

## How to process multiple OOIs in my EKF update?

We can process all of them simultaneously (in parallel), or, if we prefer, sequentially.

### Sequential approach:

For each *useful* OOI we can perform an individual EKF update. We can process them sequentially because the noises that affect those measurements are independent.

### How to do that?

Suppose you have 3 OOIs. Then you will process the first one, so that you will get a **posterior** PDF (its expected value and covariance matrix). Then you proceed with the 2<sup>nd</sup> OOI, but now the prior PDF is the posterior PDF we got after processing the first OOI. Thus, we get a new posterior PDF (updated expected value and covariance matrix). That PDF is now the prior of the subsequent update (based on the 3<sup>rd</sup> OOI). And so on, you repeat this as many times as useful OOIs you have, in that LiDAR event.

The *output equation*, for all of them, does have the same structure.

$$\text{range} = \mathbf{h}(\mathbf{x}) = \sqrt{(x_k - x)^2 + (y_k - y)^2}$$

(we “measure” it from the OOI position in the vehicle’s CF). That range has the role of the measurement in our EKF update.

The couple  $(x_k, y_k)$  is the position, in GCF, of the landmark that is associated to the OOI being processed.

Our measurement are scalars, so that the **R** matrix is a scalar (as 1x1 matrix), and the Jacobian matrix **H** is 1x3.

The rest of the details are those related to the general procedure of the EKF update,

In our program we do already have everything that is needed: In the LiDAR event we process the LiDAR scan (or scans if we use both LiDARs). We process those scans to detect OOIs, we perform DA, so we refine the list to a list of useful OOIs (i.e. those who have been associated to landmarks). We get the positions, in the vehicle CF, of those useful OOIs, and we calculate the modulus (range) of each of those positions. Those ranges are now our measurements.

All those mentioned calculations were solved in project 1, parts B and C. In project 2 we simply add the EKF updates.