

Assembling the cogX robot platform

Sagar Behere
behere@kth.se

May 18, 2009

1 Before you begin

1. Unpack all parts carefully
2. The fasteners (nuts, screws, washers etc.) are in a separate plastic bag/envelope. Please keep them in a box and **try not to lose any of them**. Most are standard, but some screws might be difficult to obtain from your local hardware store.
3. Do the assembly **without** the batteries in place. This makes the robot lighter and easier to handle.
4. Print these instructions and keep them with you for reference while doing the assembly

The manual is exhaustive. Please get clarifications from KTH in case you have any questions regarding the assembly.

2 Tools needed



Figure 1: Tools needed

You will need

1. Screwdrivers (width: 3mm, 6mm, and 1.2mm)
2. Long nose plier
3. Hex keys (size: 5/64 and 3/16)
4. Ratchet with size 10 socket and an extension rod
5. Measuring tape/ruler
6. A permanent marker

3 Fasteners used



Figure 2: Fasteners used

The fasteners you will use during the assembly are shown in figure 2.

4 The robot top plate assembly

The robot top plate is the black plate on top of the Pioneer DX robot. The superstructure is mounted on this top plate. Note that the T-nuts inside the beams can be moved along in the slots and you might have to bring them into position for the following assembly.

1. Remove the robot top plate.

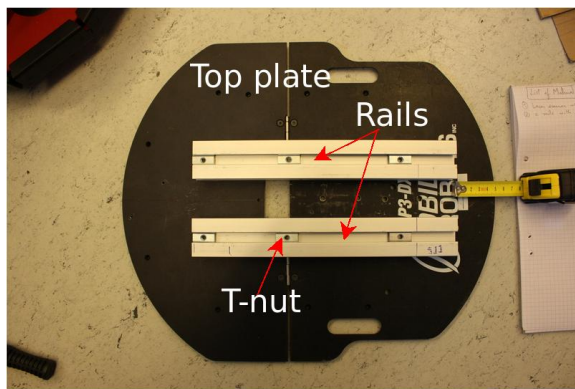


Figure 3: Rails on top plate (top view of top plate)

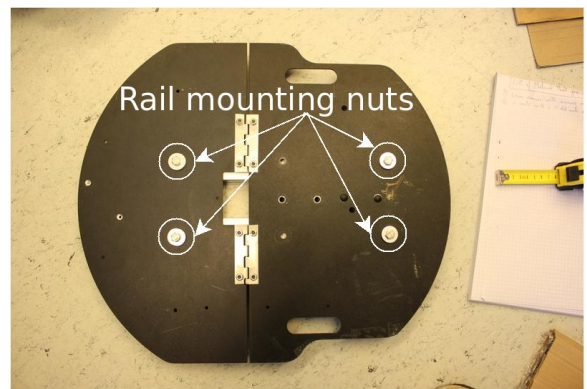


Figure 4: Rail mounting screws (bottom view of top plate)

2. The two rails are on the top surface of the plate (figure 3). They are mounted with four set screws (screws with hexagonal heads) on the bottom surface (figure 4). Loosen these set screws till both the rails can be jiggled around.
3. Mount the big bracket on the top surface (figures 5 and 6) between the rails, with the shorter side horizontal and the longer side vertical. Use 2 M6x16 **set screws** with 1 penny washer per nut. A normal M6 nut goes on the bottom surface (figures 7 and 8). *Don't tighten the mounting of the bracket yet.*

