

1 USV position

1.1 Uncontrolled

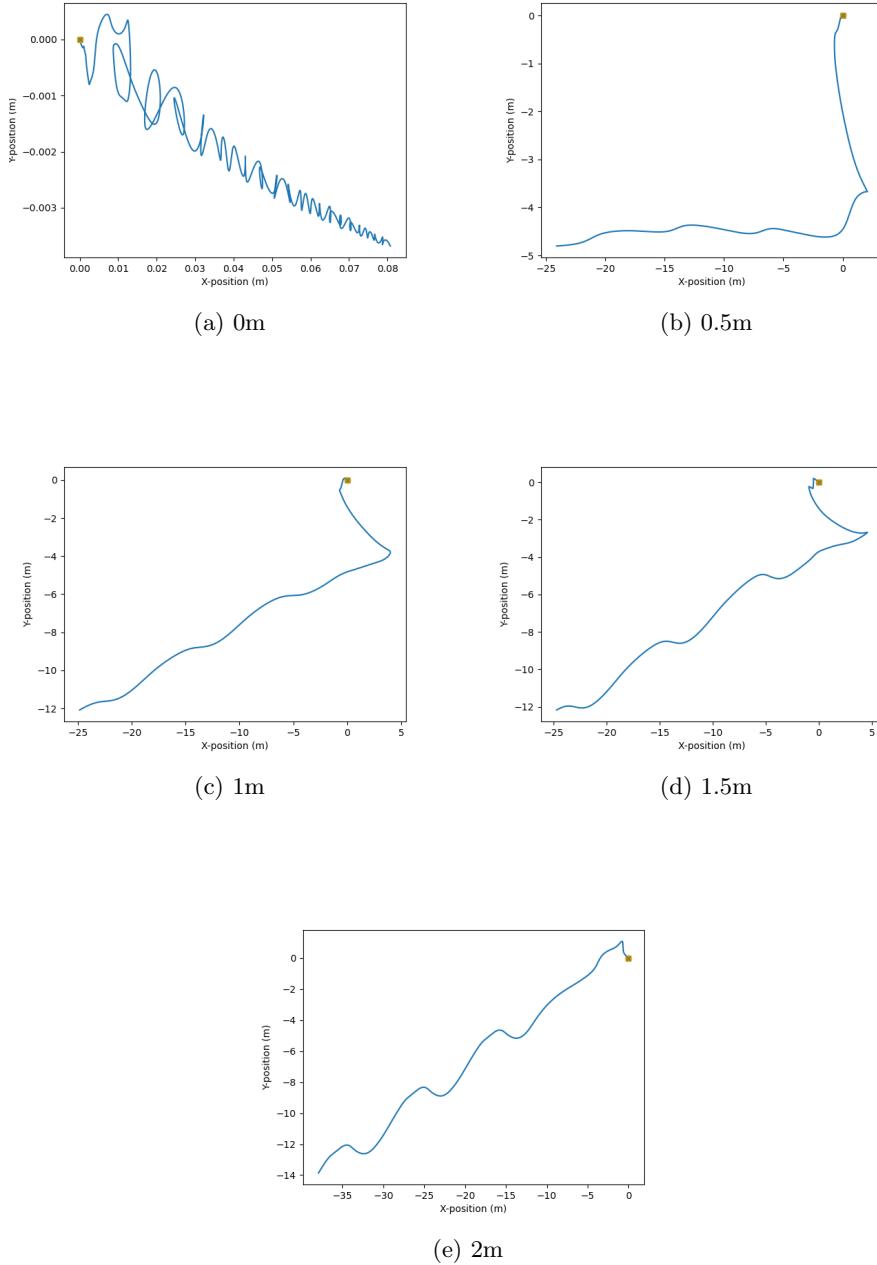


Figure 1: USV position over time at different wave heights, ROV at 0m

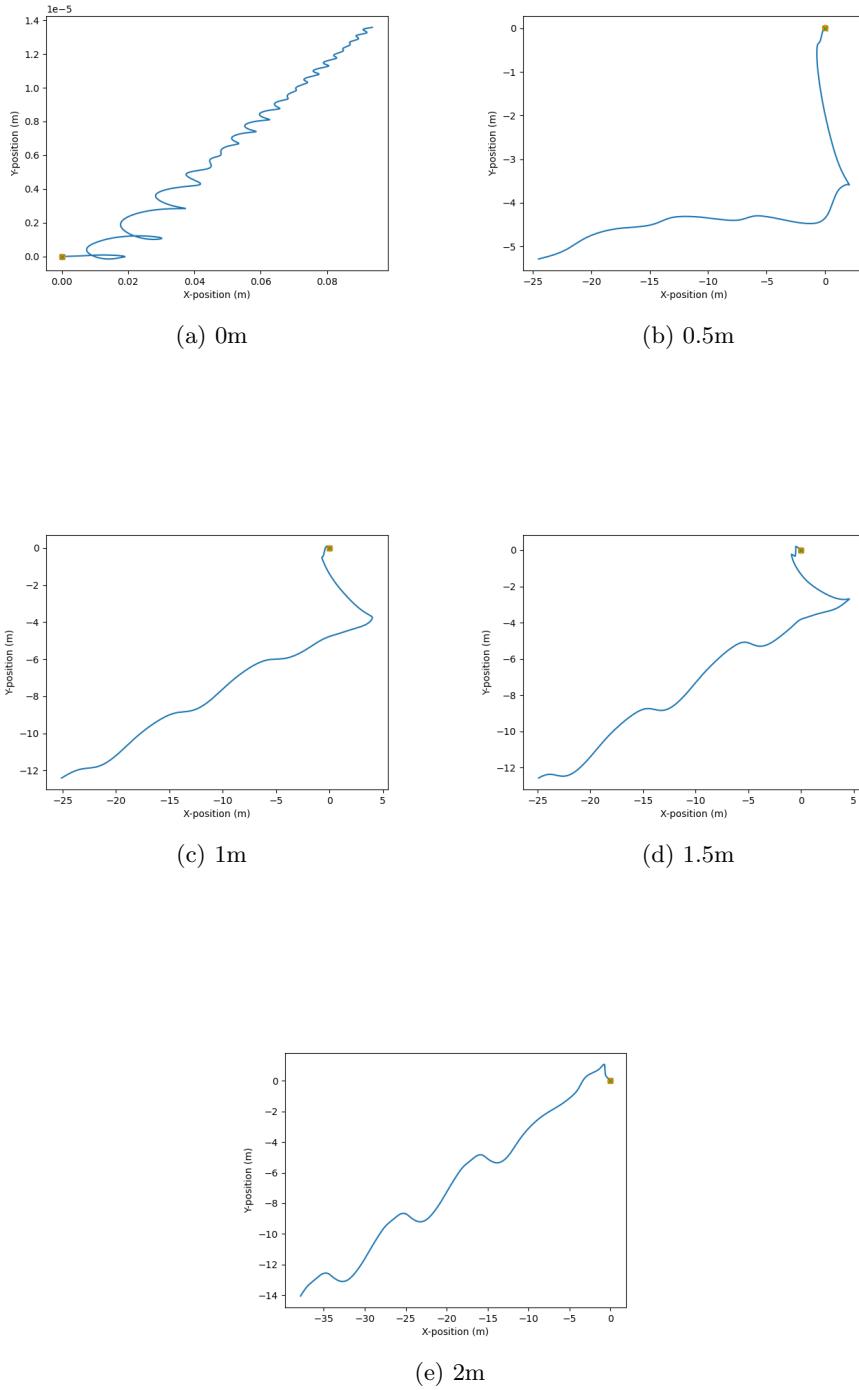


Figure 2: USV position over time at different wave heights, ROV at 50m

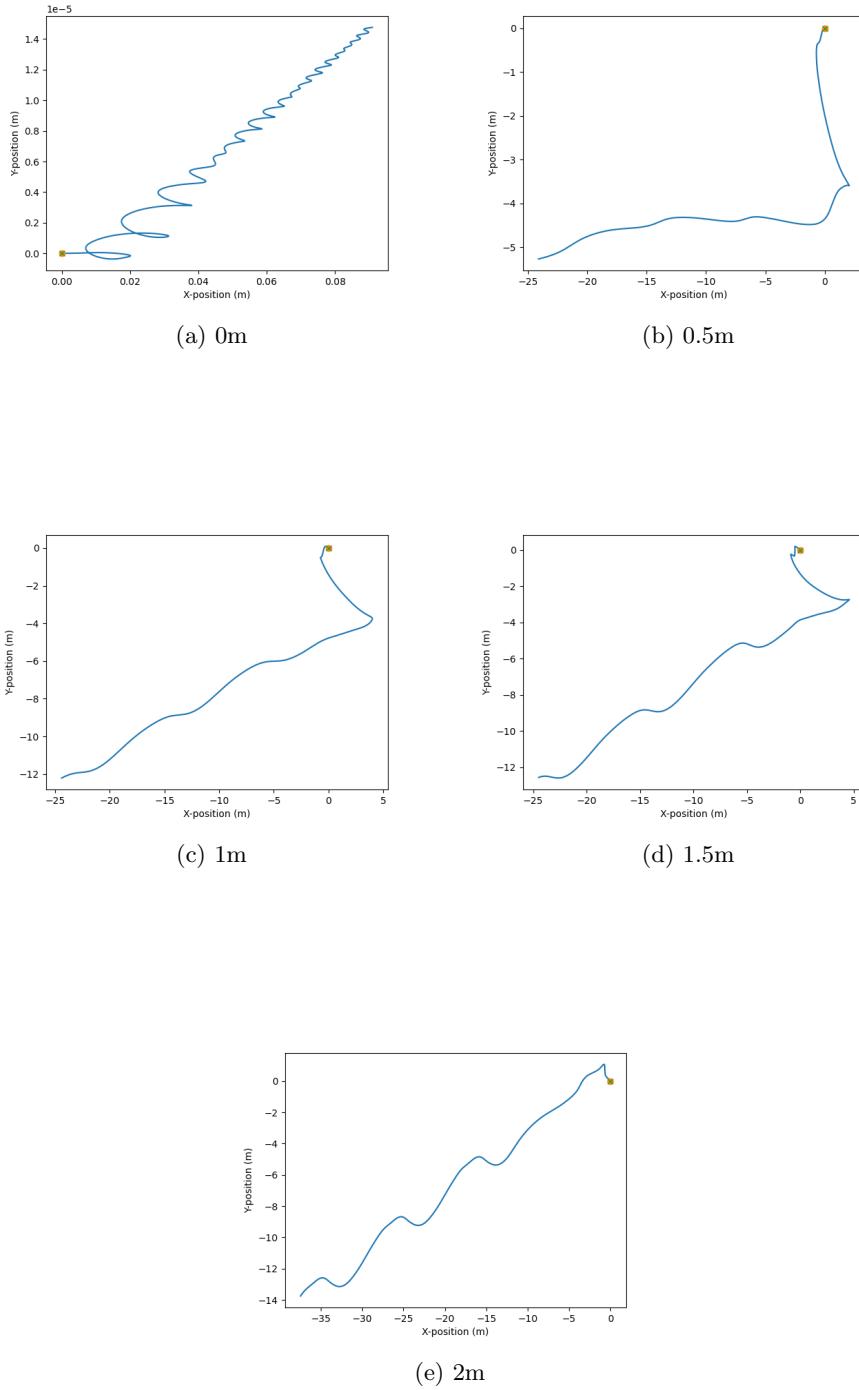


Figure 3: USV position over time at different wave heights, ROV at 100m

1.2 Controlled

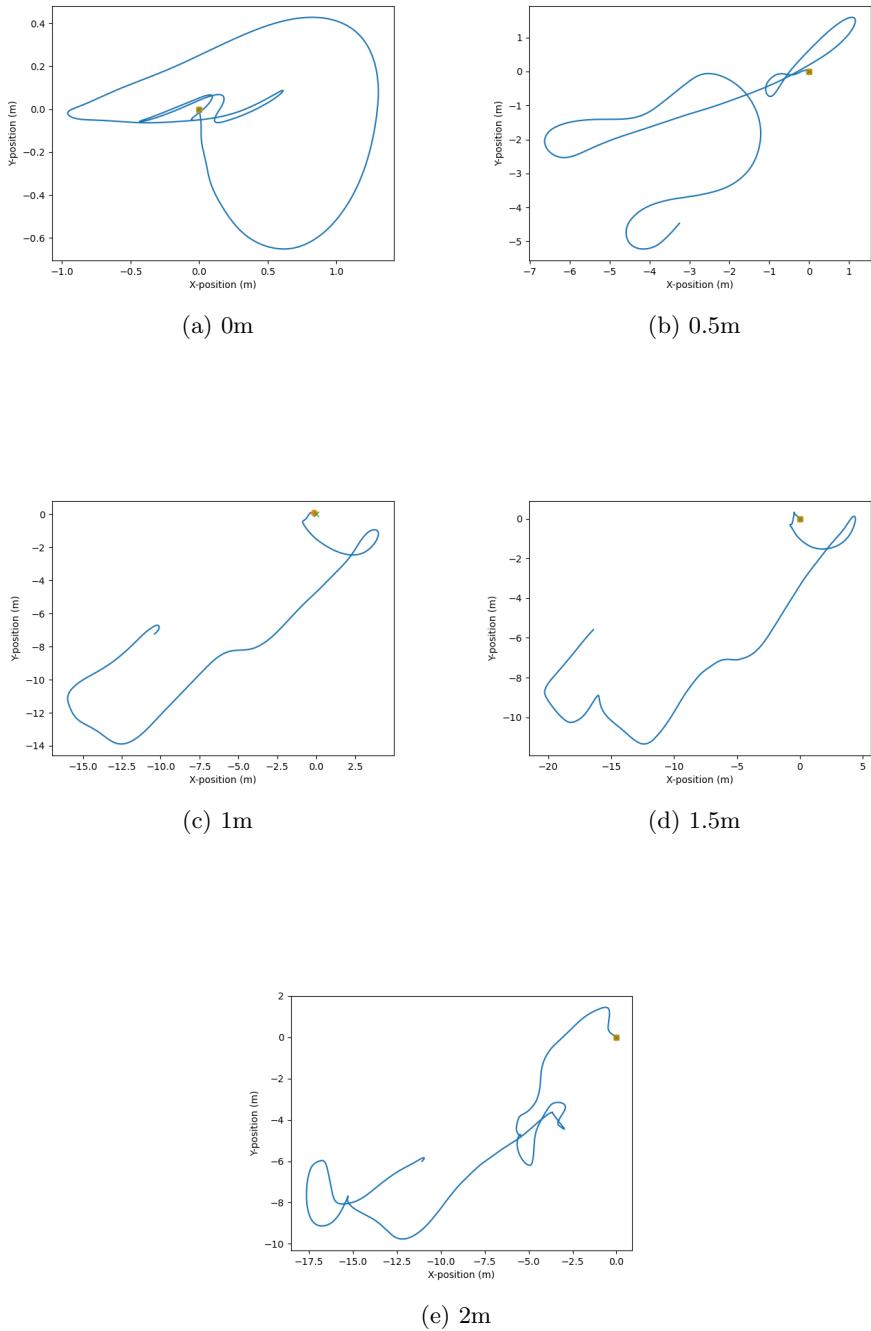
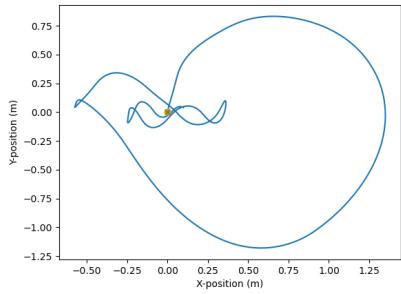
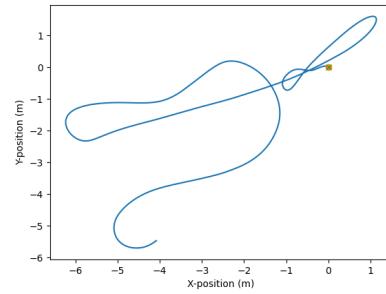


