Applications of virtual reality on training oar movement in rowing

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ABSTRACT

This study focused on attempting to identify ways to teach proper oar usage technique to novice rowers by using an indoor rowing machine and engaging the rowers in a virtual reality experience while using the rowing machine. Handle height was an important

Keywords: Rowing. virtual reality. rowing technique

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1 INTRODUCTION

Previous studies have shown that virtual reality can be help rowers maintain consistency of power delivery when rowing on a concept2 rower as compared to non-virtually engaged rowers. [1] The purpose of this study was to investigate the applications virtual reality could have in teaching rowers correct rowing technique about oar movement in outdoor rowing, while only using an indoor rowing machine.

With the concept2 indoor rowing machine (the most commonly used training machine used among rowers), an athlete sits on a sliding seat and uses his or her legs and arms to pull on a bar that is constantly experiencing a pull in the opposite direction of the rower from the machine. The machine measures how much force the athlete uses by analyzing how quickly the athlete is able to pull the bar back. This action simulates outdoor rowing, where rowers need to dip the head of the oar (the blade) into the water and then push with their legs and pull with their arms the oar handle as quickly as possible so that the boat accelerates quickly.

2 SETUP

A virtual reality simulation was built, in this setup, an Oculus Quest was used and worn by the rower. The virtual reality environment placed the rower in a boat in the middle of a lake, with two oars attached to the rigor (the two sides) of the boat. The placement of the oar handles related directly to the placement of the controllers of the Oculus Quest. Thus, when the user moved the handheld controllers around in the real world, he/she would subsequently see the oar handles and therefore the entire oar move around in the virtual reality environment.

The simulation was programmed so that when the oar blade dipped below the water, and an acceleration was applied to the controller handle parallel to the boat direction, the boat, along with the user, would accelerate in the opposite direction of which the force was applied (simulating a real boat experience). Being a virtual reality environment, the user has the ability to look around and view the location of the blade before pulling it in the water, verifying that the blade is in the water before yanking the bar back on the erg.

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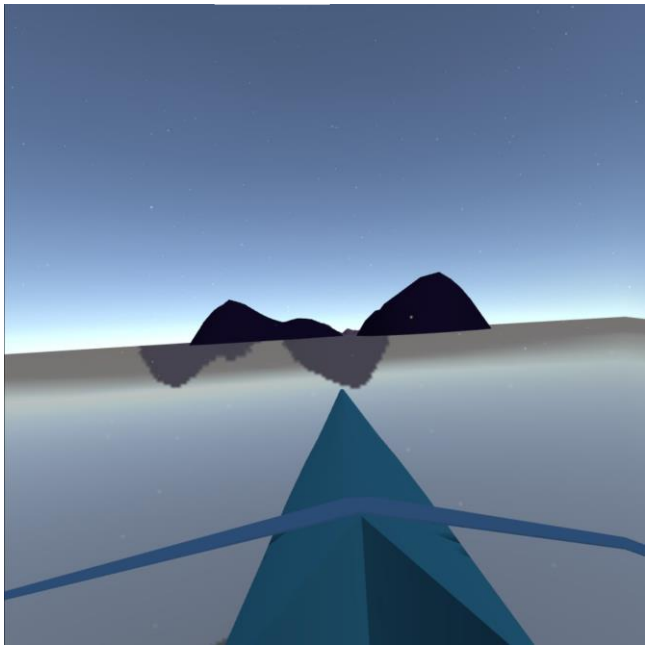

Figure 1: The view from inside the boat in the virtual reality environment

Next, the simulation was started and the controllers were tied to the handlebar of the rowing machine in the center of the bar, giving the user little access to the controllers, allowing the rower to have as much access to the bar as possible. Video was captured of the rower while rowing in this virtual environment and was analyzed for handle technique.

3 RESULTS

Overall, from initial observations, we saw that it was difficult for rowers to learn proper technique for a couple of reasons, which we will detail now. The virtual reality environment instigated a couple of behaviors that are generally frowned upon in outdoor and indoor rowing. We felt that these poor behaviors would counteract any future oar handling technique that could be learned.

3.1 Handle height

Firstly, we observed the rower demonstrating much higher than expected handle height when using the virtual reality system. This problem likely arises from the rower's lack of understanding where the blade is currently in the water, and the rower's desire to have the blade digging as far into the water as possible. In outdoor rowing, the blade ideally should dip into the water just enough that it is fully submerged, yet not too deep that the blade "digs", or goes too deep that it gets stuck in the deep water. "Digging" can cause the oar to get stuck in the water for a moment, which does the opposite of pulling the oar through the water, because it creates a little anchor that ultimately slows down the boat. Therefore,

minimizing the rowers handle height is a primary goal when training for good outdoor rowing form.

In addition to the negative effects this action has on teaching outdoor rowing, this behavior is also inconsistent with indoor rowing technique. In indoor rowing, the handlebar height should stay constant throughout the whole workout.

This behavior is likely observed from the rower during the experience because of the rower's lack of ability to feel the effects that the water or gravity has when holding the oar handle too high / low.

Figure 2: A novice rower holding the handlebar too high on the drive, instigating poor posture.

3.2 Head movement

Another behavior observed is the rower's tendency to check the height of the blade to see if it's in the water or not before pulling the bar back. This behavior is also frowned upon in outdoor rowing. In outdoor rowing, maintaining a straight forward sight is essential to ensure that you can watch the person's shoulders in front of you, which ensures that you maintain the same stroke rate and that everyone in your boat is rowing together at the same time.

Just like mentioned above, this behavior likely results from the rower's inability to feel where the blade of the oar is, forcing the rower to check the oar position before yanking the bar.

This behavior is also problematic for indoor rowing because staring at the split rate in front of you gives you knowledge about how well you're rowing at the current moment and can help you improve from one stroke to the next.

Figure 3: A novice rower looking sideways when rowing, likely looking at his oar as it dips in the water.

4 Conclusion

Given the simulation created, and the few tests conducted, the feasibility of using virtual reality for teaching rowing is left unknown. From the current simulation experience, too many poor behaviors are learned that would counteract any of the positive of teaching handle height of the rower.

5 Future Work

Creating an improved simulation that could account for handle height drastic changes (like raising the handle too low, causing the blade to go too high, off setting the boat, or causing the blade to dig when yanking) would certainly improve the accuracy of the rowing simulation, and hopefully could teach novice rowers the importance of maintaining a steady handle height.

In addition to adding handle height consequences, possibly adding in more virtual players in the boat and forcing the player to row at the same time the AI players do should cause the novice rower to learn how to row in sync – and make sure that he/she is keeping their head in the boat, and not drifting off to look at the oar. Ideally the rower could learn what height the blade is based from just the height of the oar handle they are holding, and therefore will never have to check the water and be distracted by that.

Another improvement that could be made is basing the speed of the boat be correlated to the speed that the rowing machine reads, as opposed to trying to predict the force that user generates based on how fast he/she moves the controllers while in the water. It might also be possible to combine this feature with calculating the proportion of the blade that is in the water and multiplying that by the force calculated by the rowing machine to get the force on the virtual boat.

References

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