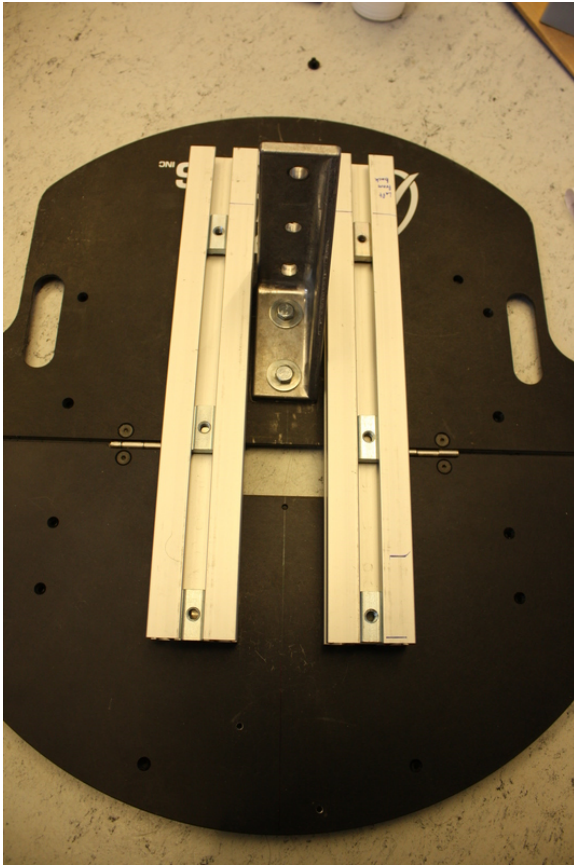


Figure 5: Big bracket between rails

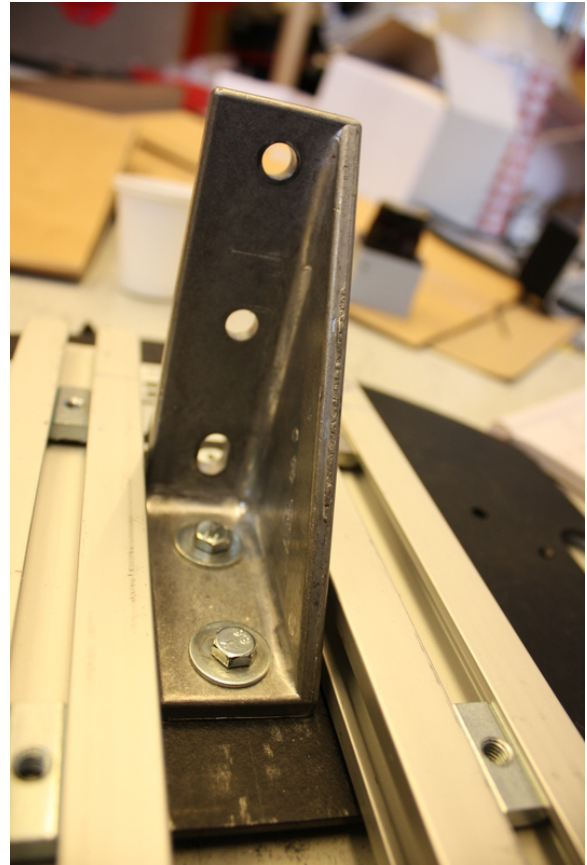


Figure 6: Big bracket zoom up

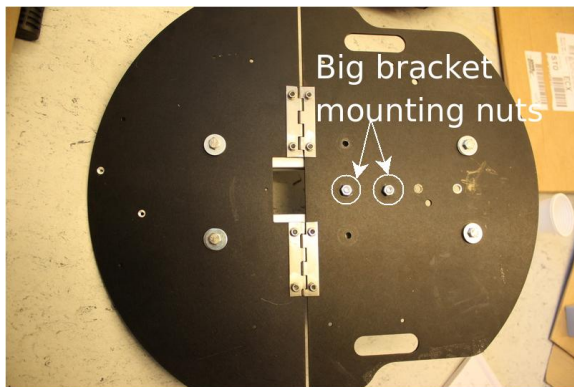


Figure 7: Big bracket mounting nuts



Figure 8: Big bracket mounting nuts zoom up

4. Mount the laser protector on the **long** side of the small bracket using a **spring washer**, a M6x12 **slot screw** (screw with a slot in its head for a screwdriver) and a normal M6 nut (figure 9). Thoroughly tighten this assembly right now! Then slide the right rail (as seen from robot front) back (figure 10) and fix the small bracket to the left rail (there will be a T-nut in place already), using a M6 **hex socket head screw** (figure 11). This type of screw will allow you to later remove the laser protector with a L-hex key without sliding the right

rail back. The long face of the bracket should be inline with the leading edge of the rail. Slide the right rail back into position (figure 12).

