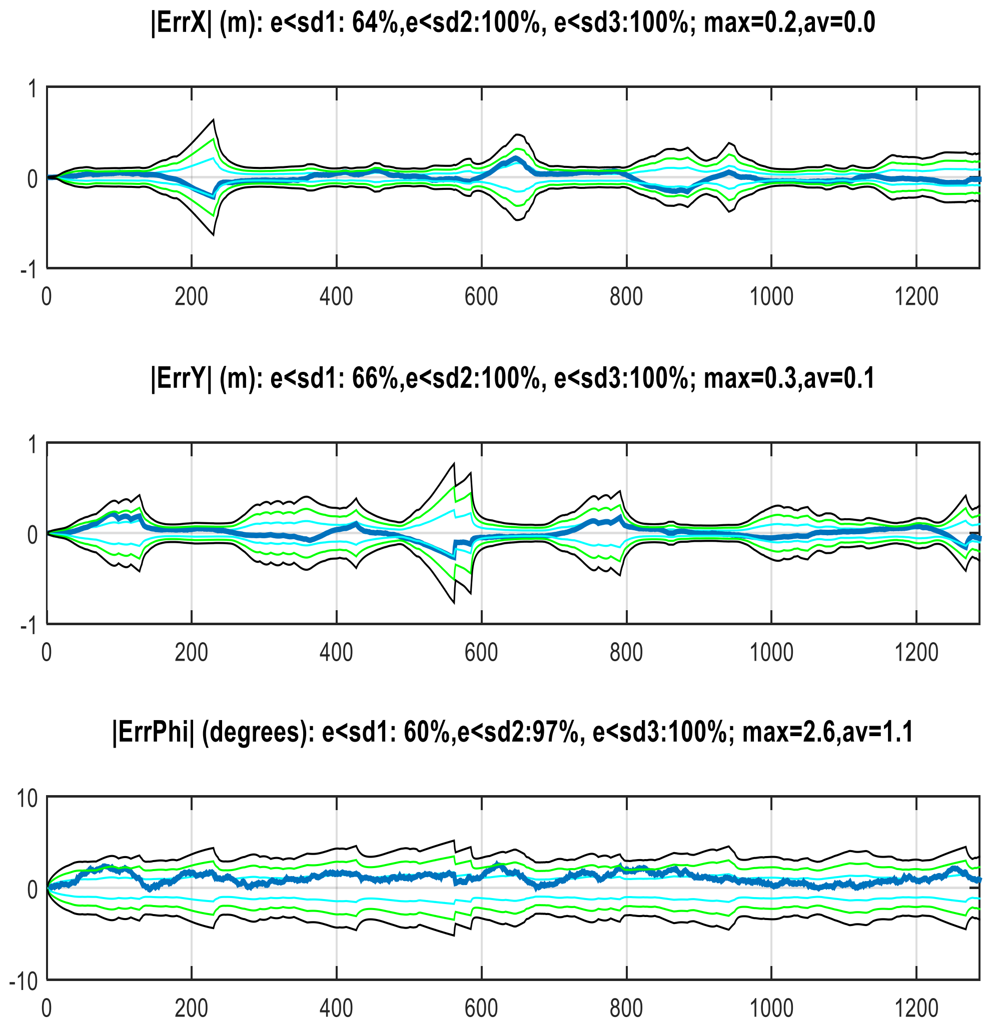
“Consistency Plots”

Your Consistency plots may look like these ones, in aspect (but not in values, as these may correspond to a different dataset, and different paths followed by the platform, etc). These plots do correspond to cases exploiting observations from just LiDAR1. You may use both LiDARs.



These plots are showing the performance, inspecting each scalar component (x, y, heading) individually. For instance, in the top subfigure, we see details about ***x***. We see in dark blue the discrepancies, for the pose component ***x***, $d_x(t) = x^{GT}(t) - \hat{x}(t)$. In light blue we show the standard deviations, $-\sigma_x(t)$ and $+\sigma_x(t)$ (we also show the negated values, for better visualization, as the discrepancy may be positive or negative.)

Similarly, in green and in black, we show $(-2\cdot\sigma_x(t)\ ,\ +2\cdot\sigma_x\ (t))$ and $(-3\cdot\sigma_x(t)\ ,\ +3\cdot\sigma_x\ (t))$ respectively.

The ***std*** is the square root of the variance. During runtime we record the expected values of the pose and, also, the *diagonal elements of the covariance matrix*, at each LiDAR event, so we have all the information we need to produce these plots.

We remark that the diagonal element $\mathbf{P}(k,k)$ in the covariance matrix $\mathbf{P}$, is the variance associated to the marginal PDF about the k-component of the vector being estimated. In part A of the project, we estimate the state vector $\mathbf{x}=\left[x,y,\varphi\right]^T$ so that k=1 corresponds to ***x***, k=2 to ***y*** and k=3 to the heading φ component of the state vector.

So, we just need to evaluate the square root of those recorded marginal variances to obtain the standard deviations of those marginal PDFs.

In the figures, we show 1,2 and 3 standard deviations. We plot -STD(t) and +STD(t), to see if the discrepancies are usually inside of those “envelopes” of -/+ c*STD, being c=1, 2 or 3. It would be statistically unusual to see the discrepancy “perforating” the $(-3\cdot\sigma(t),+3\cdot\sigma(t))$ limits, but it is not impossible, and it may occur sporadically.

For part B, similar plots can be produced, following the same approach.

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