Assignment 2, part 4 - Guidance

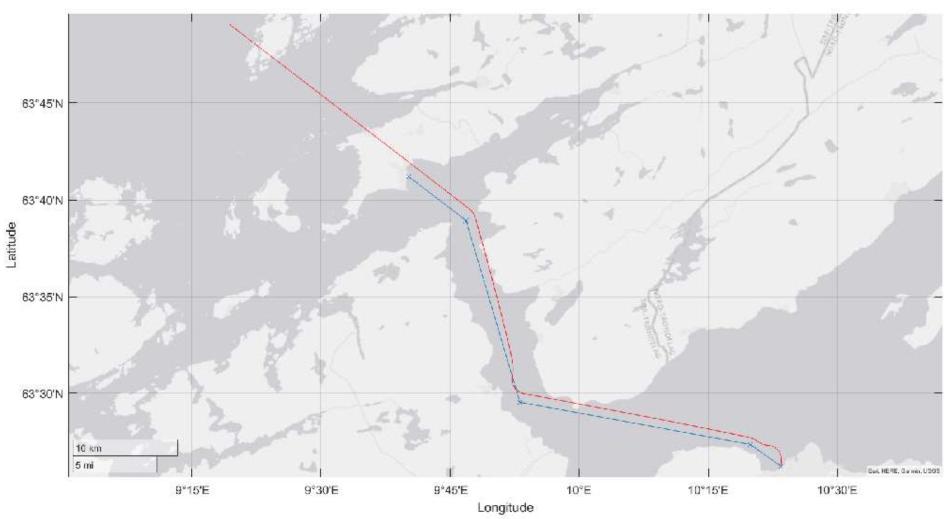
Task 1 - a

We have used LOS (line of sight) guidance. Lets say that the desired trajectory is a straght line between two waypoints. This guidance law is based on the insight that the ship does not have to drive right towards the desired trajectory, then follow it, but rather drive towards a point lying a certain distance ahead. The angle between the ships direction, and the desired trajectory will become smaller when the ship is close to the trajectory.

The look ahead ditance is set to 1e04, which is in the same order as the distance between the way points. We observed that when the distance was to small, the trajectory oscillates, instead of going in a straght line between the way points. If the look ahead distance is very large, it will take longer to converge.

