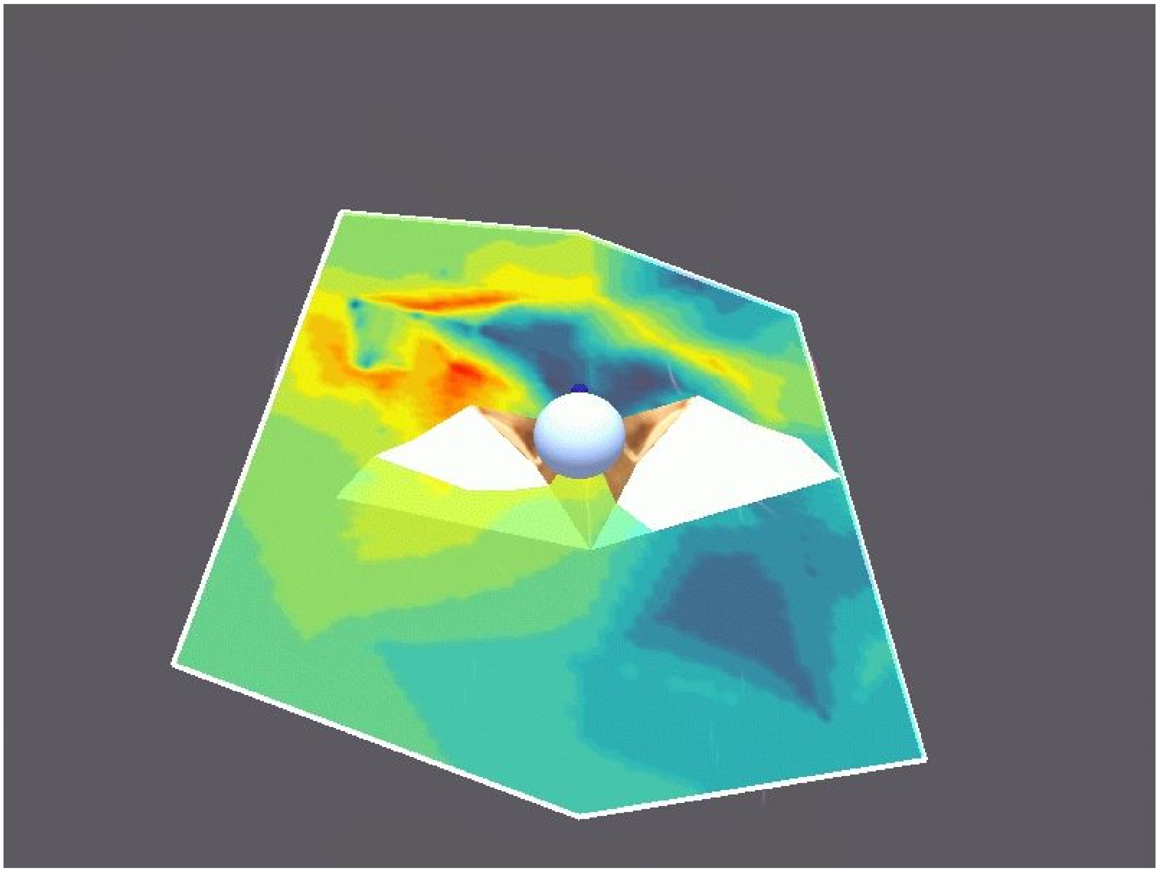
In the Cave's former implementation, the closest available visualization to streamlines is a windsock-like object that is produced from a CavePainting stroke. This visualization moves very erratically, however, making it difficult to understand. The windsock will often jump from below the wing to above the wing abruptly, jarring the user.

With our addition the user would instead be able to introduce smoke into the visualization, which would provide for the most readable and clear visualization (smoke, in effect, produces "streak-lines"). Wind tunnels already use such tools to help visualize airflow; the introduction of simulated smoke into the Cave's airflow visualization is a significant improvement. Because the transparency of Smoke is very graphics-intensive, and cannot currently be performed in real-time. we focused our smoke to a manageable object that operates as a combination of streamlines and streaklines.

The "hose" tool streams out a steady line from wherever it is placed, following the air flow (image i). When this line streams into an area of high turbulence or velocity, it begins to break up into smaller icons. In this way, we have both the benefit of the clarity of streamlines while maintaining readability in areas of high airflow changes. We also propose to extend this "hose" idea to a plane – a plane will flow out a line oriented and placed by the user (imange ii). This plane, like the stream above, will start to break apart into icons wherever the airflow is too violent for the plane to maintain its shape.

These two visualizations, by synthesizing two other methods, will introduce a new perspective on airflow in the cave. It will especially highlight areas of turbulent airflow, while allowing for visualization of vortices in such areas.

