Weekly Progress Report
Week 8: 3/17/09-3/24/09

Travel Computer Mount

We will have the Stenglein’s sign the release forms during our visit on Wednesday this week. In the mean time we are in the process of developing a comprehensive user manual.

Assistive Jumping Device

We spent two days testing the system at the University of Connecticut Health Center in Dr. Peterson’s biodynamics lab. On our first visit we spent most of our time setting up our system. The heavy crane trolley was very difficult to get on the upper beam of Dr. Peterson’s gantry crane. We measured out the webbing of the I-beam of the gantry crane and tried to center the load of the harness along the trolley bolt by spacing the washers accordingly. We also had to line up the trolley hanger so that the bungee cord connecting to the chair would feed straight up into the trolley hanger. In doing this, we realized that we will need to purchase a large wrench to safely and securely fasten the trolley nuts to make sure it remains on the I-beam of the crane. Figure 1 shows the trolley secured on the gantry crane and the suspended vertical rail.

![Figure 1. Crane trolley and vertical rail supported by gantry crane.](image)

Once the trolley and vertical rail were secured along the top of the gantry crane, the harness was put on the rail. We tried moving the harness up and down to see how it moved along the rail. The harness moved fairly easily, but the rail seemed to be slightly bending. We thought this effect could be reduced by bungee cord suspension. We tied bungee cord around the cylinder in the upper framework of the harness and around the crane trolley hanger. The bungee seemed to easily support the weight of the harness with
only a few wraps. However, we needed to conduct more testing to determine the optimal bungee length.

We spent much of our second trip to the Health Center testing the bungee cords to obtain the optimal strength and stretch properties. We wanted the bungee cords to support the weight of Sean and the harness at a height that would allow Sean to bend his knees as he comes down from a bounce. To keep the harness from going off of the rail, we determined the maximum length of the bungee cords to be approximately 40 in. long. We devised a test set-up to determine the bungee cord properties. We wrapped and knotted lengths of bungee cord around an I-beam and suspended free weights to determine the stretch per force of the bungee cords. Figure 2 shows the test set-up. Graph 1 shows the displacement of the bungee cord as a function of the load applied to it.

![Figure 2. Bungee cord testing methods.](image)

**Graph 1.** The increase in bungee cord length as a function of the weight suspended by the cord. Each series “6 times”, “8 times”, etc. refer to the number of bungee cords supporting the weight.
From the graph it can be seen that by wrapping the bungee cords 5 times so that there were 10 bungee cords supporting the load, we could achieve a stretch of approximately 23 in. With cords of an initial length of 15.75in, we were able to achieve a maximum bungee length of 38.75in which was within our set optimal range. This length will allow Sean to easily bend his knees as he comes down from a jump, but will still help support his body.

The one issue for bungee cords this short, is that it may be difficult to get Sean into the harness when there is no load on the harness. We may have to develop some sort of clip so that Sean’s parents can pull the harness down and secure it into place until they get Sean into the harness. Once he has been fastened into the harness, the clip will be released and the bungee cords will support his posture with an upward force.

One other issue we saw with the system is that the rail was bending at the end, and if Sean jumped with a backwards or forwards force, he would bend the rail and compromise the efficiency of the rail. We decided that a square tube bolted on to the back of the rail would solve this problem. Since the harness is approximately 30lbs and Sean is about 60lbs, I determined the maximum horizontal load to be applied to the bottom of the rail would be 90lbs. In reality the load applied to the end of the beam would be much lower than this. This would be the case where Sean pushed horizontally off a wall to bend the rail at full force. With this load in mind, the maximum deflection of the rail (or bend) would be just over 4 in. at the end of the rail. This is a significant amount that would effect the movement of the system. We were able to get a 2in x 2in x 1/8in square aluminum tube to support the rail. A 90lb load applied to the square tube would result in a deflection of only approximately a quarter of an inch. Therefore, the rod will greatly reduce the bending of the rail, and improve the upward/downward motion of the harness.

We will be going back to the Health Center on Wednesday to test again, now that the square rod has been bolted to the back of the vertical rail. We need to see if the rail still bends at all. However, the main question we need answered is whether the user will be able to kick the rail and possibly be injured. We also need to solve the problem of getting Sean in the harness.

This week we will visit the Stenglein’s to finalize the delivery and installation of the crane and cement foundation. Hopefully the cement will be poured this weekend, so the crane can be installed the following weekend. Once the crane has been installed we can install the assistive jumping device and make a video of the project.