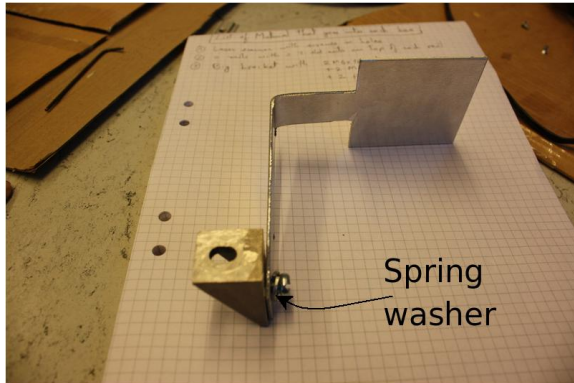


Figure 9: Laser protector assembly

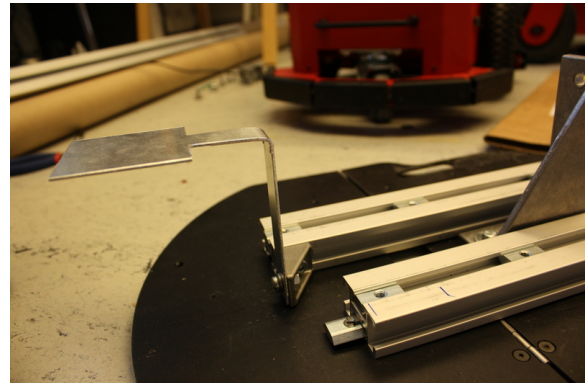


Figure 10: Slide right rail back to get better access for mounting

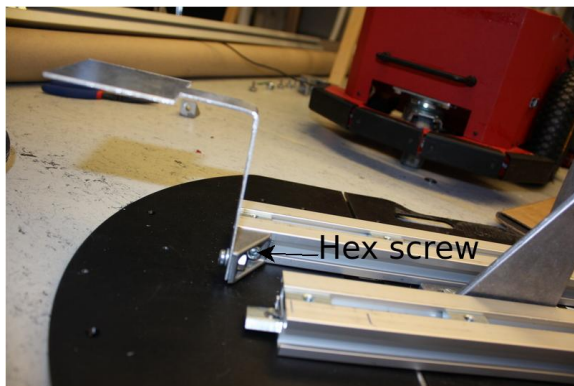


Figure 11: Laser protector mounting

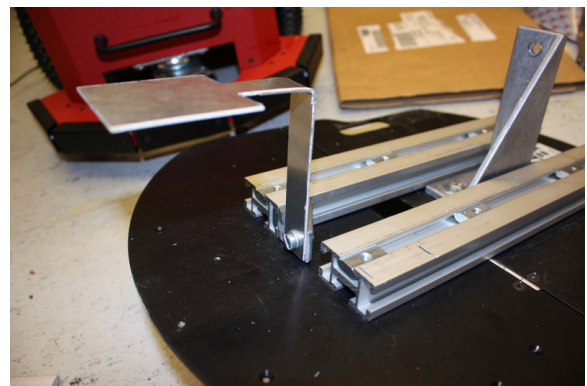


Figure 12: Laser protector final setup

5. Now we assemble the big beam (figure 13). Use M6x16 set screws with 1 penny washer per screw. Make sure the beam is in position as shown in figures 14 and 15. **Push the big bracket as far to the back as you can.** The bracket edges should be parallel to the rails and the bracket must be in the center of the space between the rails. Then tighten the 4 big bracket screws (2 horizontal, 2 vertical) thoroughly. The sides of the big beam should fit flush against the rails. (You may have to jiggle the rails around a bit. This is why we loosened them in step 1). *The rail mounting screws should still be loose at this point.*



Figure 13: Big beam

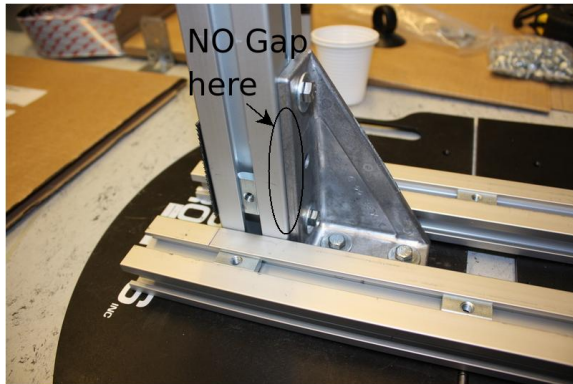


Figure 14: Big beam mounting #1

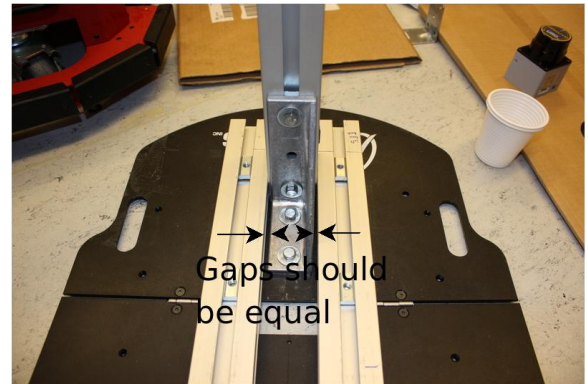


Figure 15: Big beam mounting #2

6. Fix the medium-sized brackets against the sides of the vertical beam using M6x16 set screws and 1 penny washer per screw (figures 16 and 17). Ensure that all surfaces fit flush against each other. First tighten the vertical screws (bracket to vertical beam) on both sides. Then tighten the horizontal screws (bracket to rails)

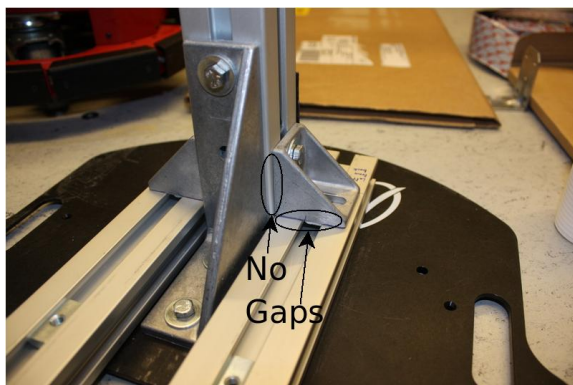


Figure 16: Mounting of medium brackets #1

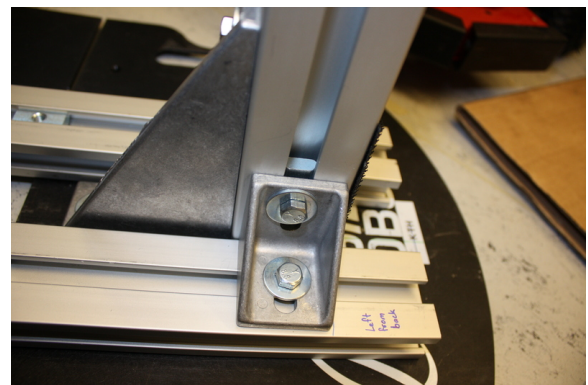


Figure 17: Mounting of medium brackets #2

7. Now check the relative positions of the beam and rails. The rear end of the rails should be 50mm from the extreme rear point of the top plate (figure 18). The rear end of the vertical