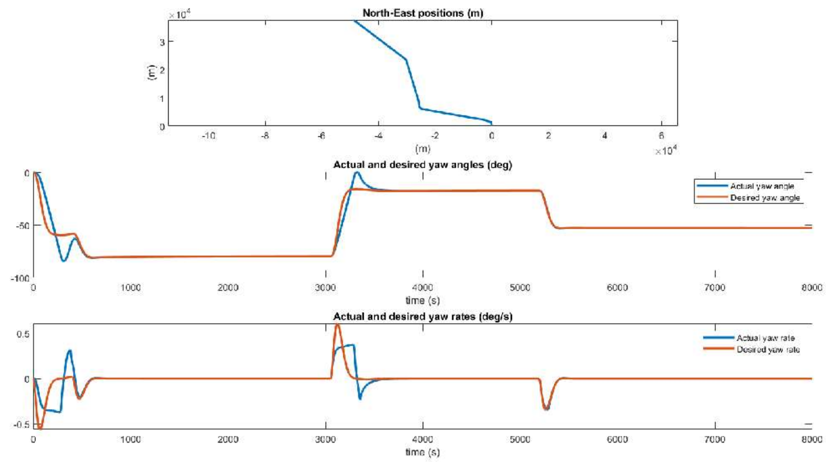
Task 1 - c

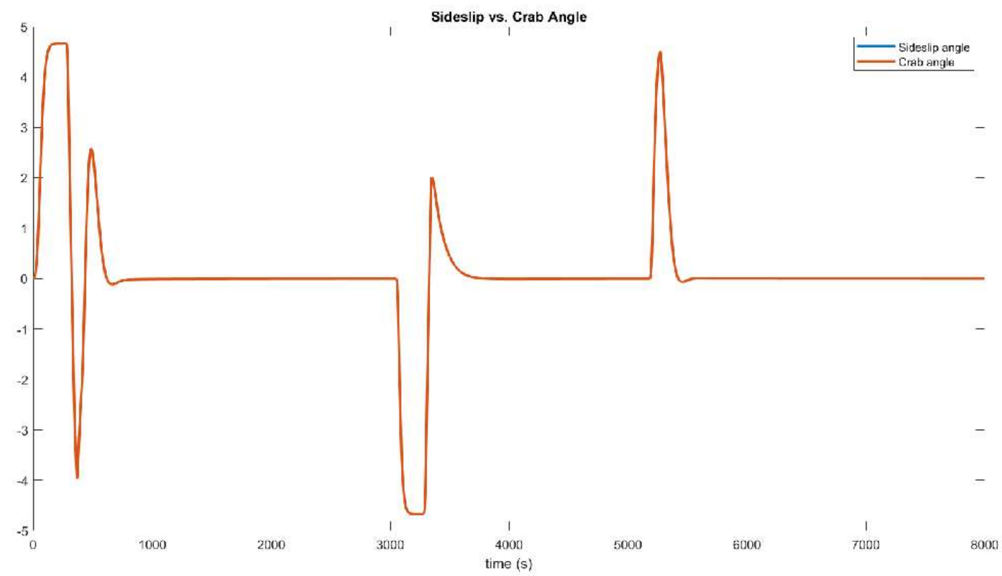
The trajctory follows the way points, but there is a persistant offset due to the current. The current does affect the results because we have not yet included crab angle compensation, nor integral action.

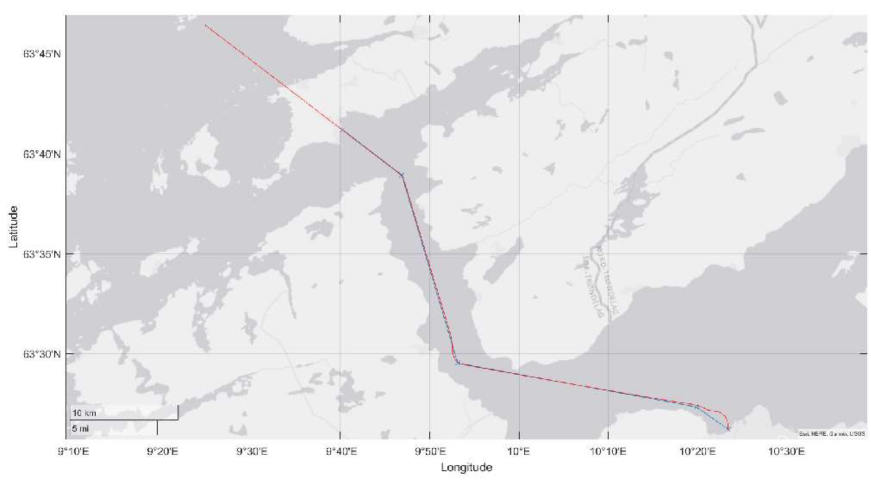


Task 2 - a

When there is no current, the trajectory follows very well. Crab angle compensation is not necessary here, since the crab angle is equal to sideslip.