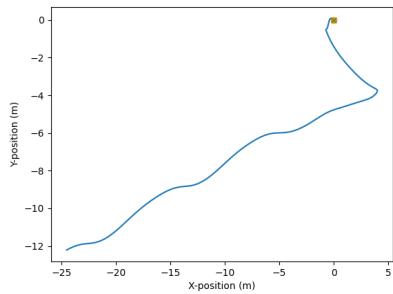
Figure 4: USV position over time at different wave heights, ROV at 0m



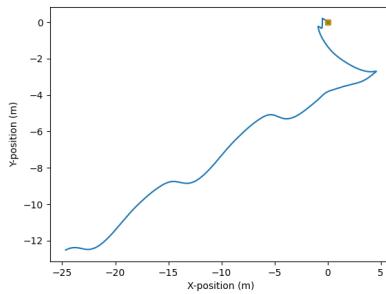
(a) 0m



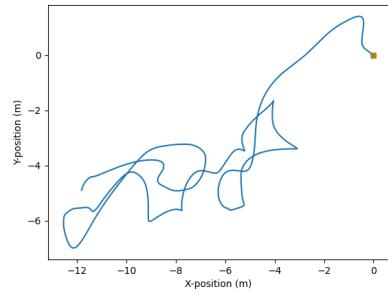
(b) 0.5m



(c) 1m

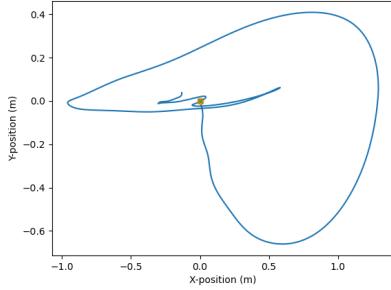


(d) 1.5m

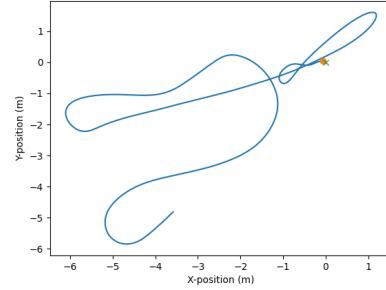


(e) 2m

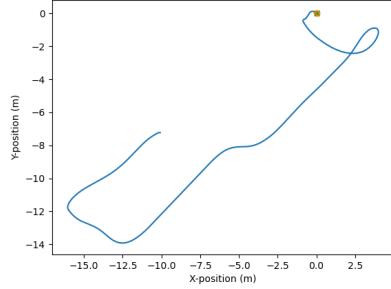
Figure 5: USV position over time at different wave heights, ROV at 50m



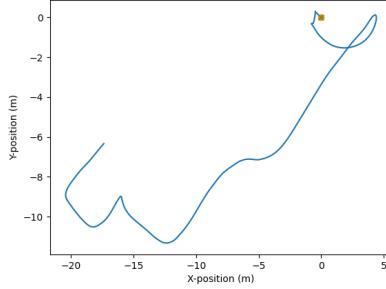
(a) 0m



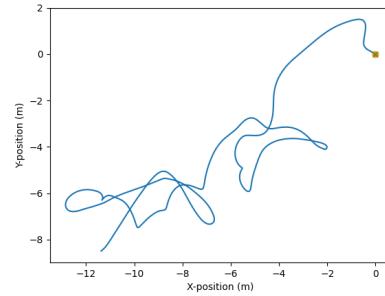
(b) 0.5m



(c) 1m



(d) 1.5m



(e) 2m

Figure 6: USV position over time at different wave heights, ROV at 100m

2 USV position errors over time

For the following figures the X- and Y- components of the movement of the USV are shown as blue and yellow respectively.

2.1 Uncontrolled

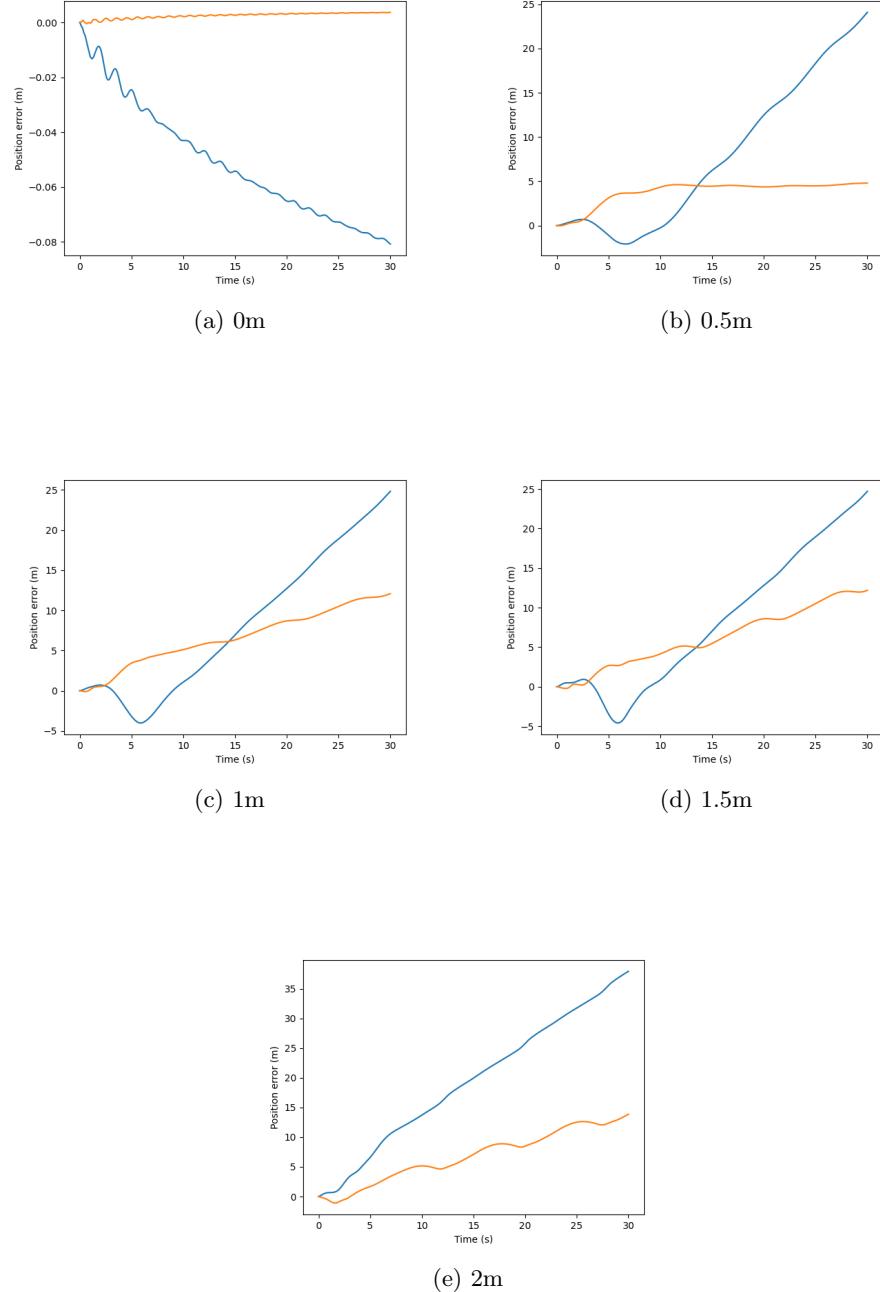
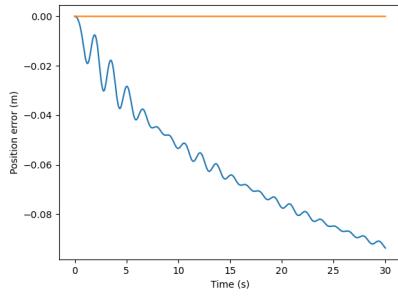
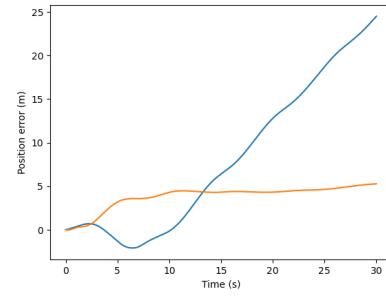


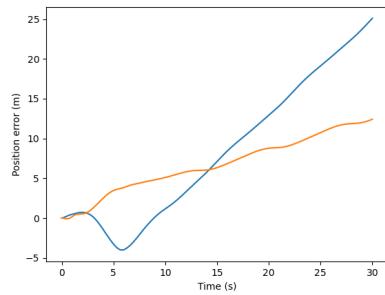
Figure 7: USV position error over time at different wave heights, X-direction as blue, Y-direction as yellow. ROV at 0m



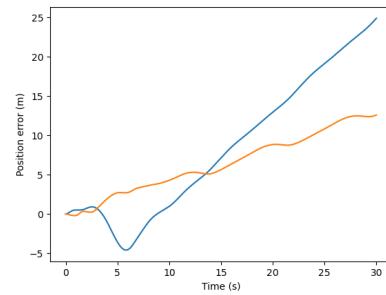
(a) 0m



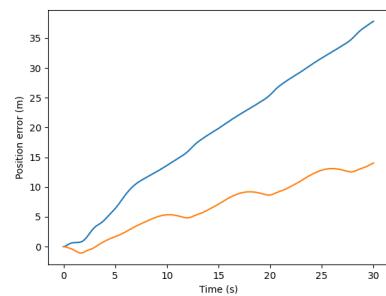
(b) 0.5m



(c) 1m

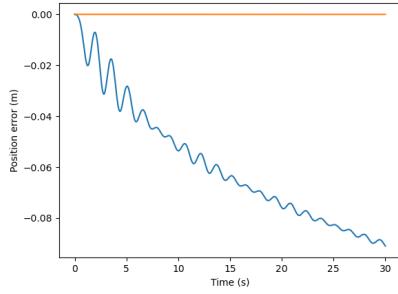


(d) 1.5m

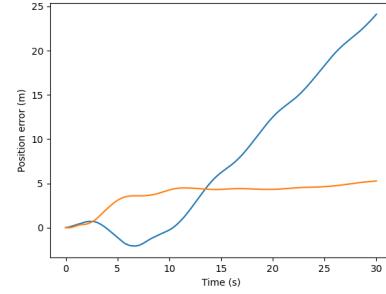


(e) 2m

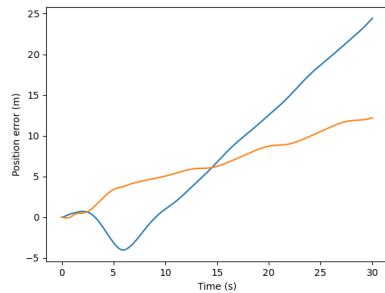
Figure 8: USV position error over time at different wave heights, X-direction as blue, Y-direction as yellow. ROV at 50m



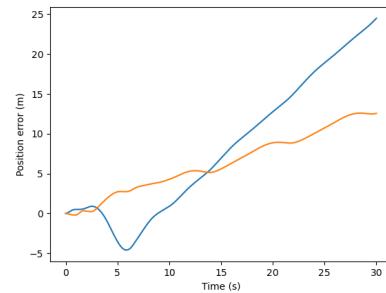
(a) 0m



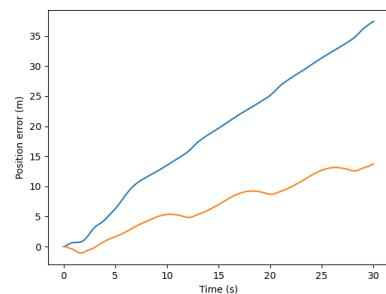
(b) 0.5m



(c) 1m



(d) 1.5m



(e) 2m

Figure 9: USV position error over time at different wave heights, X-direction as blue, Y-direction as yellow. ROV at 100m