beam should be 45mm from the rear end of the rails (figure 19). These locations are important for later mounting of the robot arm. If they are not so, move the rails a bit, fiddle with however much the big bracket can be moved and reach these positions. Then tighten the mounting screws of the rails.

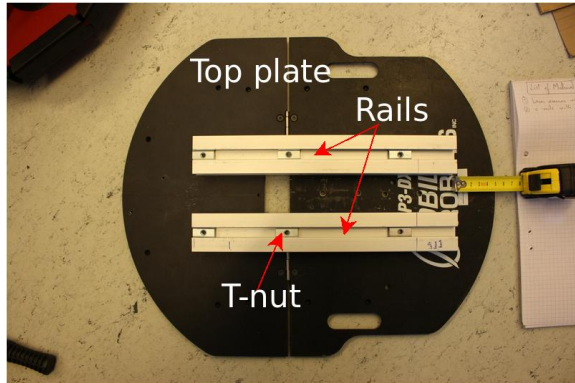


Figure 18: Rails location on plate

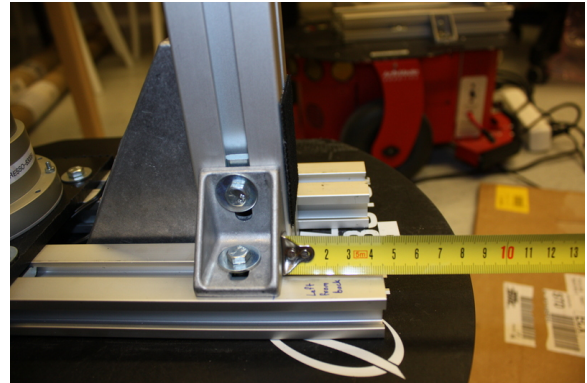


Figure 19: Vertical beam location

8. Mount the laser. It already has 2 M3x6 screws in its mounting holes. Remove them and mount the laser on the top plate using the countersunk holes provided at the front of the top plate (figure 20). **Check that the laser is oriented correctly.** A correctly oriented laser will have the connection ports to the left, when the robot is viewed from the front (figures 22 and 23). The mounted laser is shown in figure 21.

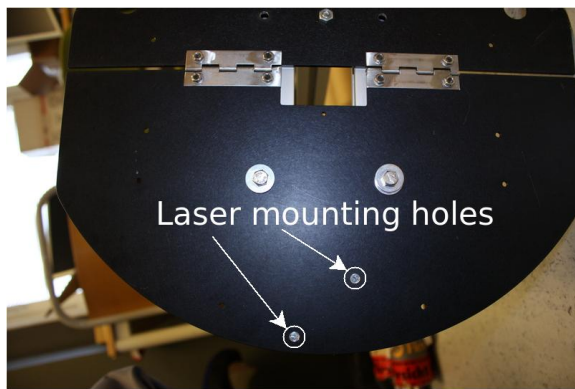


Figure 20: Laser mounting holes (bottom side of top plate)

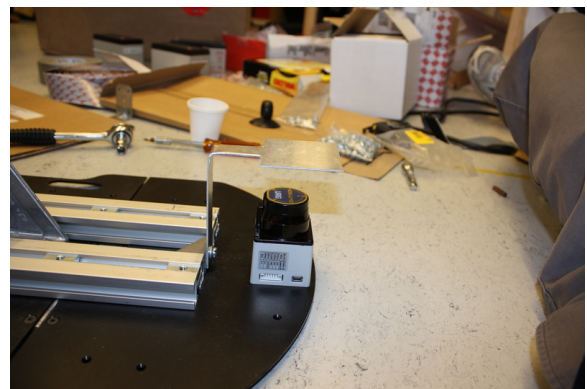


Figure 21: The mounted laser

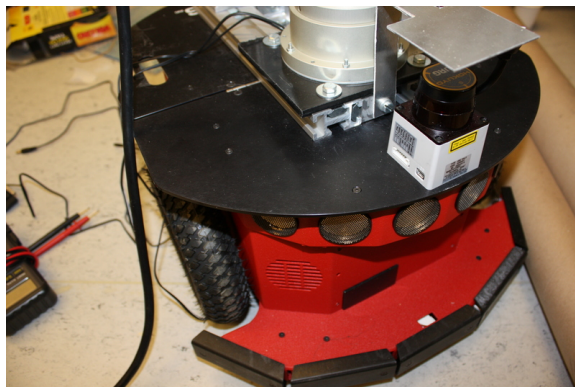


Figure 22: Correct laser orientation



Figure 23: Zoom of correct laser orientation

9. Next, fix the 2 power supply cables with the 2.1mm power plugs at one end and red/blue cable shoes at the other end (figure 24). Make sure you attach the polarities properly. Red is positive, blue is negative. Once you fix the cable shoes, loop the cables around stud shown in the figure and tie it there with a knot. This will ensure that if someone pulls at the cables later on, the knot will take the load and the cable shoes will not slip off from the connections.