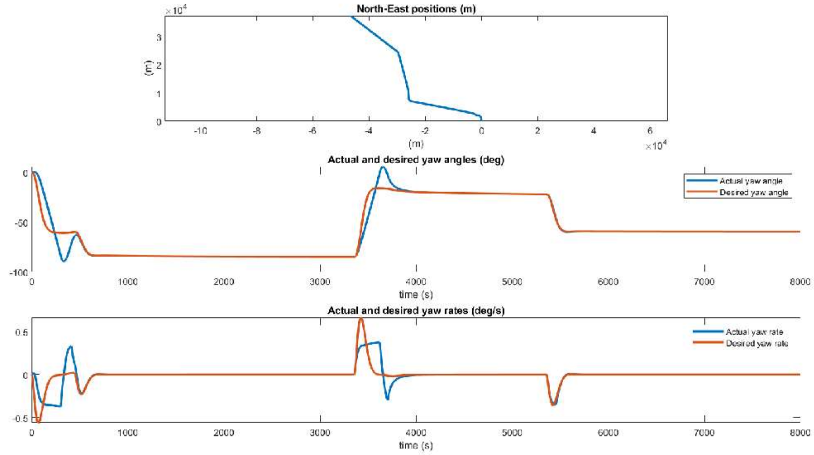


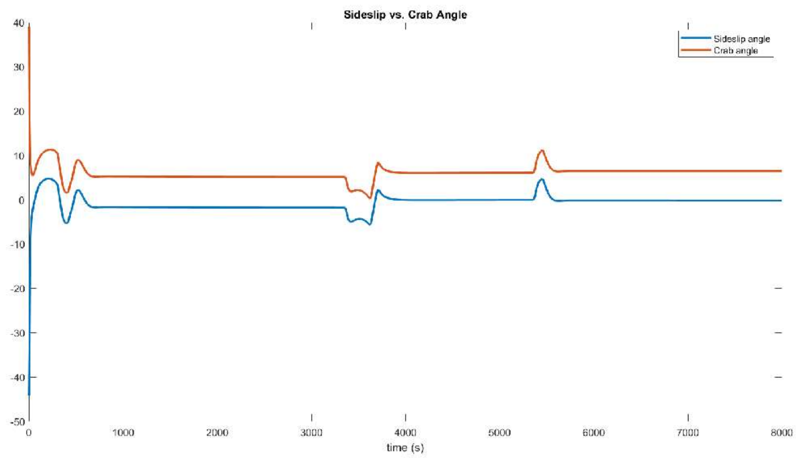


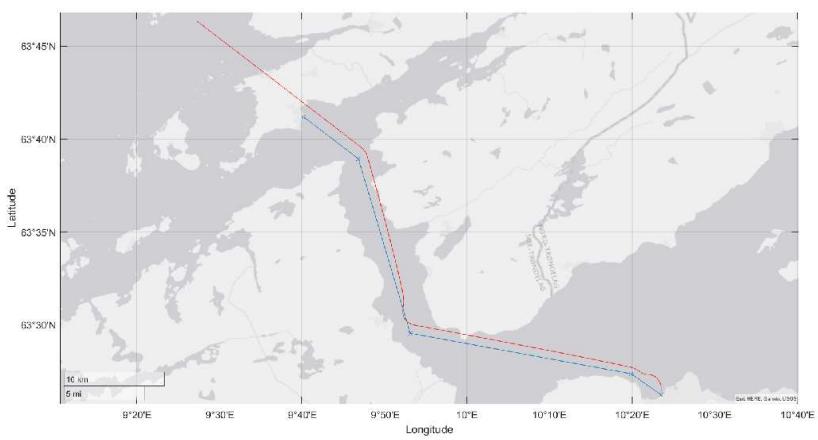


Task 2 - b

Here we see clearly that we must compensate for crabe angle.