2.2 Controlled

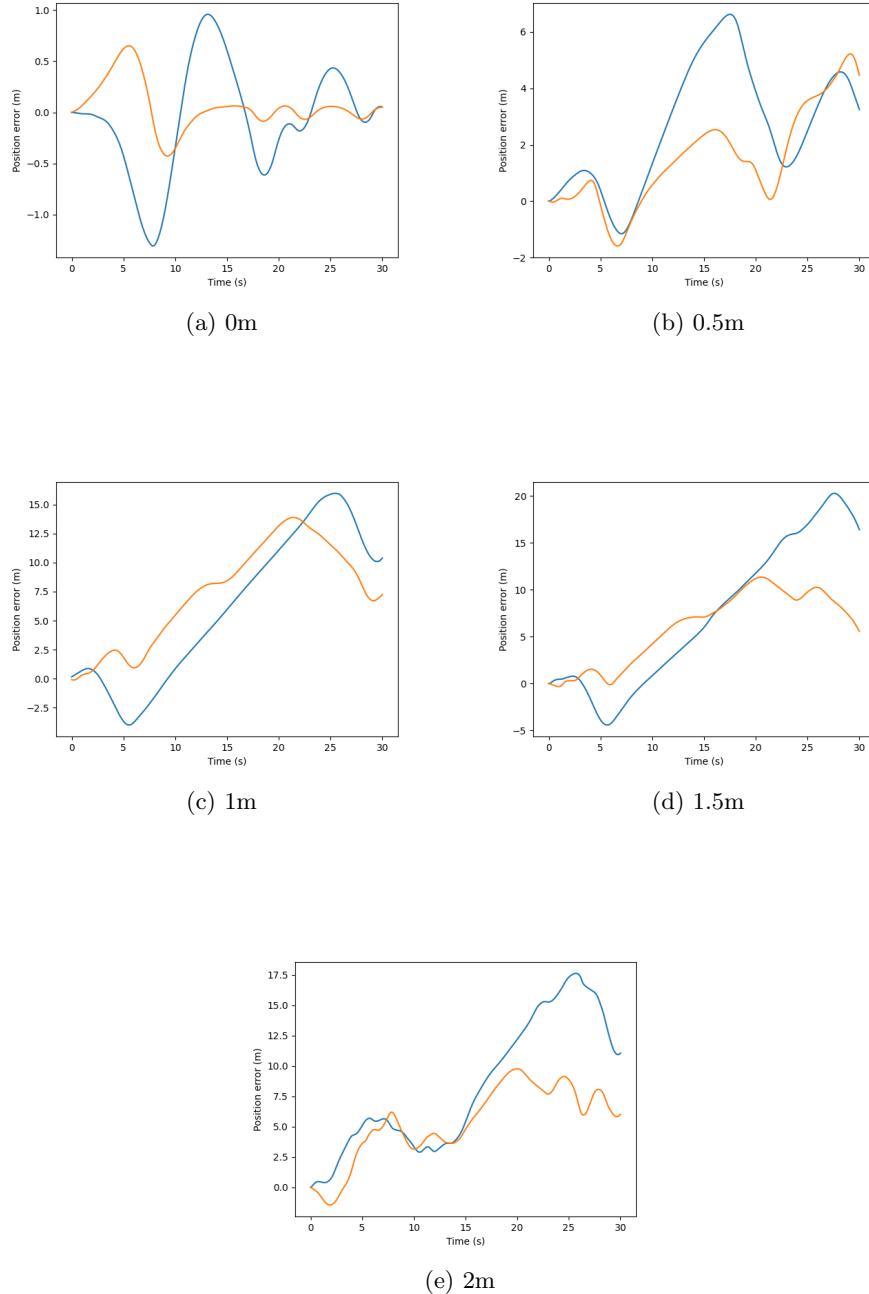
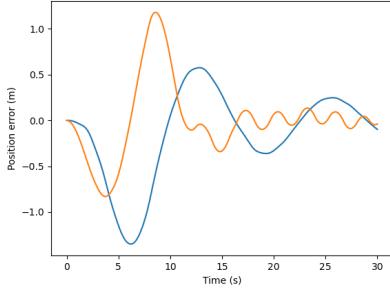
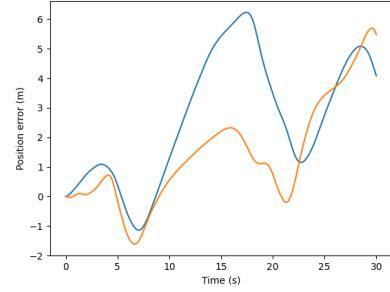


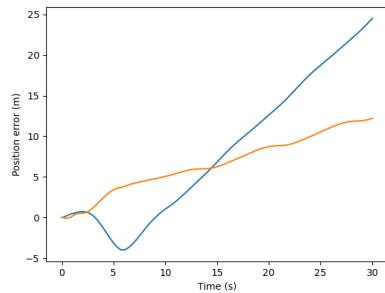
Figure 10: USV position error over time at different wave heights, X-direction as blue, Y-direction as yellow. ROV at 0m



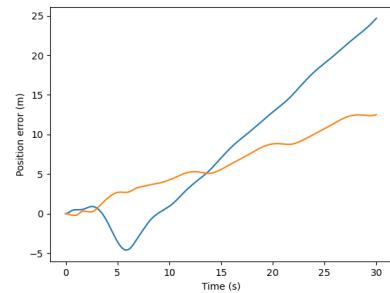
(a) 0m



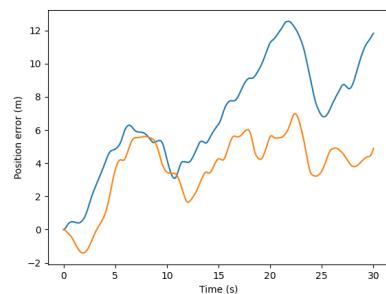
(b) 0.5m



(c) 1m

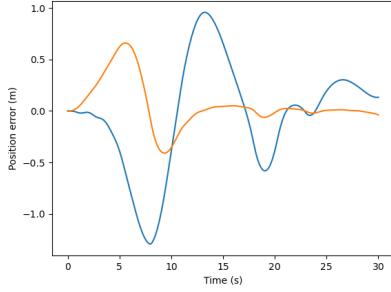


(d) 1.5m

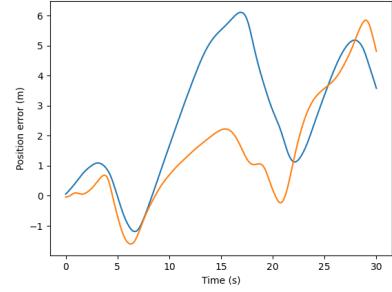


(e) 2m

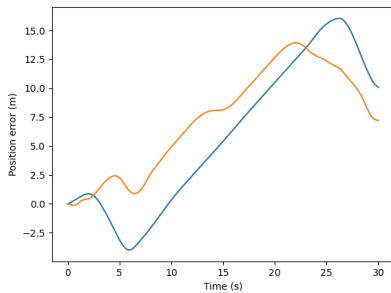
Figure 11: USV position error over time at different wave heights, X-direction as blue, Y-direction as yellow. ROV at 50m



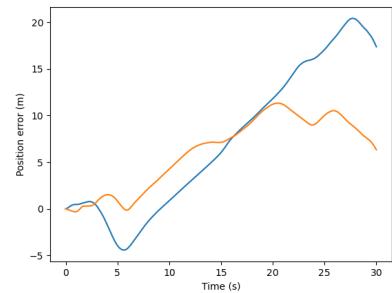
(a) 0m



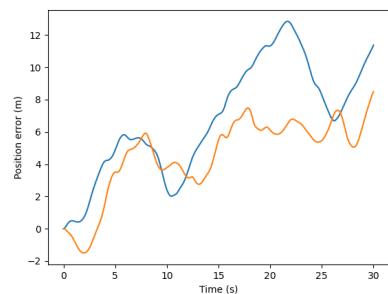
(b) 0.5m



(c) 1m



(d) 1.5m



(e) 2m

Figure 12: USV position error over time at different wave heights, X-direction as blue, Y-direction as yellow. ROV at 100m

3 USV heading error

3.1 Uncontrolled

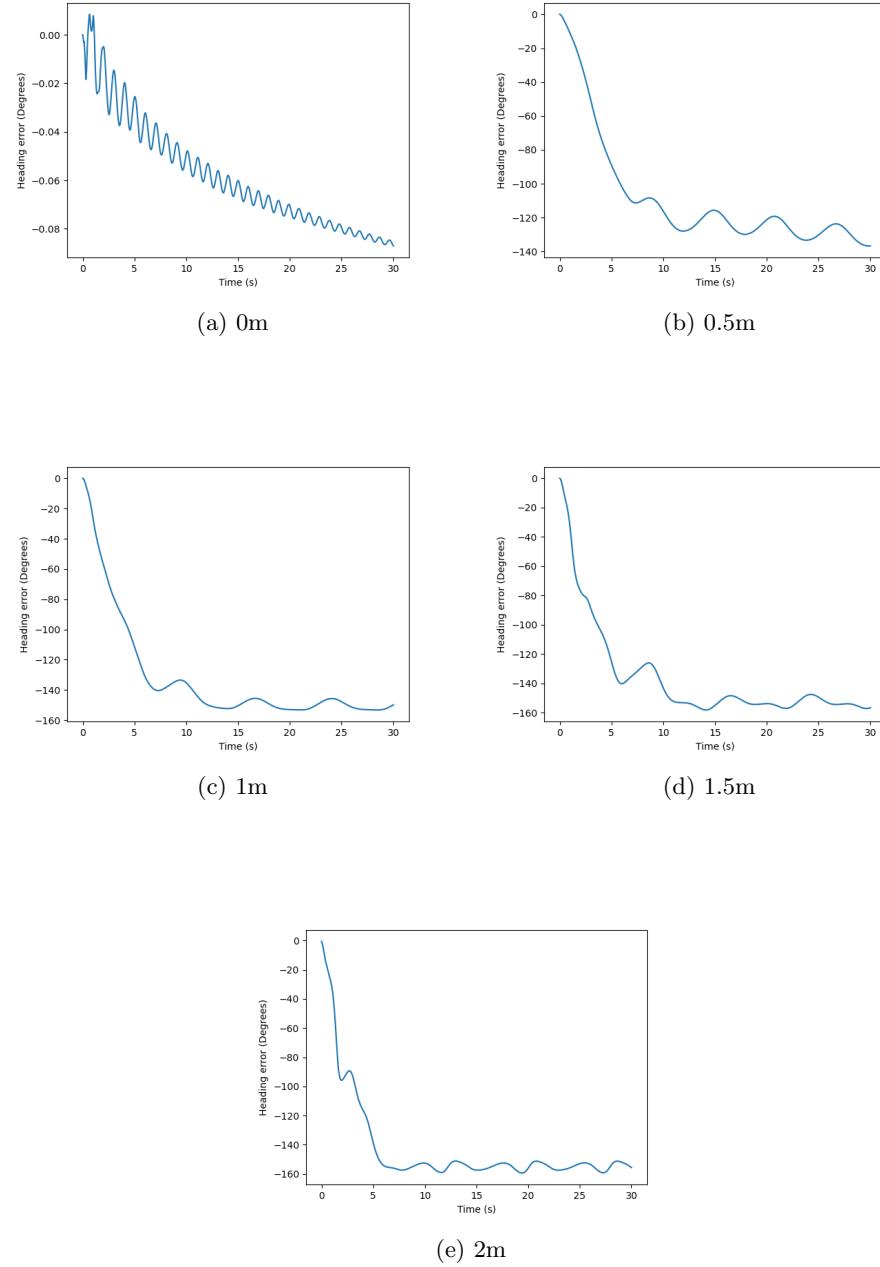


Figure 13: USV heading error at different wave heights, ROV at 0m

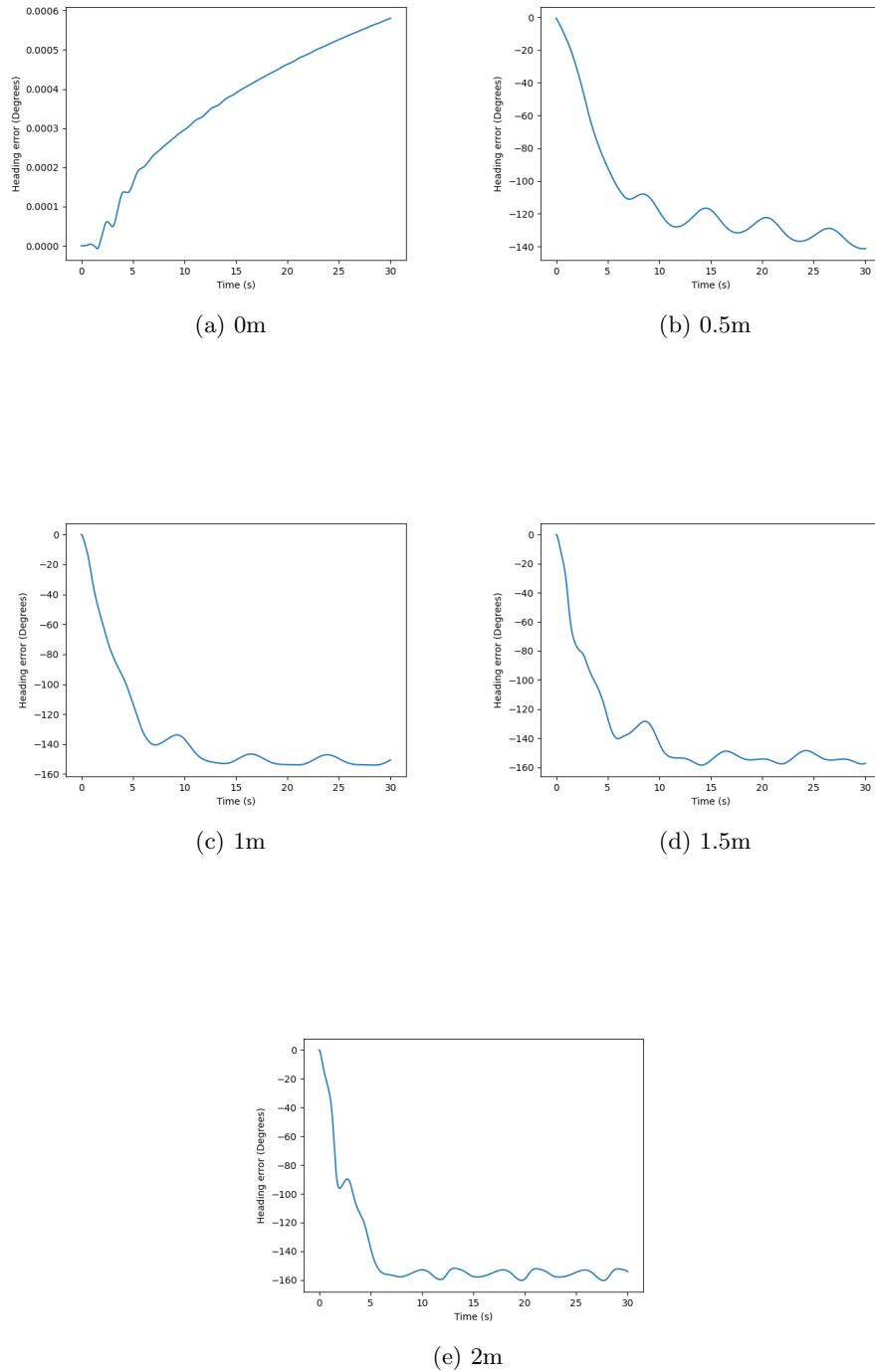
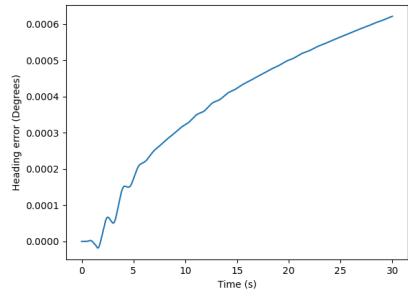
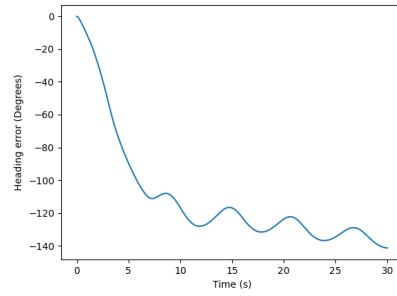


