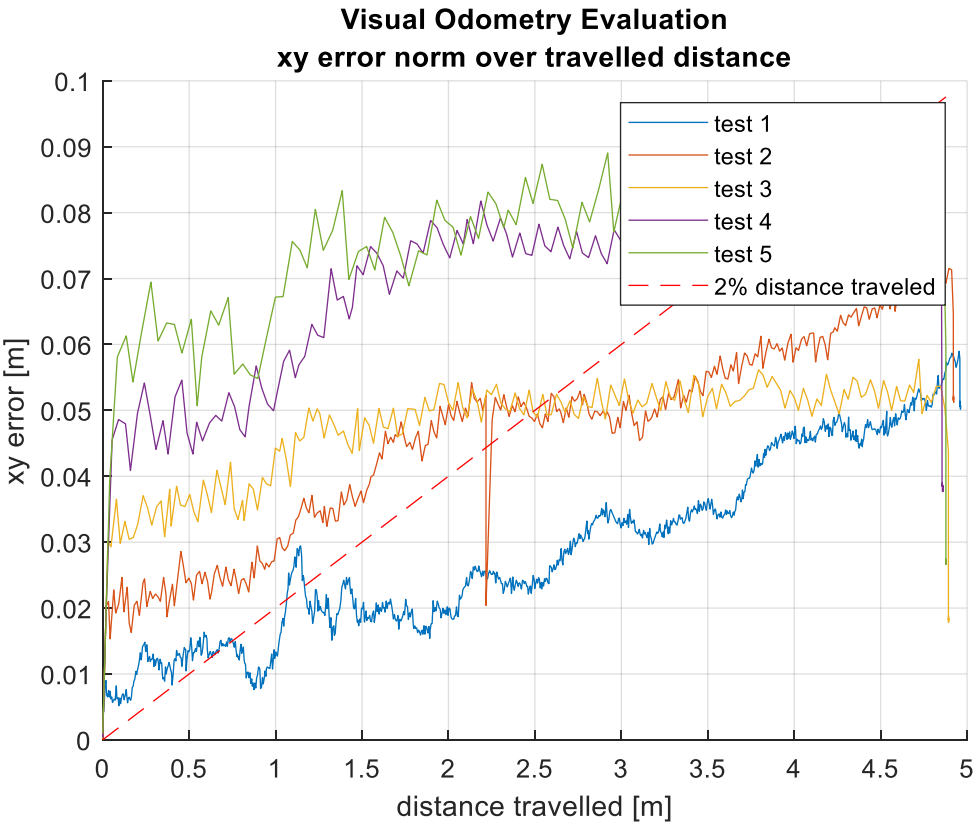
WEEKLY REPORT DE BENEDETTI MATTEO

WEEK 10: 04/10/2019 – 08/11/2019

SPARTAN VO VELOCITY TESTS:

I started investigating the behavior of the Spartan VO at different speeds.

I performed 5 tests at different translational velocities: 0.01-0.03-0.05-0.07-0.09 m/s for 5 m (in the legend the tests are numbered in order of increasing speed)



It has been observed that the final error norm, after the 5mt traverse, strongly depends on an initial error, which seems to be proportional to the speed

I think it is more informative to look at the slopes of the error curve: I fitted a 1st degree polynomial to the curve using Least Squares.
Here are the slope coefficients for the 5 experiments:

0.0129
0.0153
0.0078
0.0086
0.0111

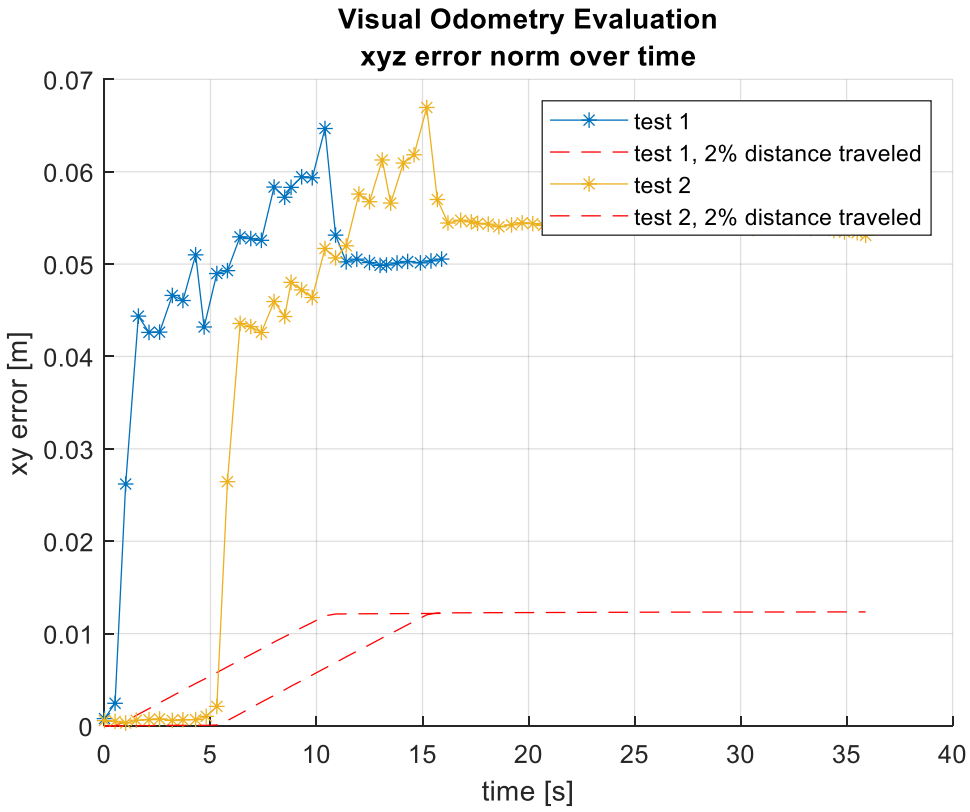
There is variation between them, but it is not significant and more importantly does not look like it increases with the speed.
It could be interesting to study a longer traverse to obtain a more stable error curve and a more accurate estimate of the slope.