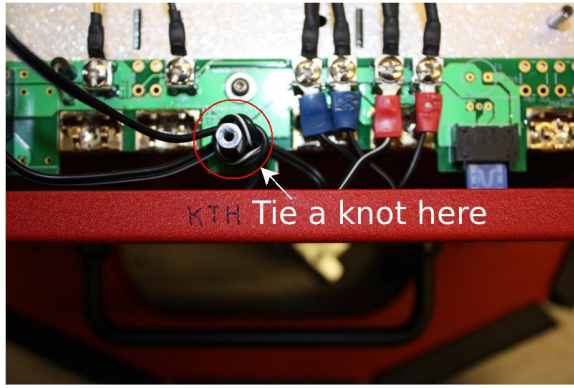


Figure 24: Power cable attachment

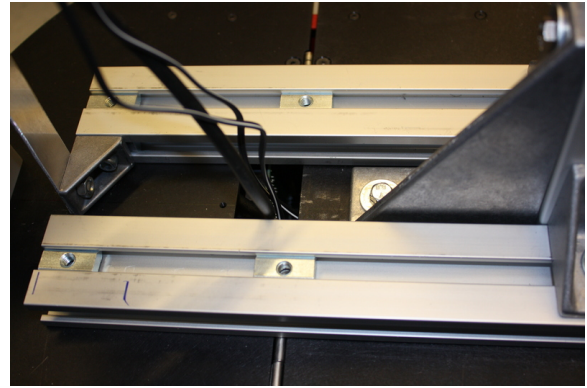


Figure 25: Cables come out from there

10. Now fix the robot top plate back on the robot. The power cables and the laser cable should come out from the square hole near the hinge on the top plate (figure 25).

5 The top beam assembly

The top beam is the 35cm long beam included in the package. We will fix this beam horizontally at the top of the vertical beam. A plate will be mounted on the top beam to place a laptop on. We recommend you use heavy duty Velcro to stick your laptop to this top plate.

1. Fix a medium bracket 92mm away from one end of the top beam, on a wider face (figure 26). The bracket's vertical face should be facing as shown in figure 26. The bracket should be fixed with a M6x16 set screw with 1 penny washer. **Ensure that the bracket is at the center of the slot in the beam and bracket edges are parallel to the beam edges!** (figure 27)

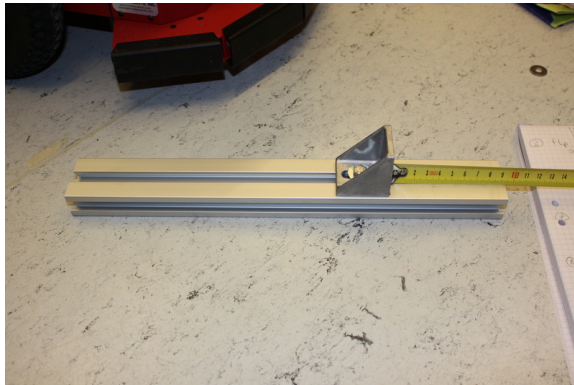


Figure 26: Bracket for top beam mount



Figure 27: Bracket positioning

2. Fix the top beam to the vertical beam as shown in figure 28. Use a M6x16 set screw and 1 penny washer. Ensure that the sides of top beam are flush with the sides of the vertical beam,

and the top beam isn't inclined or tilted in any way. It should be perfectly perpendicular to the vertical beam. This will be so if the bracket is fixed properly to both beams (figure 29).

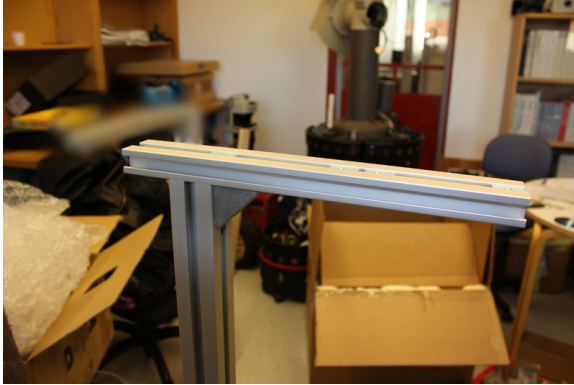


Figure 28: Placement of top beam



Figure 29: Bracket mounting of top beam

3. Now we will fix the top plate and PTU unit base plate to the top beam. **THE INSTRUCTIONS FOR DOING THIS ARE PROVIDED IN THE SUBSEQUENT POINTS.** The finished assembly will look as shown in figures 30 and 31