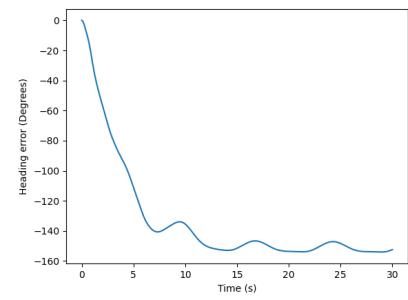
Figure 14: USV heading error at different wave heights, ROV at 50m



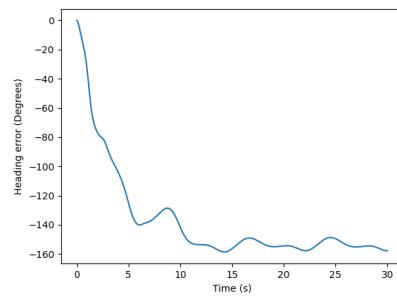
(a) 0m



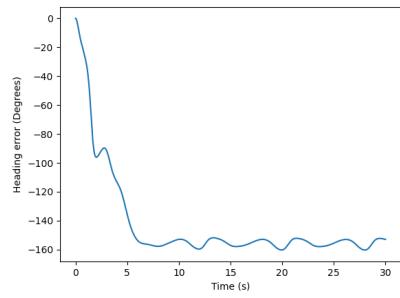
(b) 0.5m



(c) 1m



(d) 1.5m



(e) 2m

Figure 15: USV heading error at different wave heights, ROV at 100m

3.2 Controlled

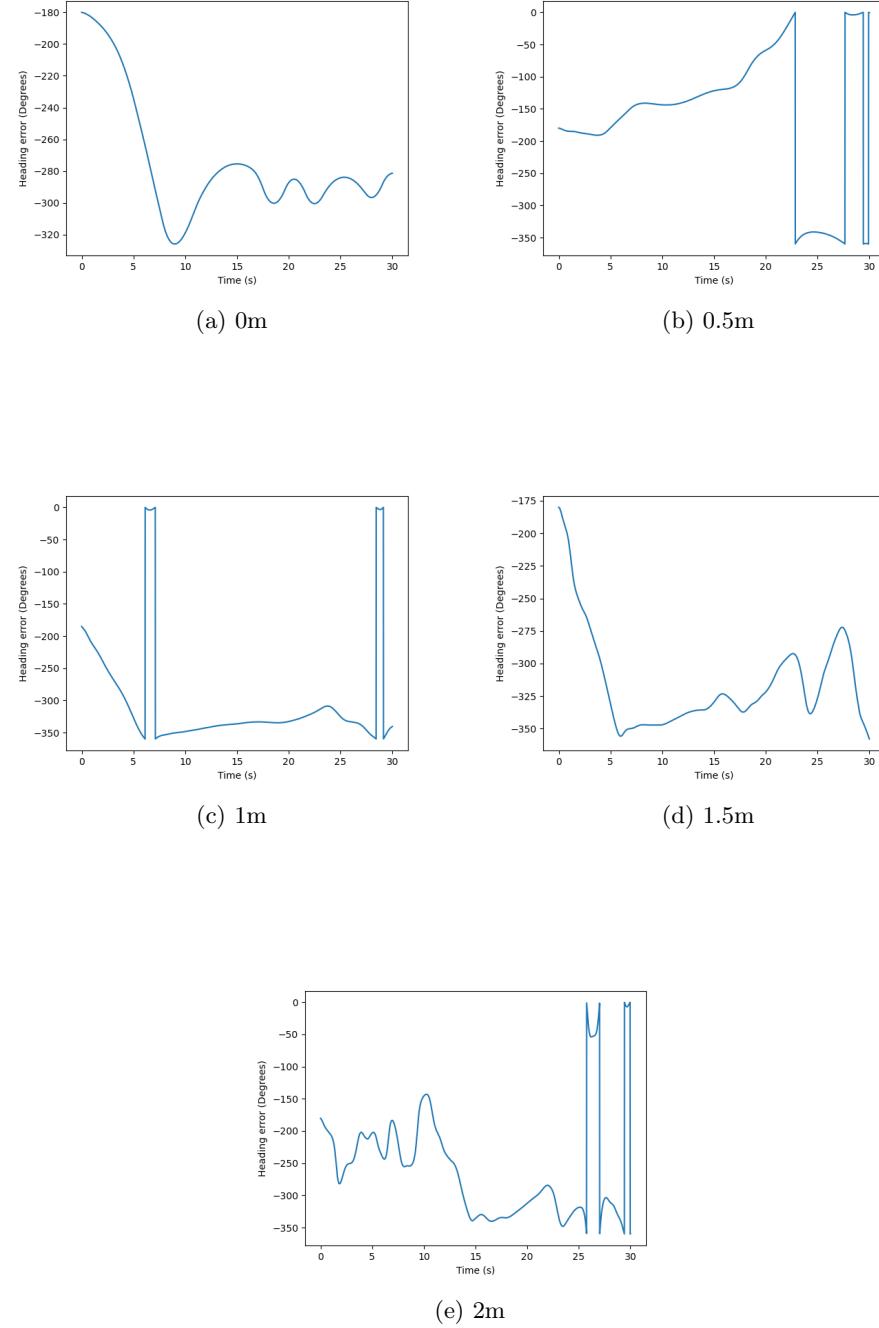
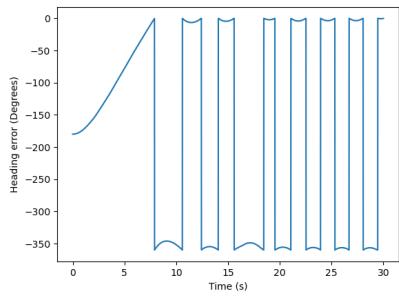
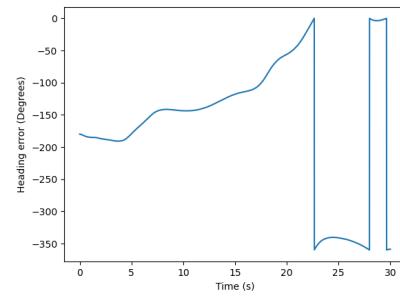


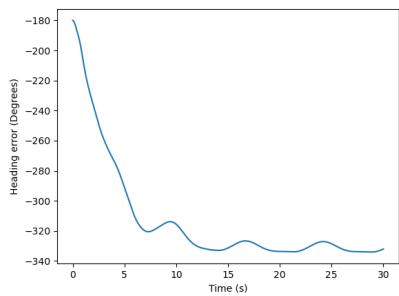
Figure 16: USV heading error at different wave heights, ROV at 0m



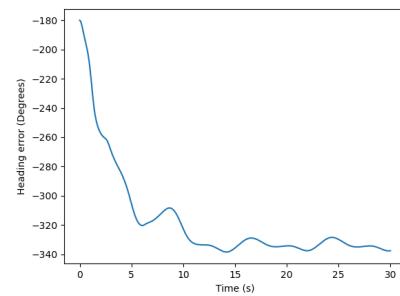
(a) 0m



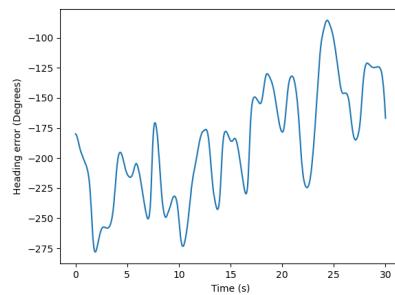
(b) 0.5m



(c) 1m

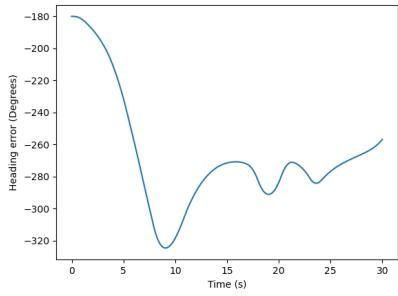


(d) 1.5m

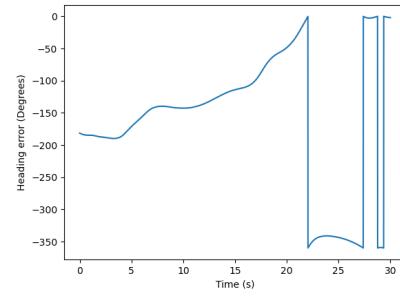


(e) 2m

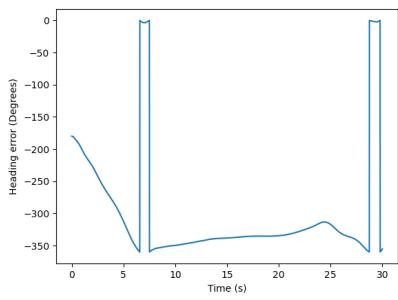
Figure 17: USV heading error at different wave heights, ROV at 50m



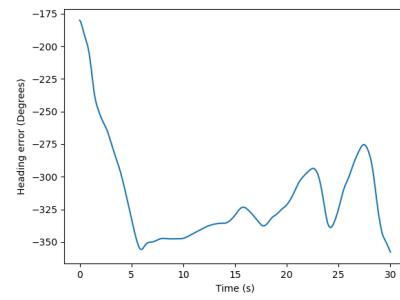
(a) 0m



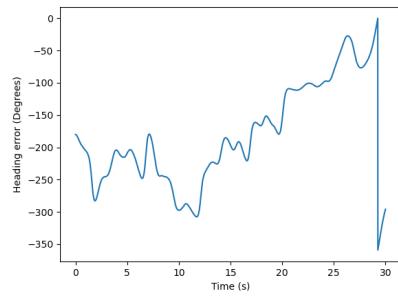
(b) 0.5m



(c) 1m



(d) 1.5m



(e) 2m

Figure 18: USV heading error at different wave heights, ROV at 100m

4 USV applied forces

4.1 Lateral forces

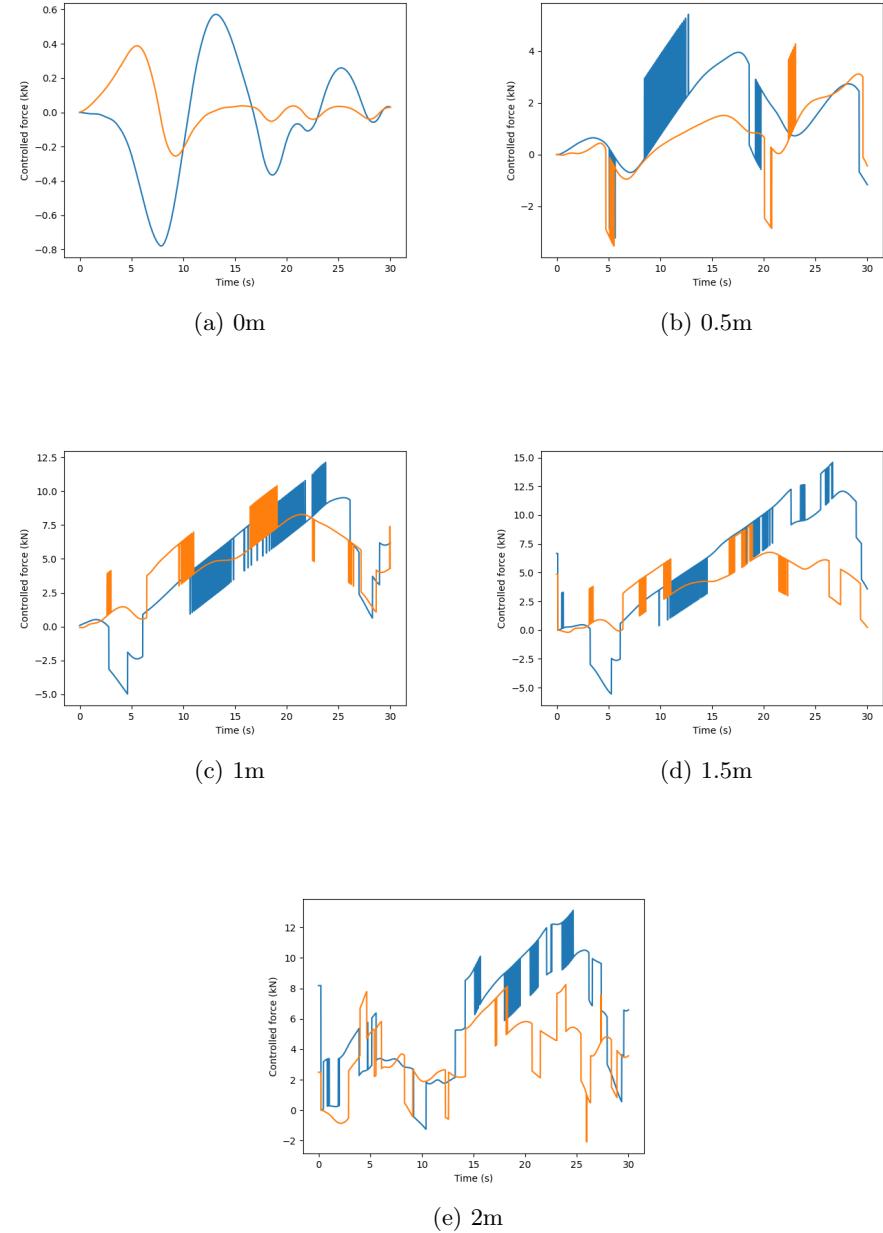
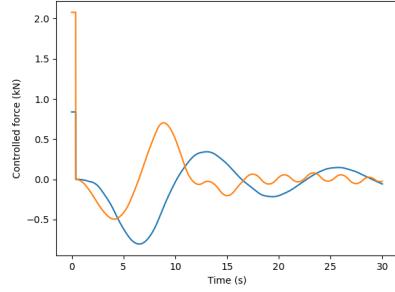
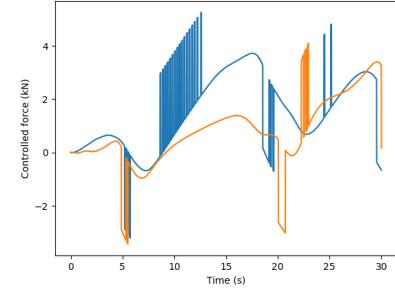