INVESTIGATING INTERESTING BEHAVIOUR OF THE VO:

Since the initial jump in error of the VO, that seems to occur when the rover changes speed, is the major cause in error (though after a short traverse of 5m this error is already compensated and falls well under the 2% line) I think it is worth investigating it further.

I tried to see if this initial error is caused by the fact that I started moving immediately in the experiments.

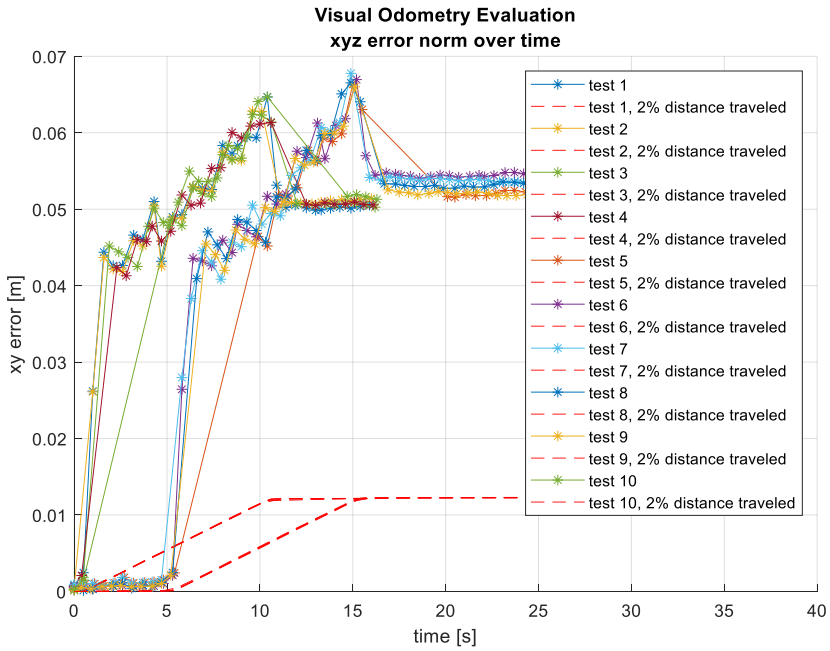
The following plot shows 2 tests where the rover moves at the same speed (0.06 m/s) for the same time (10 s) but in the 1st test I start moving at t=1 s, in the 2nd case I start moving at t=6 s



There is not much difference between the 2 cases, so I would conclude that it is not a problem of moving immediately.

Since it seems to happen the moment it starts moving, I thought it could be coming from the images that may be too blurry when the rover accelerates or maybe the camera is not perfectly fixed to the rover and when it accelerates to go from 0 to 6 cm/s, and vice versa, the camera could move a little.

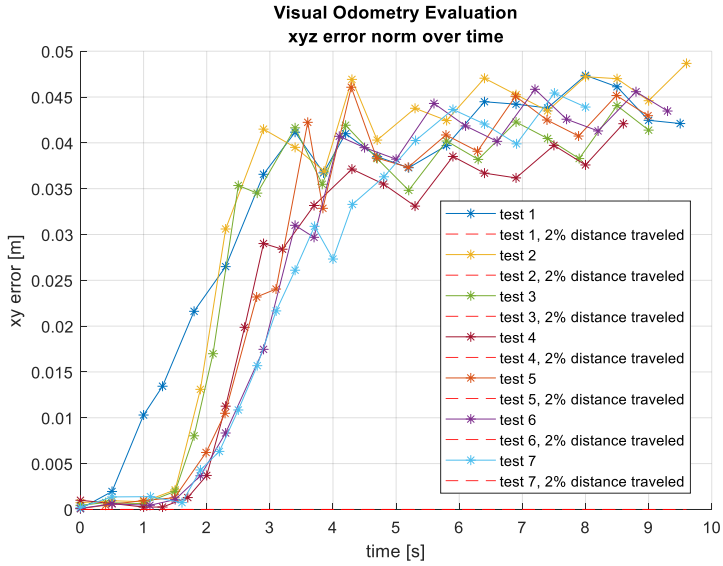
I implemented a function in the SpartanVO which stops computing new transforms when a new and different motion command arrives and does it for a varying number of steps after that.