Figure 30: Top plate and PTU base plate on top beam

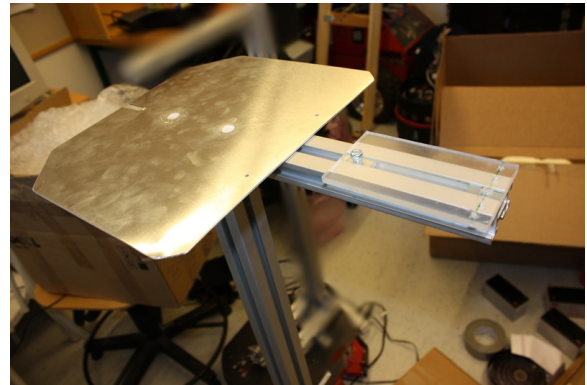


Figure 31: Top and PTU plates

4. The top plate is fixed using 2 white Nylon countersunk M6x6 screws. The plate is positioned such that the rear edge of the plate is 70mm away from the rear face of the top beam (figures

32 and 33).

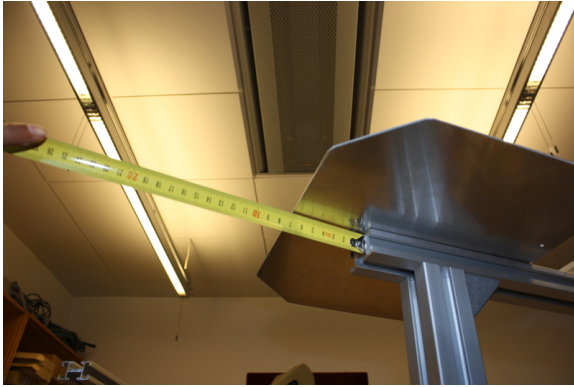


Figure 32: Position of top plate

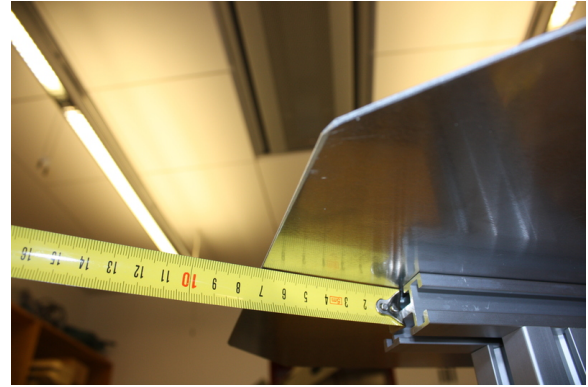


Figure 33: Zoom of top plate position

5. The PTU base plate is mounted using a **M6x12 slot screw** at the rear end and a **M6x16 slot screw** at the front end. To fix the PTU plate, position it such that the front edge is flush with the front edge of the top beam (figure 34). Then put a M6x12 slot screw in the rear hole, and an M6x16 slot screw in the front hole. Tighten both screws till they enter the nut in the beam slot below. This orients the PTU plate properly. Then, **tighten the rear screw completely. Only the rear screw** (figure 35). Remove the front screw from the front hole.

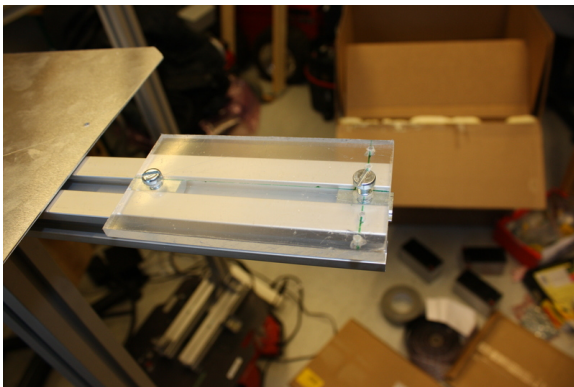


Figure 34: PTU base plate position

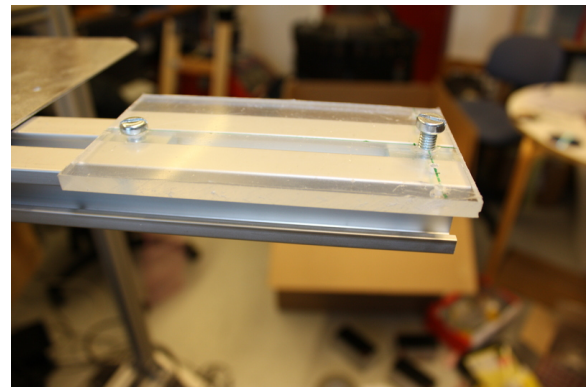


Figure 35: PTU base plate mounting

6. Fix the PTU unit using the hole at the front of the PTU base plate with a **M6x16 slot screw** and a **spring washer** (figures 36 and 37). You should have received the PTU with an L-bracket already mounted on it. The side edges of the PTU should be parallel to the edges of the top beam. *Since the PTU is mounted using a single screw and spring washer, this is your chance to orient it such that faces the front of the robot properly, regardless of any positioning errors you made in the previous assembly.*