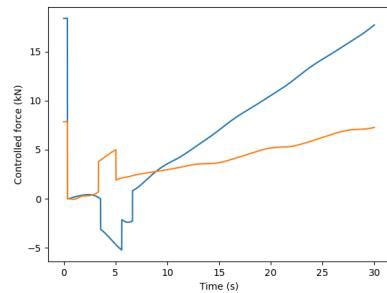
Figure 19: USV lateral forces applied by controller at different wave heights, ROV at 0m



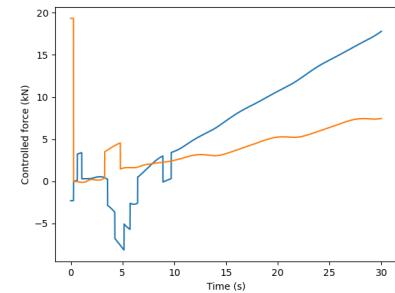
(a) 0m



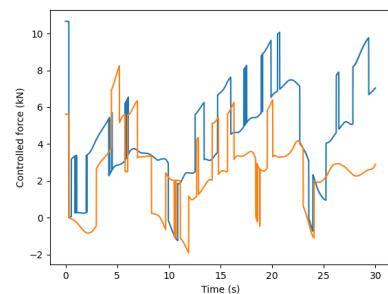
(b) 0.5m



(c) 1m

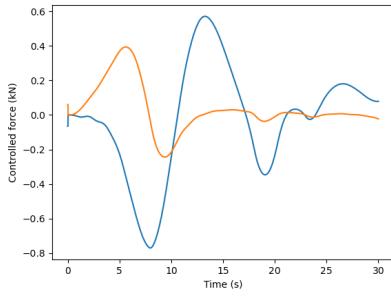


(d) 1.5m

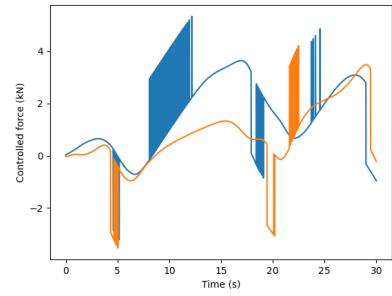


(e) 2m

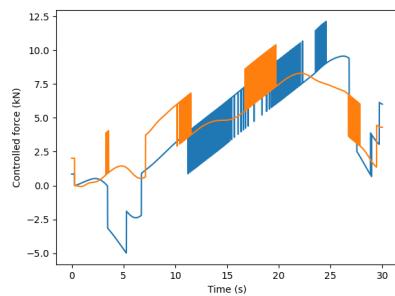
Figure 20: USV lateral forces applied by controller at different wave heights,
ROV at 50m



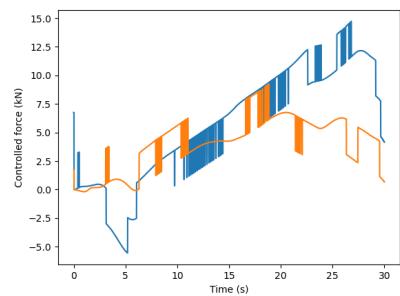
(a) 0m



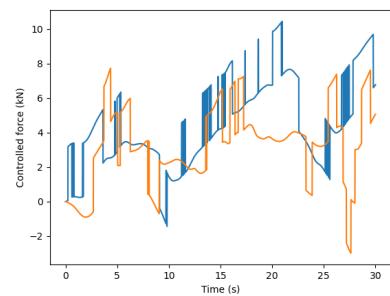
(b) 0.5m



(c) 1m



(d) 1.5m



(e) 2m

Figure 21: USV lateral forces applied by controller at different wave heights,
ROV at 100m

4.2 Torque

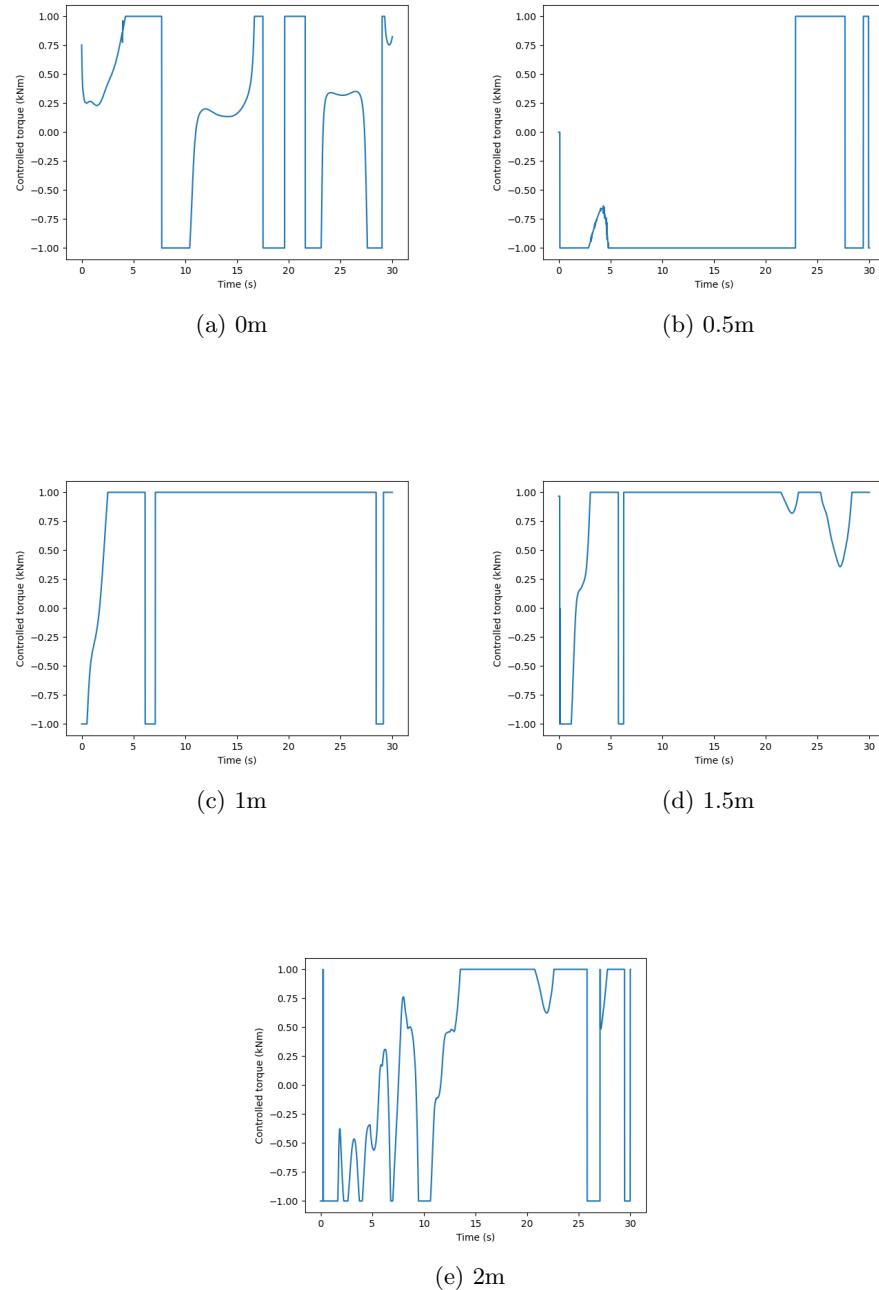


Figure 22: USV torque applied by controller at different wave heights, ROV at 0m

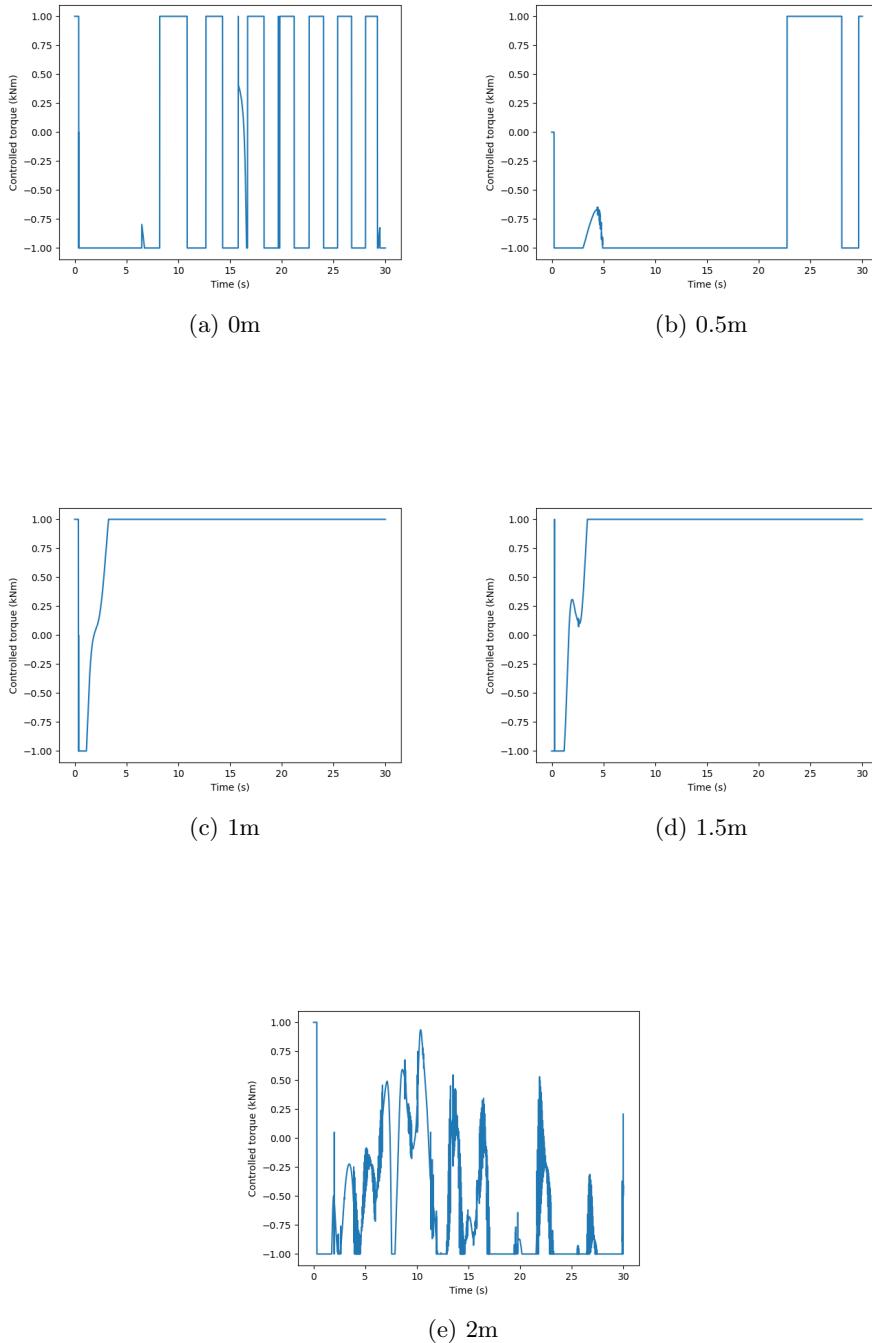


Figure 23: USV torque applied by controller at different wave heights, ROV at 50m

