Individual project

RLG data-processing and course alignment

Course alignment

1) Get familiar with the provided code in Matlab "*CourseAlignment.m*" and implement the code of the following blocks of code:
   a) Define the transformation matrix for the ACC and RLG from the sensor frame into ENU -> Par.TRs2enu_SF, Par.TRs2enu_W. Use Fig. 1 to define the matrices. The sensors used are ACC: QA2000, RLG: GG1320AN.
      Note: Based on their datasheets define their sensitivity axes' directions and define ACC and GYR framework. Use it as an origin for your transformations.
   b) Define the ENU->NED transformation matrix since all remaining calculations should be performed in the NED frame -> Par.TRenu2ned
   c) Define the Earth rate and a local gravity vector in the NED frame -> WieN, gLOCAL (magnitude), gN.
      Note: gLOCAL is evaluated in the comp_gravity function, get familiar with it.
   d) Estimate the mean and std values within the INIT time slot -> gMin, wMin, SFstd, Wstd
   e) Estimate wM and gM based on gMin, wMin – compensate the cross-coupling and the bias. Resultant values should be defined in NED.
      Note: Be aware of frames in which individual compensation should be performed and those parameters are expressed.
   f) Evaluate the Euler angles based on Course alignment procedure. Learn the procedure from the available sources. Resultant values -> EAall compare with the reference values.
      Use the reference values: phi = -0.018666, theta = 0.006606, psi = 29.790710 (all in degree). Your final deviation should not be greater then 0.05 deg in all individual results.
      Note: there is possible to use Comparison of Initial Alignment Methods for SINS.pdf as one of the useful sources of information.
   g) Compare the EAall with EAacc obtained directly from gM.

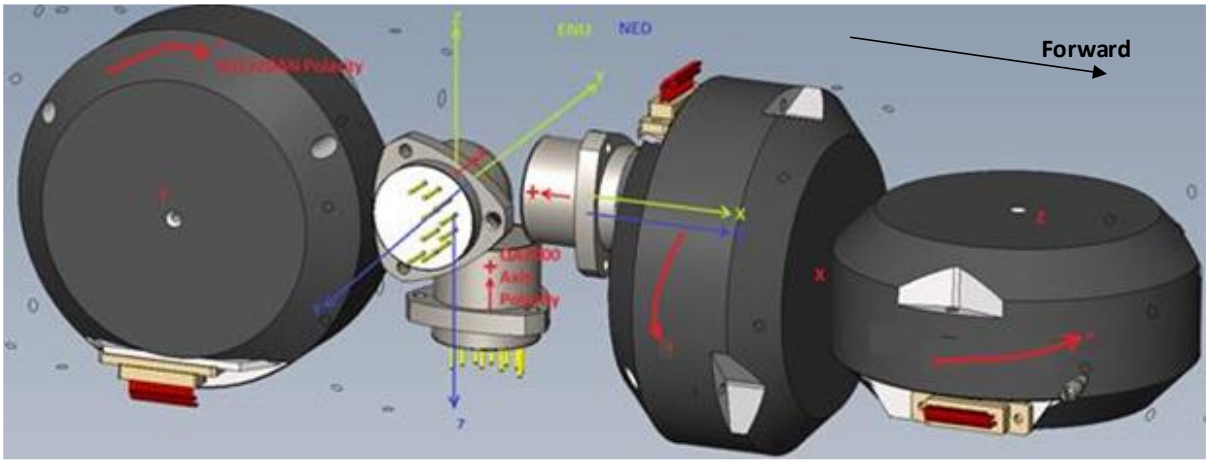

Fig. 1 – Sensor frame

IMU data processing

1) In separate code in Matlab perform:
   a) ACC and RLG data a single-side FFT analysis for all 3 axes
      Note: Be aware of correct amplitudes (would be nice you get familiar with a correct computation).

b) Apply low-pass filter with a cut-off frequency of 100 Hz and compare the results with those progression of original signal FFTs. In the case of RLG data, check the dithering frequencies and how this dithering is affected by the filtration. Your intension should lead to minimize the dithering effect on data for further procession.

   Note: 6 graphs at all, in the single graph two FFT progressions should be seen.

c) For both ACC and RLG data compute the vector magnitudes with respect to the length of averaged window. Resultant values should be plotted together with the referential values. The deviations should be analyzed. Determine the length of the averaging window for which the resultant value reaches the theoretical one as close as possible.

What is needed to deliver:

- Entire codes – completed CourseAlignment.m + additional one for the IMU data analyses – sent by email to xrohac@fel.cvut.cz. Please, send the codes **without** SFin.mat and Win.mat.
- All codes should be completed and easy to run.
- All subjects should be completed and results should be with sufficient accuracy and form. When all is in this order, the author may be awarded by 12 extra points. No points will be given for incomplete solution. All authors should understand all aspects of their codes, otherwise there will be a doubt of the authorship.
- Two individual consultations at max are offered to a student who works on this.
- Deadline: delivery should be finished by the end of January. No later delivery gets accepted.