Swimming Across the Pacific: A Virtual Swimming Interface

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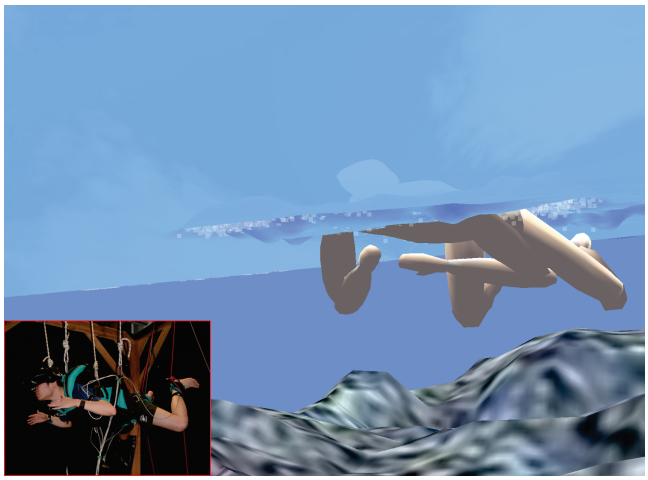

Figure 1: The SAP apparatus

We have created a new locomotion interface for swimming and floating in a virtual ocean in a VR environment as part of our Swimming Across the Pacific (SAP) artwork [sap]. The artwork is motivated by Alzek Mischeff's Swimming Across the Atlantic [Misheff 1982] performed in 1982. In the SAP artwork, we swim across the Pacific Ocean using the swimming apparatus in an airplane rather than across the ocean in an ocean liner as Misheff did.

The Technology

SAP provides an exciting and fun swimming apparatus for the expert performer and the novice. It is a locomotion interface comparable to Sarcos Treadport [Hollerbach et al. 2000], Trike [Allison et al. 2000] and Peloton Bicycling Simulator [Carraro et al. 1998]. The swimmer is suspended in a real swimming apparatus but navigates in a virtual Pacific Ocean environment. The apparatus, an 8ft x 8ft x 8ft wooden frame, may resemble a torture-chamber but it is actually very comfortable to be suspended in. The use of bungee cords adds buoyancy, while sand bags counterbalance the swimmer's weight and adds inertial resistance to the swimmer's kicking actions. Swimmers wear a minimal amount of equipment (a tracked HMD, a hang-gliding harness, and wrists and ankle bands for securing 8 position sensors) such that he or she is hindered as little as possible during virtual swimming. Figure 1 inset depicts the swimmer in the sap apparatus.

The virtual environment comprises a sky hemisphere, a sea surface plane, an ocean floor plane, a virtual avatar and various lighting for different times of the day. Figure 1 provides a snap shot of the virtual environment. The sky hemisphere is texture-mapped with moving clouds. And the ocean floor plane has a rugged plane, texture-mapped with rocks. Both planes are animated to move past the virtual swimmer, making it appear as if the virtual avatar is swimming forward.

The virtual avatar can be adjusted so that the arms, legs and torso match every participant. This calibration is done using known configurations of the participant as well as measurements combined with the eight measured points from the trackers.

As swimming takes place, waves are shown at the sea surface plane. We use recurrence relations to solve the partial differential equation for the 2D wave as often done in standard practice. We approximate the volume of the swimmer with bounding boxes to improve performance and determine when they intersect any of the water grids as they move. When they intersect, the height of the water grids is set to the same as the bounding box. Then waves are made and propagated. If the height is over a pre-defined threshold value and/or the swimming avatar's motion interferes with waves, some particles are made in the air to simulate splashing. As the splashing water particles fall down onto the water surface, the water grids are set to the appropriate height according to the wave model.

Conclusion

SAP is a novel technology inspired by performance art and built for virtual reality. The advantage of making such locomition interface is to increase the variety of possible VR applications. The experience is fun even for non-athletes and hydrophobes because swimming actually takes place in a controlled air space, instead of in water. The SAP virtual swimming system provides cradle-like comfort for users while engaging them in the exciting virtual aquatic navigation.

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