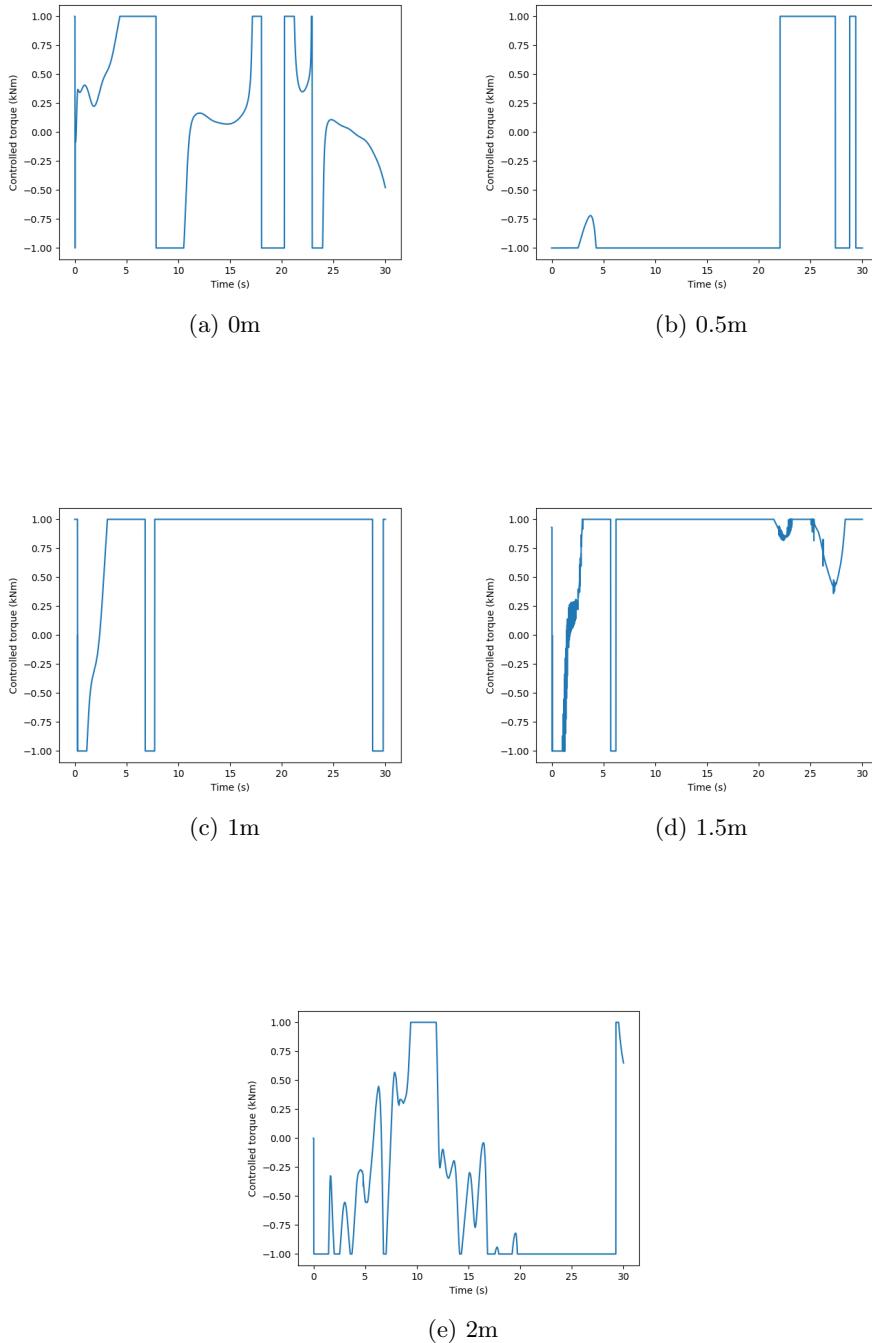


Figure 24: USV torque applied by controller at different wave heights, ROV at 100m

5 ROV position error over time

5.1 Uncontrolled

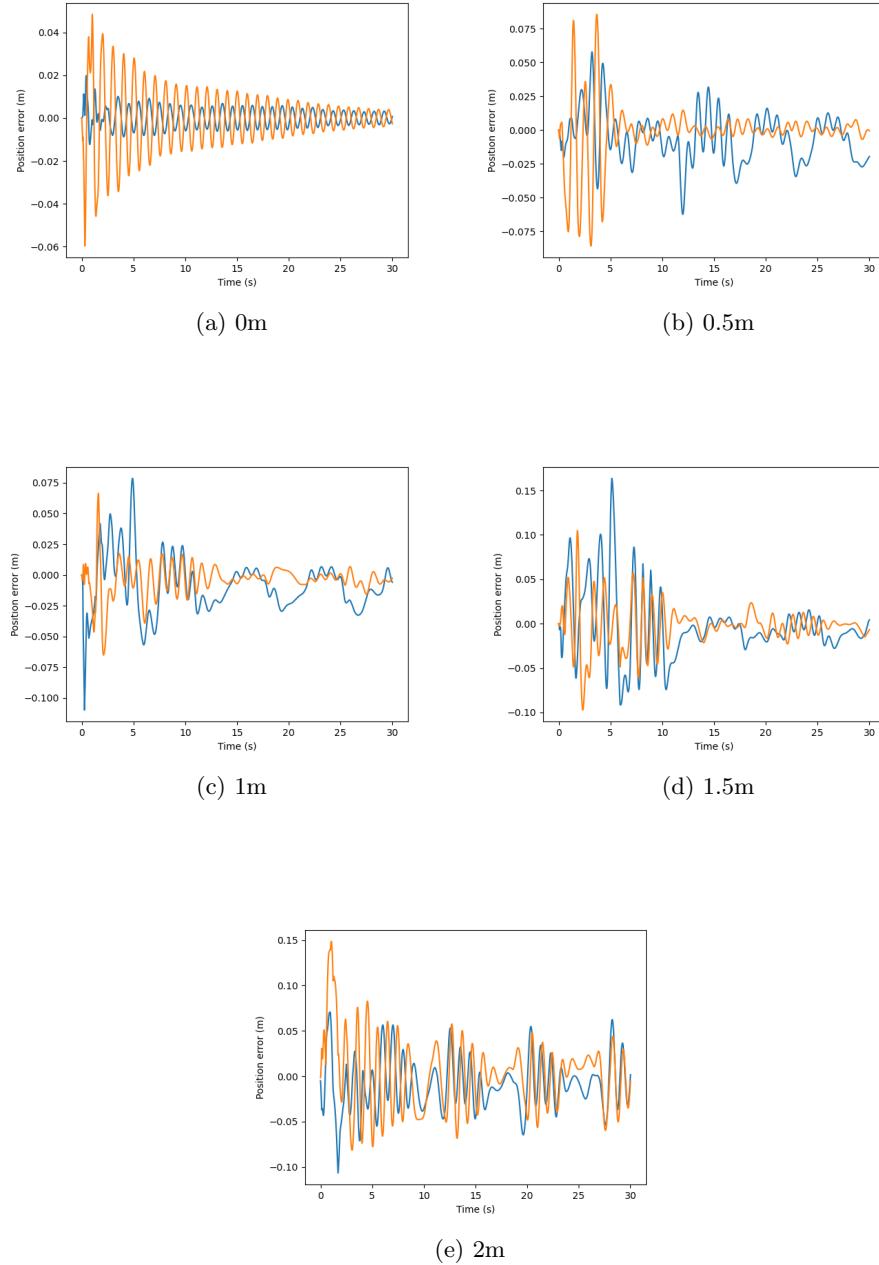
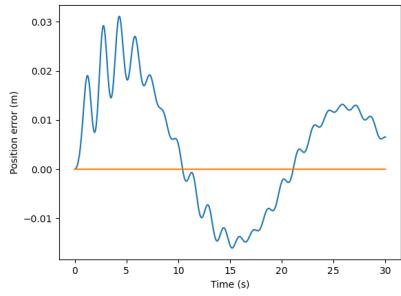
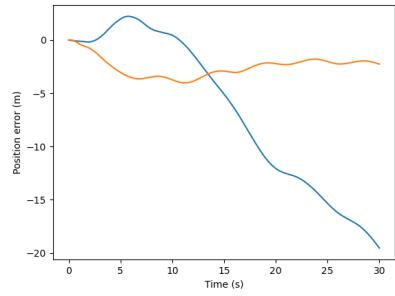


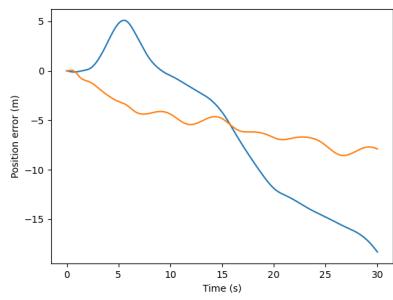
Figure 25: ROV position error over time at different wave heights, ROV at 0m



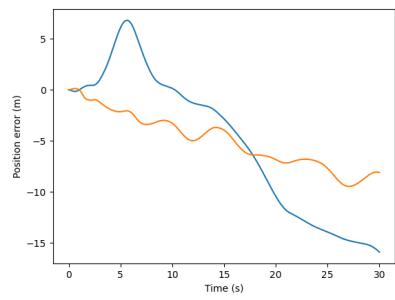
(a) 0m



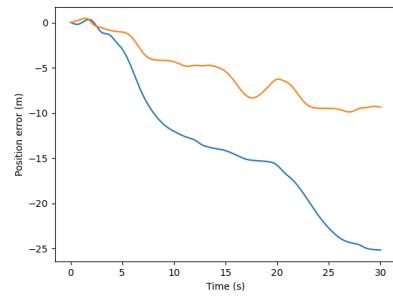
(b) 0.5m



(c) 1m

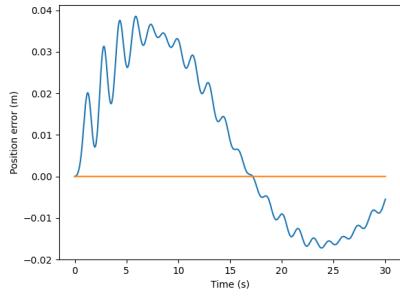


(d) 1.5m

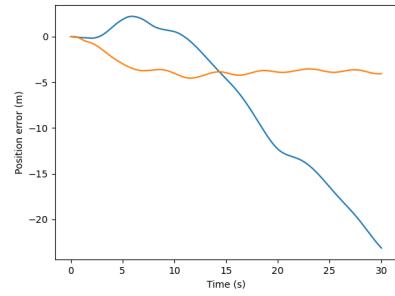


(e) 2m

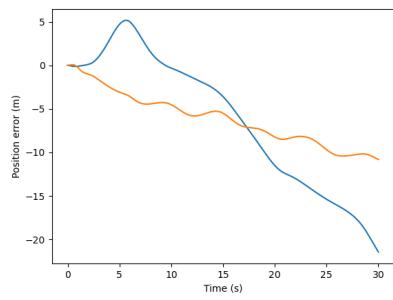
Figure 26: ROV position error over time at different wave heights, ROV at 50m



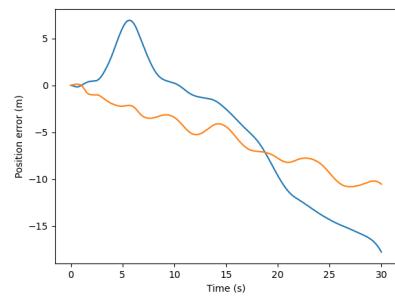
(a) 0m



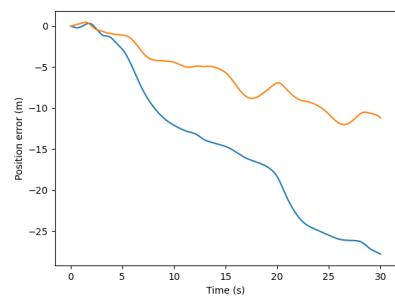
(b) 0.5m



(c) 1m



(d) 1.5m



(e) 2m

Figure 27: ROV position error over time at different wave heights, ROV at 100m

5.2 Controlled

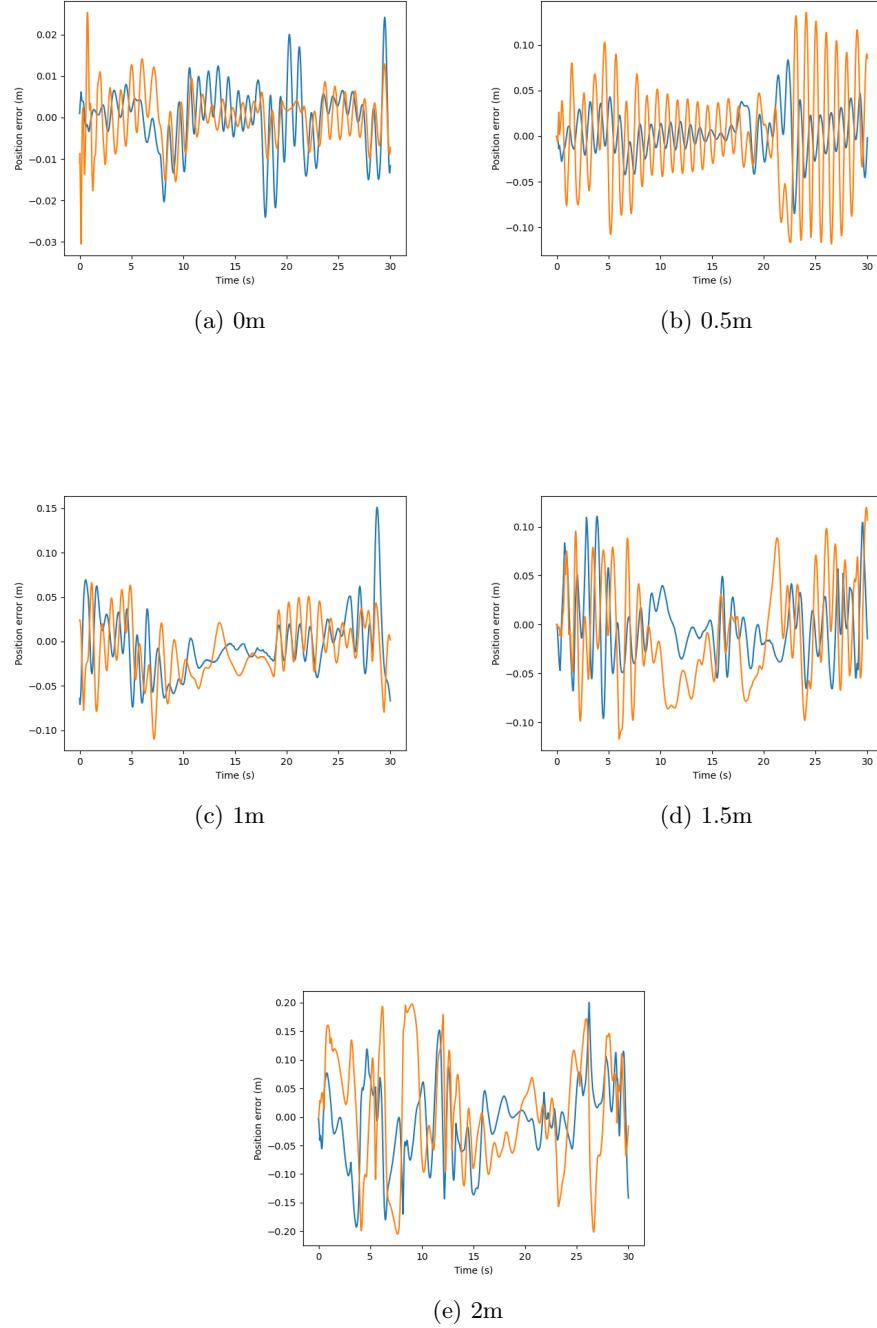
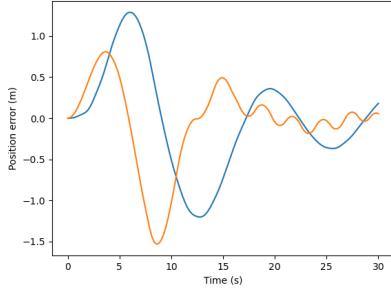
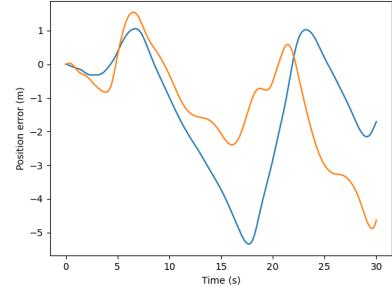