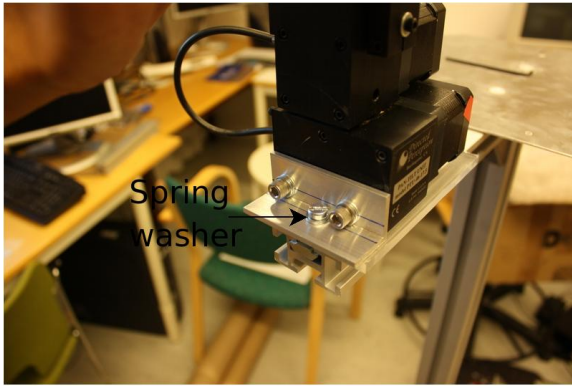


Figure 36: PTU mounting #1

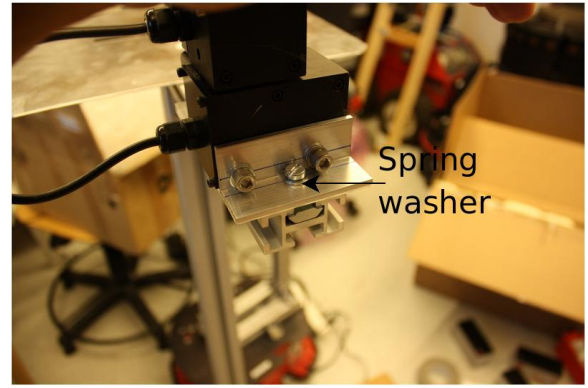


Figure 37: PTU mounting #2

7. Attach two cameras to the stereo base plate using 1 $\frac{1}{4}$ UNCx25 screw and 06 penny washers per camera (figures 38 and 39). The cameras must be mounted on the side of the stereo plate which has a slot in it. The flat part of the stereo plate will rest against the mounting flange on the PTU. *There are two types of stereo mounting plates. One with multiple mounting holes has been sent to you. The other, with a continuous groove (instead of multiple mounting holes) will be sent to you soon.*



Figure 38: Camera mounting (front view)

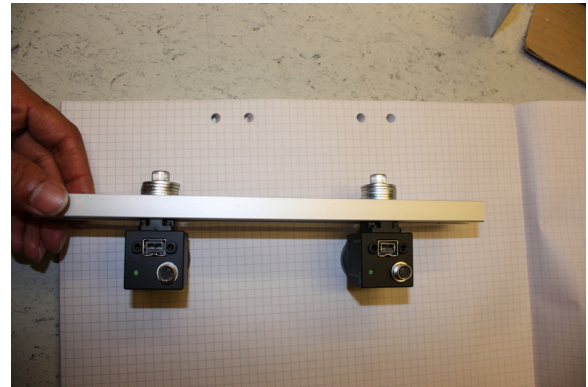


Figure 39: Camera mounting (rear view)

8. Fix the stereo plate to the flange of the PTU using a **M6x12 slot screw** and **standard M6 nut** (figures 40 and 41). *Tighten sufficiently that the nut does NOT hit the PTU unit throughout the full range of the tilt motion.*



Figure 40: Stereo camera mounting. Front view

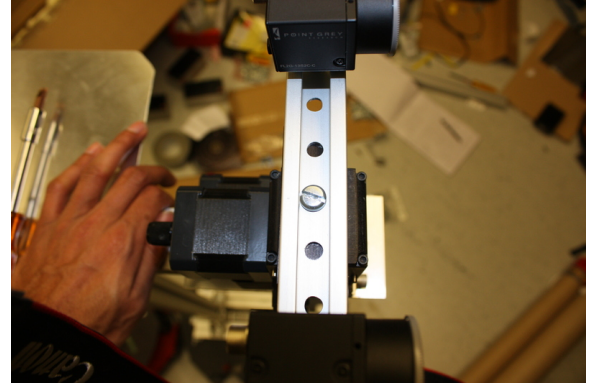


Figure 41: Stereo camera mounting. Top view

6 Mounting the laptop holders

Two laptop holders can be fixed to the rear face of the vertical beam. Each (figure 42) can hold a laptop (with its lid closed). While some effort has been made to make everything as smooth as possible, we recommend using something like a sheet of bubblewrap stuck to the laptop holder plates, so that your laptops don't get scratched. Use the Velcro band to fix the laptop to the vertical backing plate of the laptop holder.