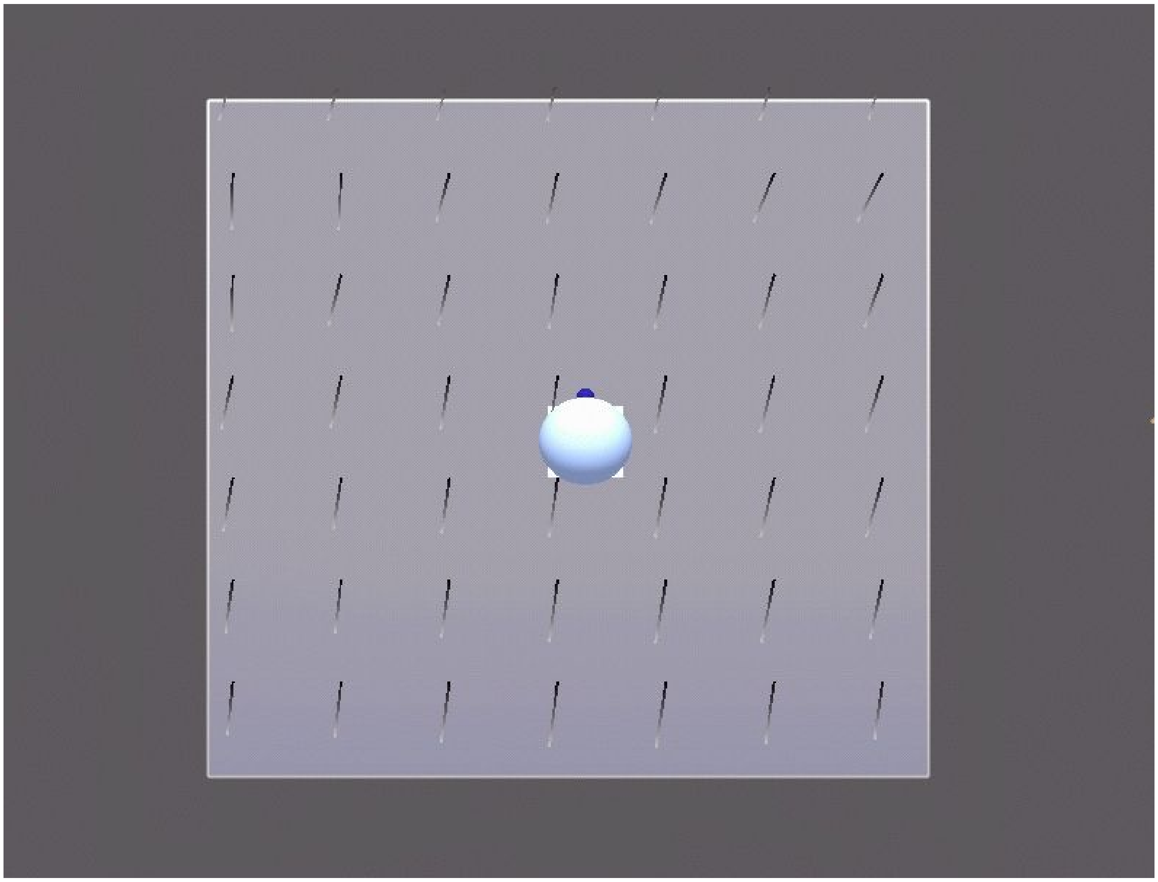
Scalar Plane.



(iii. Scalar Plane)

The visualization offers a series of semi transparent planes as viewing tools. They will be used to both intersect the form of the bat wing or held clear of it to view the flow (and only the flow). There are two types of planes involved in our visualization, the scalar plane, and the scalar plane. The scalar plane shows changing magnitude in selected data as a changing spectrum of color (image iii). For example, when the air pressure data is shown, the areas of high pressure are red, and as pressure on any section decreases, the color mapped will also move down the spectrum correspondingly. This semitransparent plane is infinitely movable and may be placed at any angle, during animation or still viewing, to allow the user the opportunity to analyze the data in fine detail.

The Cilia Plane.



(iv. Cilia Plane)

The Cilia Plane function maps vectors on the surface of the plane. These consist of a series of hair like projections that would change in length in accordance to the speed of airflow, and alter their direction, or angle to the plane based on the flow direction. Like the scalar plane, it shows the magnitude of the selected variables The length of the cilia and the changing angles of the cilia will also relate the directionality of variables shown, provided that the specific value has a direction. Like the scalar plane, the cilia plane can be moved rotated, resized in any way, and may be employed during both active and paused animation.

Visual Interface:

To improve upon the former program, we chose subtler colors in the surrounding interactive elements that did not interfere with data interpretation. However, colors representing actual data are vivid and clear, allowing for maximum distinction between subtle numeric values. Loading times and selection are suggested by shifts between grey, light blue and dark blue menu and plane backgrounds, orienting the user without distracting from the flow visualizations, which use brighter hues and saturation. Our bat texture suggests the anatomy of a bat while referencing the method by which the data was collected by highlighting the vertices that correspond to the motion tracked points on the live subject bat. The realistic wing membrane gives an illusion of billowing to the formerly rigid and off-putting bat model.

Extended Scope:

Future implementations of Team Ottoman's project might include a virtual data screen tracked to the arm controller. This screen would grant an even more focused investigation of the flow data by allowing the user to select a specific point or area of the flow and displaying the corresponding numerical data. The next evolution of the simulation would involve wing pressure rods. The rod lengths would change with changes in pressure on that area, and would be anchored to a transparent Bat wing. Additionally, the rods would be color-coded red on top of the wing and blue on the bottom to allow for comparison of data on both sides of the bat wing at once.

Conclusion:

Team Ottoman's focus on Comfort and Convenience has brought a new level of user-friendliness to the cave. The Cave chair frees the user from the physical inconvenience and distraction of standing to use the cave, and also provides docking options for other interaction devices. Our armband menu device provides easy menu navigation and function access. We introduced animation controls that allow the user to direct the flow visualization, rather than restrict them trough the pre-programmed playback options. Our Smoke hose, scalar plane, and cilia plane introduce the ability for the user to specify an area of flow for focused study, eliminating the cluttered and inundating flow representation of previous cave visualizations. While our program is far from solving the complex system of bat flight, it provides a level of usability and usefulness never before seen in the Cave, and reveals clear direction for future practical implementation of interactive virtual reality visualizations.