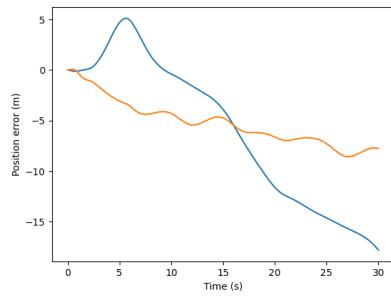
Figure 28: ROV position error over time at different wave heights, ROV at 0m



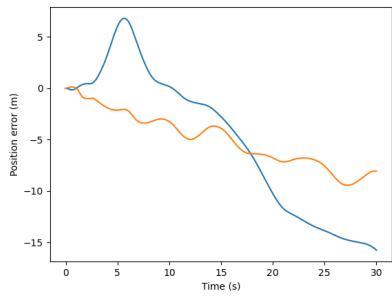
(a) 0m



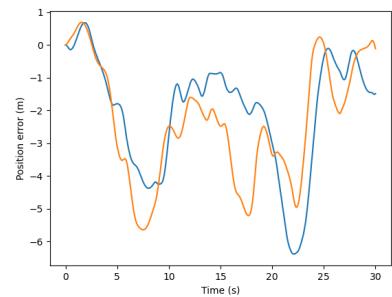
(b) 0.5m



(c) 1m



(d) 1.5m



(e) 2m

Figure 29: ROV position error over time at different wave heights, ROV at 50m

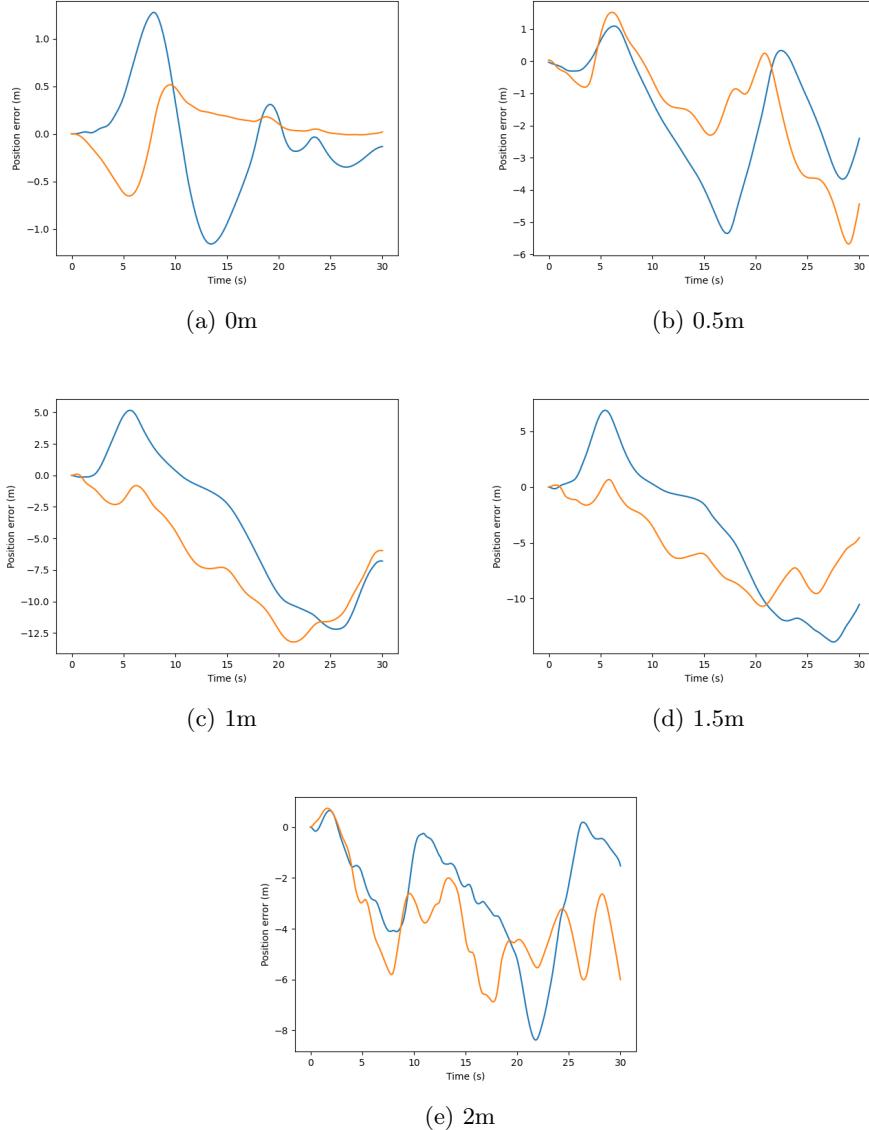


Figure 30: ROV position error over time at different wave heights, ROV at 100m

6 ROV depth error over time

Note that it seems the depth calculations for the plotting have gone wrong. They ended up being relative to 100m depth. It was not possible to fix this, so please simply imagine that the depths are correct. For the retracted ROV, the goal height is -100m, while for the fully extended one it is 0m.

6.1 Uncontrolled

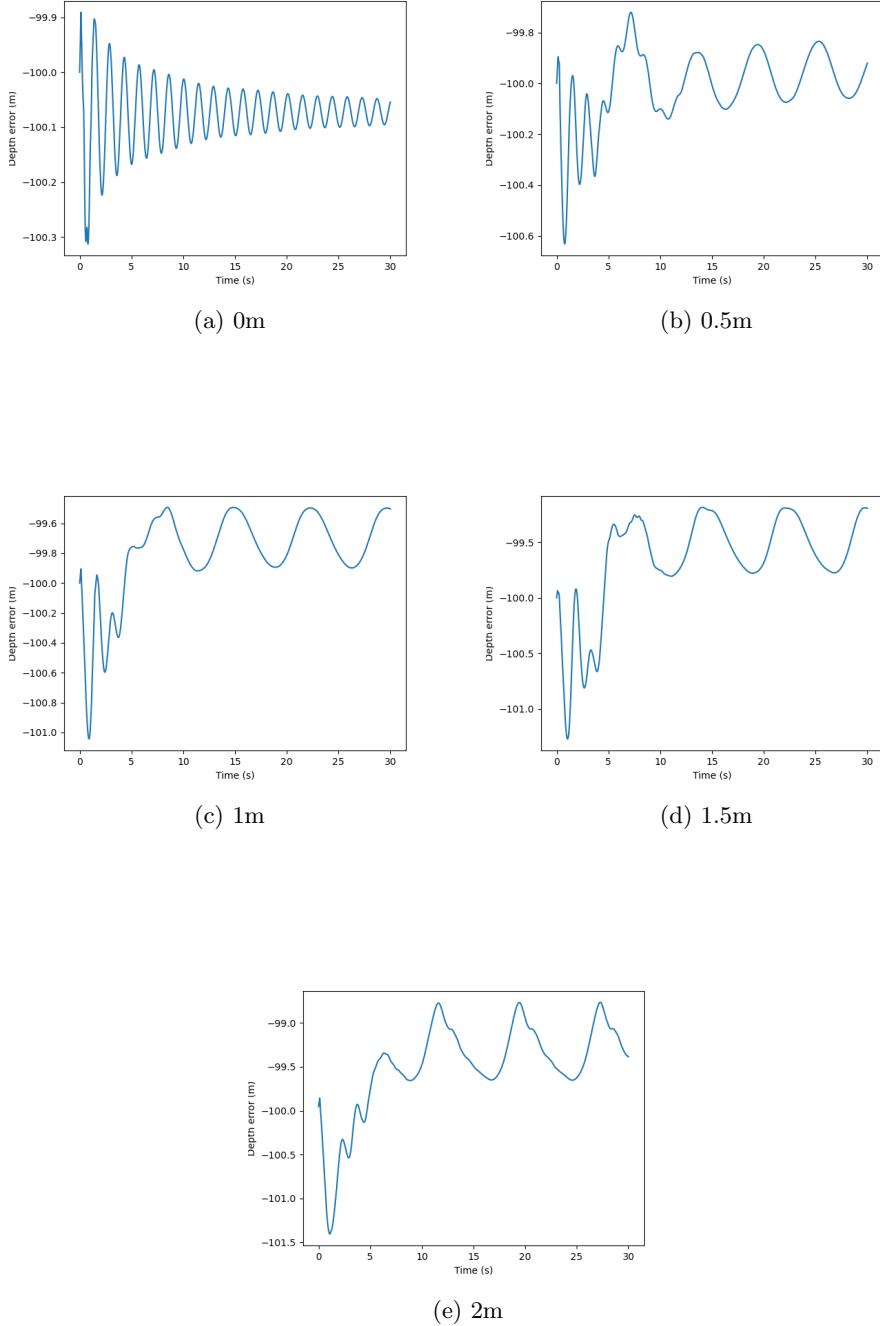
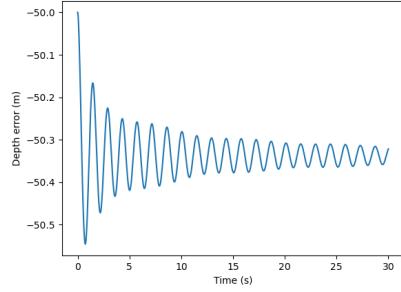
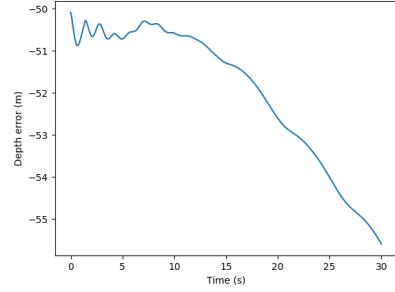


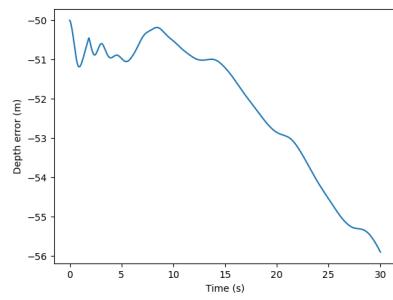
Figure 31: ROV depth error over time at different wave heights, ROV at 0m