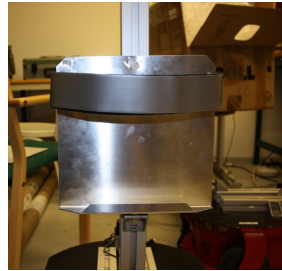


Figure 42: Laptop holder

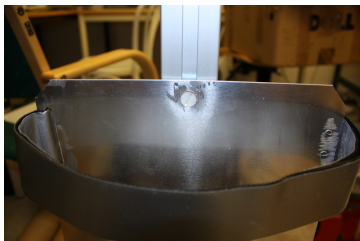


Figure 43: Fixing laptop holder to vertical beam



Figure 44: Supporting bracket at bottom of laptop holder

1. First fix a medium bracket to the vertical beam using a **M6x16 set screw and penny washer** (figure 44). The laptop holder will rest on this bracket. The lower you fix the bracket, the more stable will the platform be.
2. Use a **white Nylon M6x6 countersunk slot screw** to fix the laptop holder to a T-nut in the vertical beam (figure 43). Again, the laptop holder should rest on the bracket you just mounted.
3. You may attach one more laptop holder if you feel that you will need it. With two laptop holders, the robot will look as shown in figure 45 from the rear



Figure 45: Rear view with 2 laptop holders

7 Mounting the katana arm

The black base plate for the katana arm is already fixed on the rails using 4 set screws. Remove it and fix the katana arm on it using 6 M3x25 screws and nuts. (These are not included in the fasteners you have received).

Then, fix the base plate back on the rails (figure 46). There should be a gap of at least 5mm between the katana arm (when it is in the configuration shown in figure 46) and vertical beam as shown in the figure (47)



Figure 46: Katana arm mounting

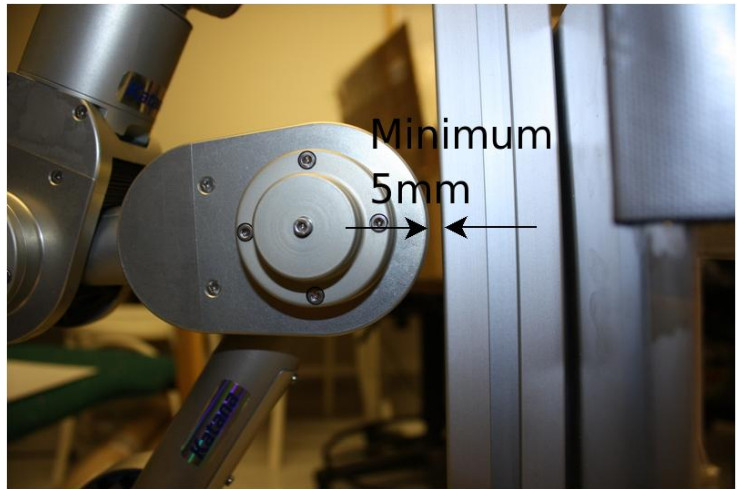


Figure 47: Gap between arm and vertical beam

8 Mounting of PTU controller box and firewire hub

2 sets of 50x60mm heavy duty velcro patches are provided. These can be used to fix the PTU controller box and firewire hub to the superstructure. The velcro holds 7kg load on a vertical surface for at least 1000 detachments. So it is good enough for our purposes. The location of the boxes is shown in figure 48. The firewire hub is mounted on the PTU controller box.

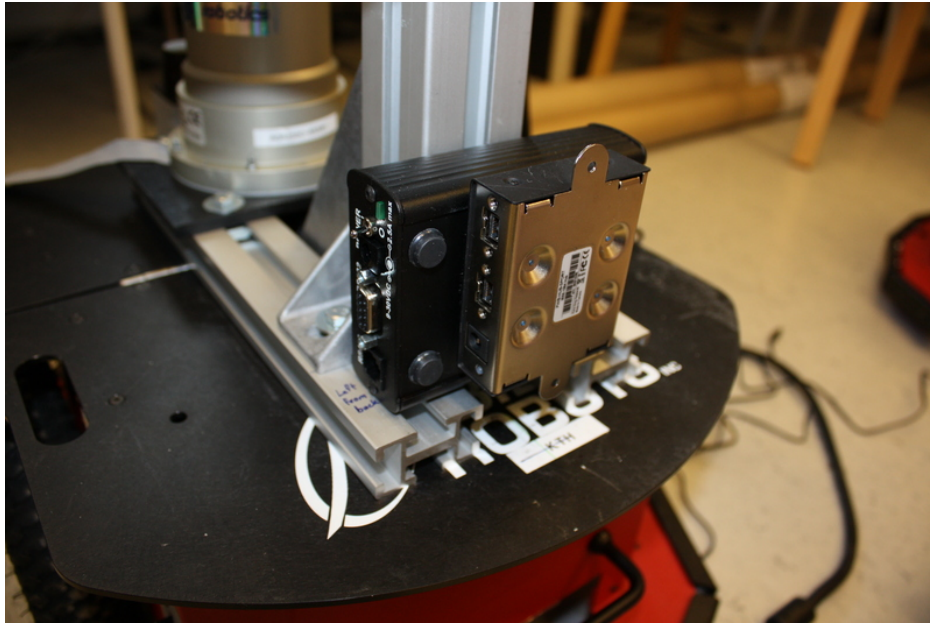


Figure 48: Mounting of firewire hub and PTU controller