LAB 2 – Analysis and Modeling of Observed Stochastic Processes (2 weeks)

Objective: Apply the knowledge in analyzing and characterizing stochastic processes on data collected from inertial measurements units (IMUs) of different size, quality (and cost) in static environment.

Available IMU:

No	Name/Fabricant	Class-grade	Gyros	Accels	In 'readimu.m'
1	AIRINS/XSEA	Navigation	FOG	Mechanical	'IXSEA'
2	LN200/Nortrop G.	Tactical	FOG	Silicon	'LN200'
3	FSAS/IMAR	Tactical	FOG	Silicon	'IMAR'
4	NavChip/Intersense	Low cost	MEMS	MEMS	'NAVCHIP_FLT
5	MTi-G /Xsens	Low cost	MEMS	MEMS	load (*.txt)
6	Smart-Phone/yours	Low cost	MEMS	MEMS	load(*.txt)

Part A (Week 3):

1. **Data collection** (*in group*): Together with your colleagues collect a data series of *20 minutes duration* each from a selected (or assigned) instrument to your group. Transfer the data from the instrument storage to a memory stick. (*Individual/smart-phone*): A) Interactive option (via Matlab) – follow the given instruction B) Third party program - install program 'Sensor Fusion' (free), select 'Log Data', check 'Log', Select sensor: (raw if possible) Gyro/Accelerometer, Settings: Set frequency, Press 'Start/Stop'.

2. **Data sharing**: Obtain data from other IMU type (either from your colleague or from the Moodle), according to the following scheme: 1-4, 2-5, 3-6, where the respective pairs correspond to the number of instruments in the above table. For example, if you collected data from instrument No.5 (MTx) take instrument No.2 (LN200) and vice versa.

3. **Data plotting** (individual): You will work only on **one type** of data (i.e. *gyros* or *accelerometers*) according to the assignment sheet. Altogether, you will have 2 time series – one that you collected by yourself and one that you obtained from a colleague/Moodle. Use the provided Matlab routine 'readimu.m' (distributed via Moodle) to read the collected data and plot the x-y-z series for the selected data type.

Part B (Week 4):

4. **Analysis**: Analyze the available data for both instruments by means of the characteristic functions you used in Lab 1 (e.g. autocorrelation, PSD, Allan or Wavelet Variance). Plot the results and compute their mean.

Answer the following questions[1]:

I. **Modeling**: *How* do you suggest to model the observed process and *why*? Decide on the process type and strength (e.g. amplitude, correlation time, etc.)

II. **Verification**: Simulate synthetic observations by applying the suggested model from Question I. Calculate again characteristic function from the simulated data and *compare* it to the characteristic obtained from *the real data* in Step 4. Answer the following question: Does the characteristic function obtained from real data correspond to the synthetic one? If not, what do you suggest to improve?

Lab weight: 3%
Distributed: Week 3
Deadline without penalty: 2 weeks after distribution (i.e. lecture of week 5)

[1] The answers and the comments should be relevant, short and consistent as would be expected during an oral exam. A long answer does not imply good understanding of the subject.