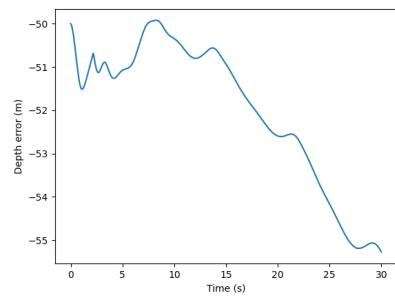
(a) 0m



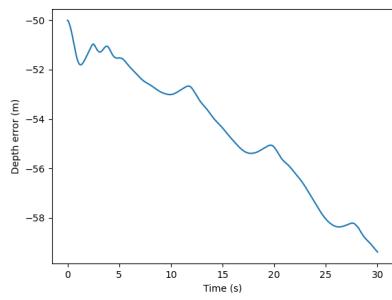
(b) 0.5m



(c) 1m



(d) 1.5m



(e) 2m

Figure 32: ROV depth error over time at different wave heights, ROV at 50m

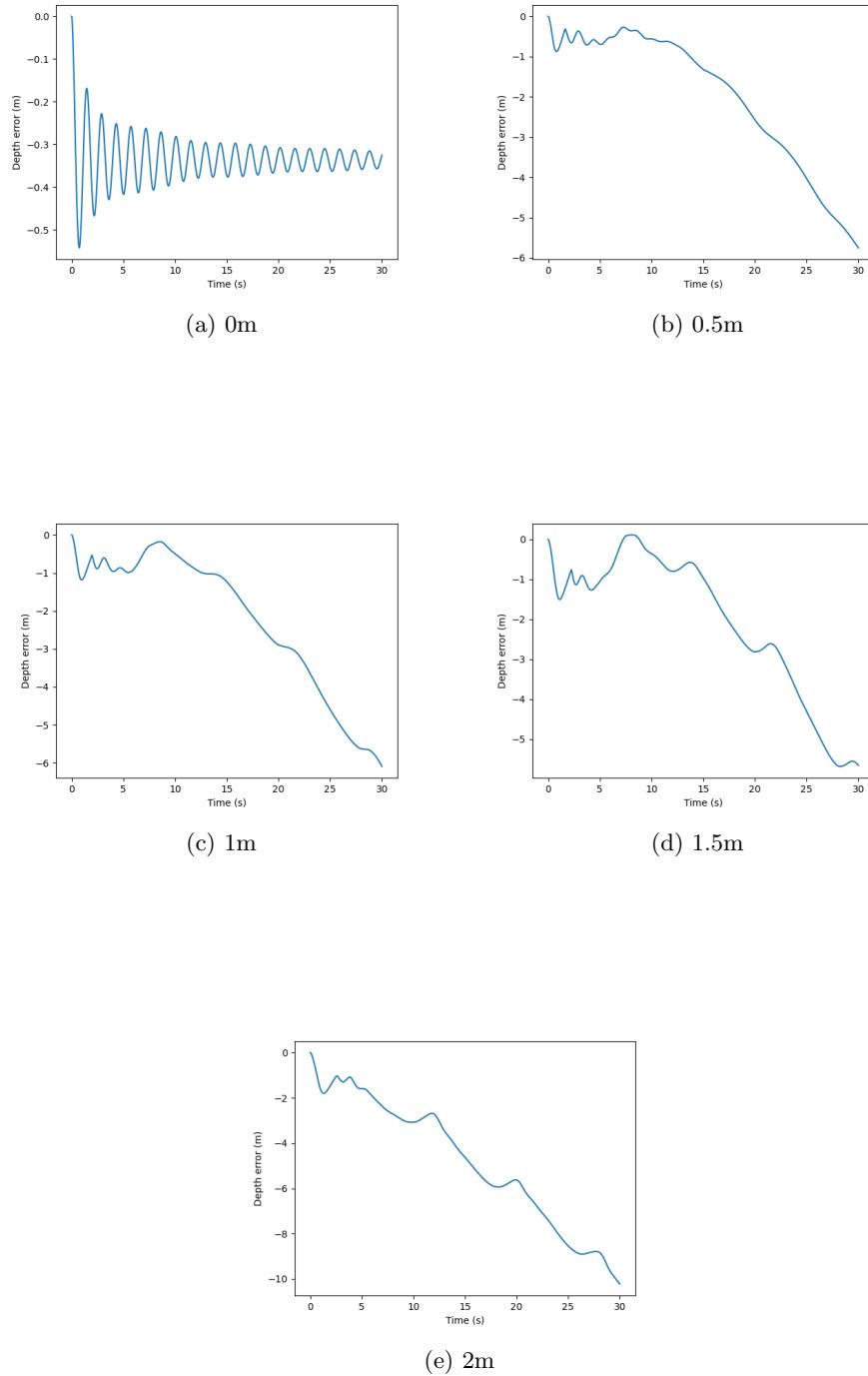


Figure 33: ROV depth error over time at different wave heights, ROV at 100m

6.2 Controlled

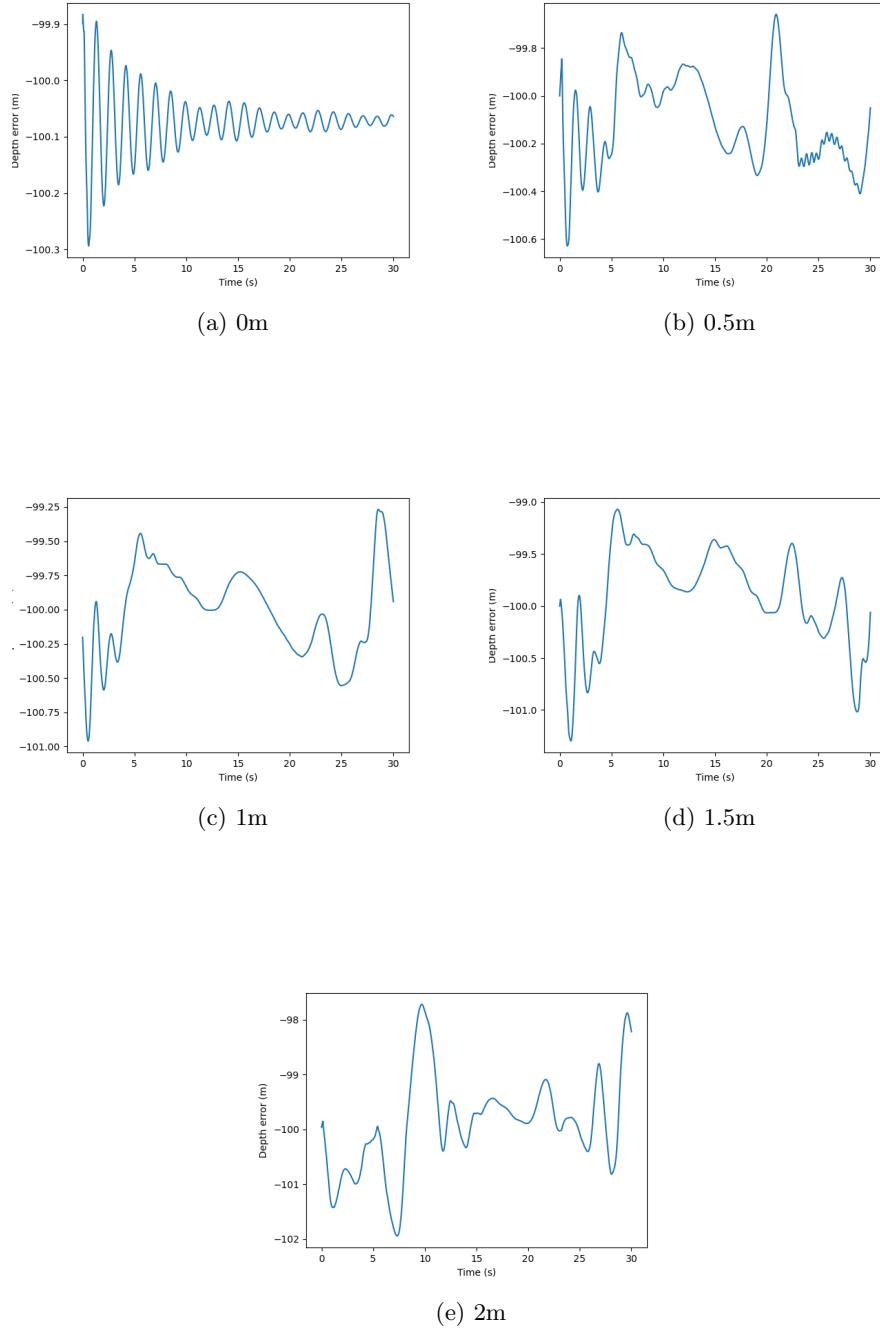


Figure 34: ROV depth error over time at different wave heights, ROV at 0m

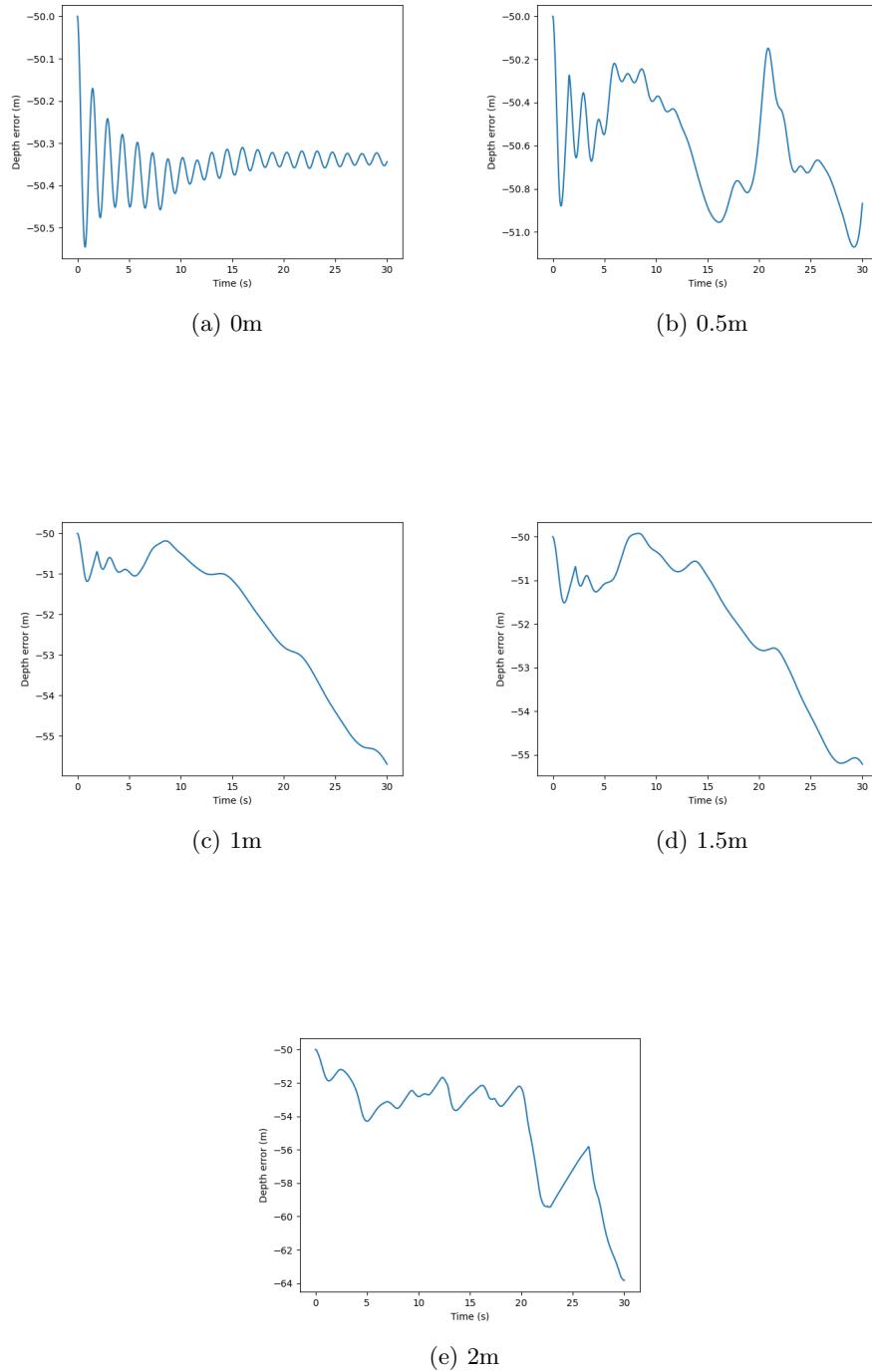


Figure 35: ROV depth error over time at different wave heights, ROV at 50m

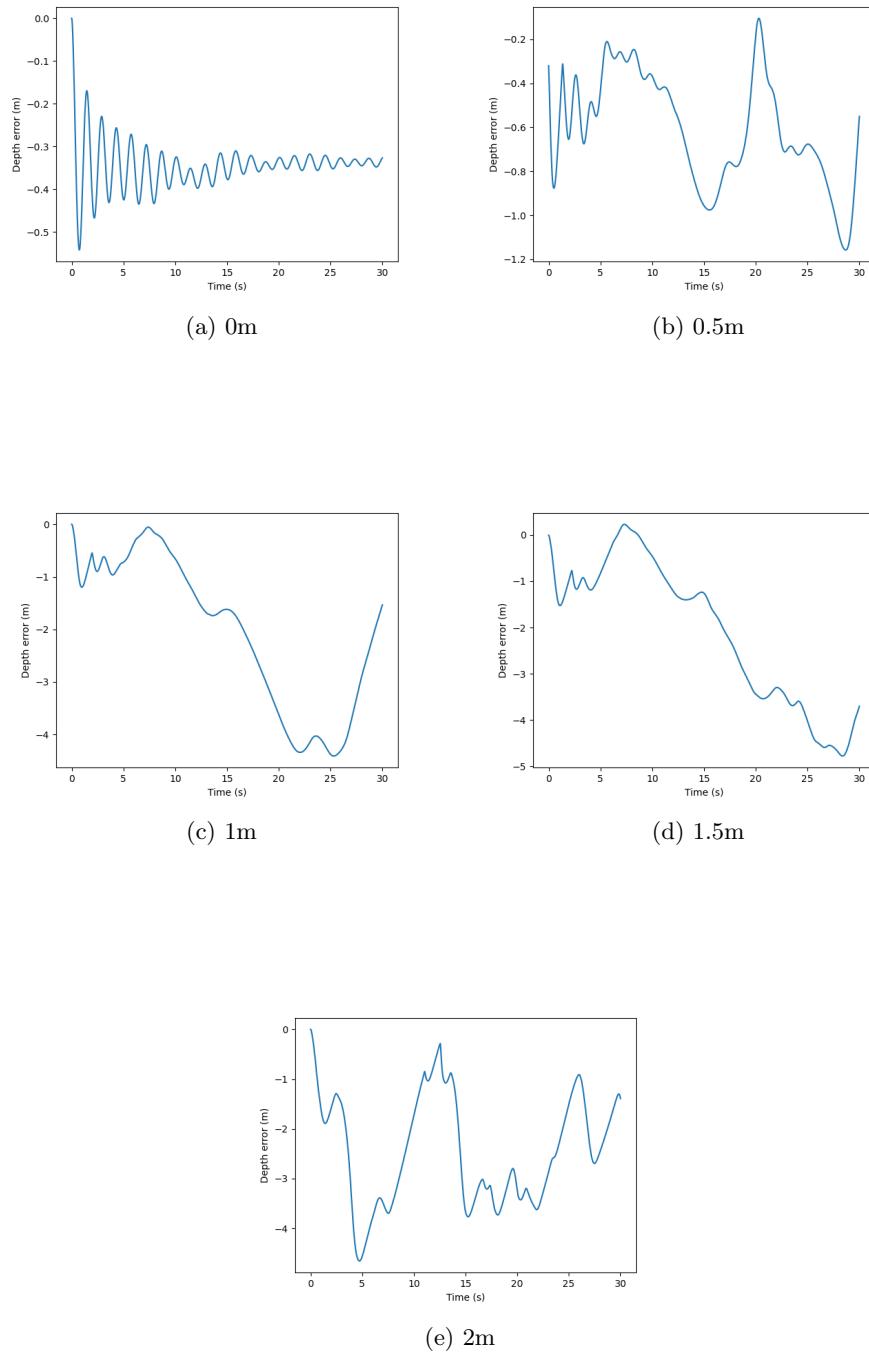


Figure 36: ROV depth error over time at different wave heights, ROV at 100m