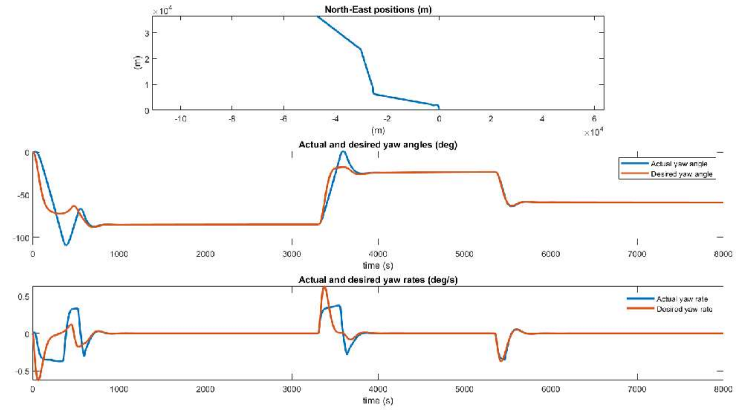


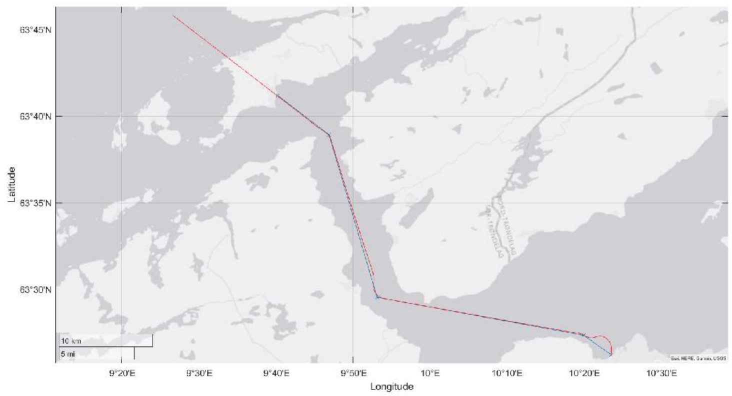




Task 2 - c

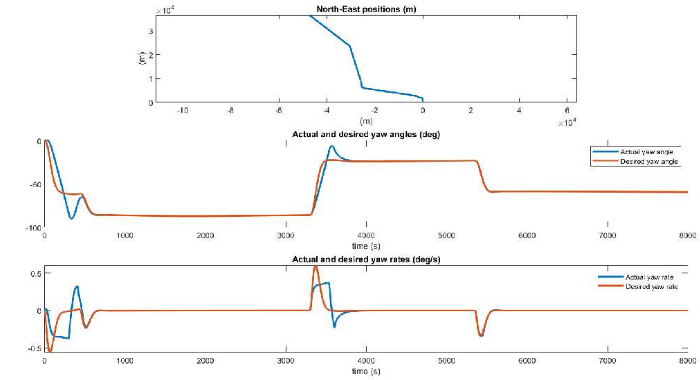
With crab compensation the ship follows the trajectory well.

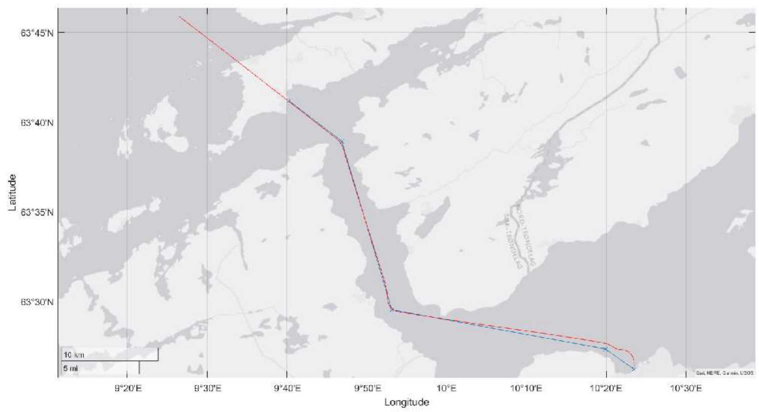




Task 2 - d

ILOS also works for compensating for crab angle, as seen in the plot below. It is beneficial over the previous method becuase we do not have to estimate beta. Estimating beta is especially difficult when the ship has low speed, and imposible when the ship is standing still. The downside of using ILOS is that we introduce a delay in the system. Also, we do not exploit the information we have about the disturbance introduced by crab angle. It is apprent in the plot below that ILOS needs more time then the feed forward appraoch, in order to compensate for crab angle.


North-East positions (m)
(m)
(m)
Actual and desired yaw angles (deg)
Actual yaw angle
Desired yaw angle
time (s)
Actual and desired yaw rates (deg/s)
Actual yaw rate
Desired yaw rate
time (s)


63°45'N
63°40'N
63°35'N
63°30'N
Latitude
10 km
5 mi
9°20'E
9°30'E
9°40'E
9°50'E
10°E
10°10'E
10°20'E
10°30'E
Longitude