Test1: start at t=1
Test2: start at t=1, skips 1 vo step
Test3: start at t=1 skips 3 vo steps
Test4: start at t=1 skips 5 vo steps
Test5: start at t=1 skips 15 vo steps
Test6: start at t=6
Test7: start at t=6 skips 1 vo step
Test8: start at t=6 skips 3 vo steps
Test9: start at t=6 skips 5 vo steps
Test10: start at t=6 skips 15 vo steps

It clearly shows that skipping VO steps when the velocity changes does not mitigate that behavior.

Then I tried to see if a smoother acceleration could help. I performed 7 tests where the rover goes from 0 to 0.06m/s in increasing time.



Test1: goes to 0.06m/s immediately
Test2: goes to 0.06m/s in 0.6s
Test3: goes to 0.06m/s in 1.2s
Test4: goes to 0.06m/s in 1.8s
Test5: goes to 0.06m/s in 2.4s
Test6: goes to 0.06m/s in 3s
Test7: goes to 0.06m/s in 3.6s

Also this solution does not seem to affect it.

SPARTAN VO WITH THE IMU:

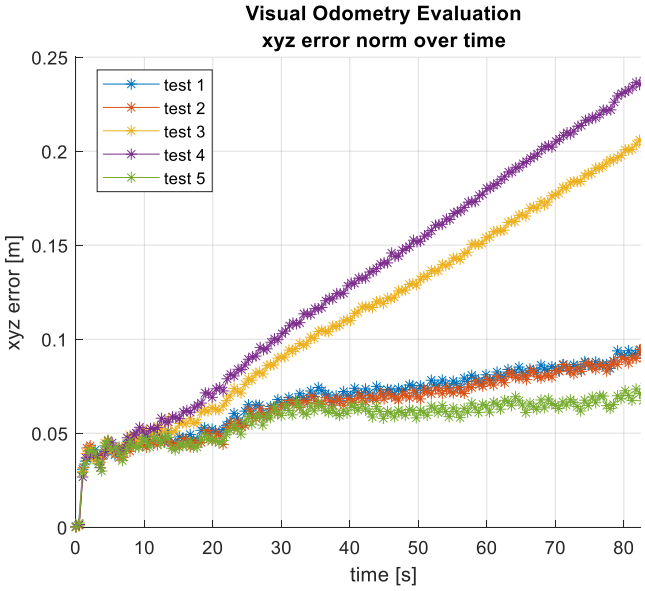
I also started working on testing the IMU also for the SPARTAN VO.
I modified the Spartan task to output the delta pose in the format that viso2_with_imu task expects and created a new script to compare the performances between using and not using the IMU.

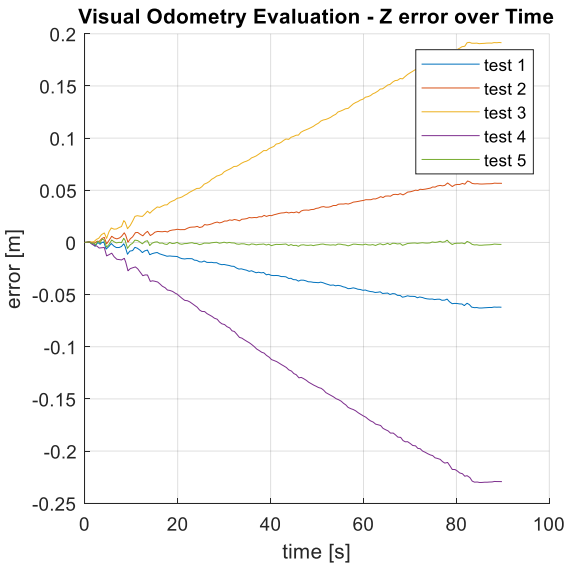
The connection between the tasks works but as of now the Spartan VO with IMU performs significantly worse than without, so I will continue working on this.

REFINING THE BODY-CAMERA TRANSFORM:

I performed the same operations I did for viso2 when measuring the body-camera transformation and this, in combination with some manual fine-tuning, led to an increase in performance of the SpartanVO.

The next plots show the results of a 5m traverse at 0.06 m/s and it can be seen in the plot on the left that the error line of test5 has a gentler slope that the others and the plot on the right shows a considerably smaller drift on the z component.





CDF STUDY:

On Tuesday was the last session of the CDF study. Further details are included in the Monthly report of October.

FUTURE OBJECTIVES:

In the next week I plan on discussing with my internal supervisor if the behaviour observed in the Spartan VO should be further looked into.

I will also work on correctly implementing the IMU with SpartanVO