Exercise on <u>22.01.2020</u>

Task 1 *(5 Points)*

In order to examine the stability of initial sensors, the so-called Allan variance is used. For measurements given as a discrete time series $x(t)$ the Allan variance is computed by

$$\sigma_y^2(\tau) = \frac{1}{2\tau^2} \left\langle (x(t+2\tau) - 2x(t+\tau) + x(t))^2 \right\rangle$$

where the averaging operator $\langle . \rangle$ is applied for all possible triplets $(x(t+2\tau), x(t+\tau), x(t))$ of the time series. A detailed description is given on e.g. `http://cache.freescale.com/files/ sensors/doc/app_note/AN5087.pdf`

On ILIAS you find measurements (`task1_sensor1.txt`, `task1_sensor2.txt`) from two acceleration sensors, which were recorded while the platform was not moving (Note: The readout frequency of `sensor1` is $100\,\text{Hz}$, the one of `sensor2` is $150\,\text{Hz}$). Compute the Allan variance $\sigma^2(\tau)$ for each sensor and plot your results in one (log-log) plot.
Describe the plots and at what you have to look at when choosing a sensor for an application (e.g. long time stability, short time stability).

Task 2 *(5 Points)*

On ILIAS you will find a time series $\Delta v^p(t)$ for $t = t_1, t_2, t_3 \ldots t_N \quad N = 1000$ (`task2_accel.txt`) which contains the change of velocities in a (fictive) 1D accelerometer which were recorded with a data rate of $100\,\text{Hz}$.
Compute the acceleration over time as it was shown in the lectures (see Eq. (9.10)), by using either $a^p(t_{k-2})$, $a^p(t_{k-1})$ or $a^p(t_k)$. Plot your results as function of t and describe the differences between them.