Kalman filter tuning and consistency – Motion and measurement models

Sensor fusion & nonlinear filtering

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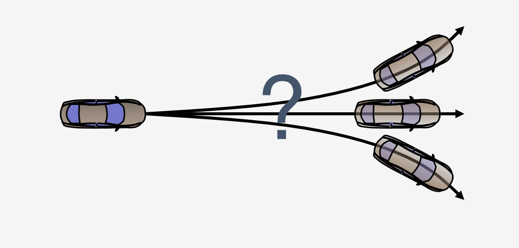
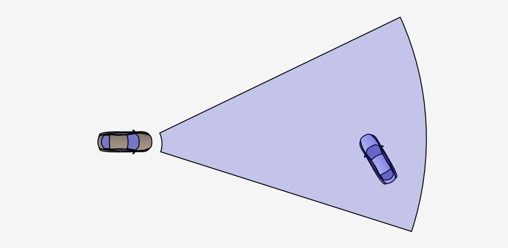
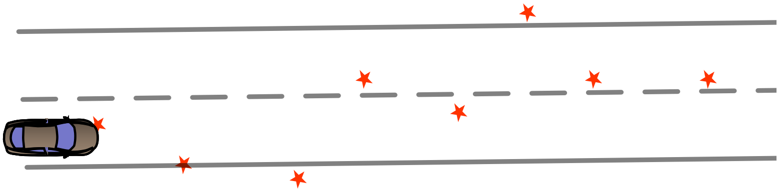
TUNING MOTION AND MEASUREMENT NOISE COVARIANCES

$p(\mathbf{x}_k | \mathbf{x}_{k-1}) = \mathcal{N}(\mathbf{x}_k; \mathbf{A}_{k-1}\mathbf{x}_{k-1}, \mathbf{Q}_{k-1})$:



$p(\mathbf{y}_k | \mathbf{x}_k) = \mathcal{N}(\mathbf{y}_k; \mathbf{H}_k\mathbf{x}_k, \mathbf{R}_k)$:





TUNING MOTION AND MEASUREMENT NOISE COVARIANCES

- A key aspect in tuning is to select the SNR $\|\mathbf{Q}\|/\|\mathbf{R}\|$:
  - If SNR is large $\Rightarrow$ a quickly adapting filter that relies more on new data than predictions.
  - If SNR is low $\Rightarrow$ the data is noise and we rely more on the predictions, the filter thus adapts slowly to data.
- The sensor noise, $\mathbf{R}$, is often described by the manufacturer and/or possible to collect data from which it can be estimated.
- The motion noise, $\mathbf{Q}$, is then selected by tuning.
- Unless you know the state sequence, study properties of the innovation to guide the tuning of the filter.

SELF-ASSESSMENT

If we design our filter such that the motion noise $\|\mathbf{Q}\|$ is small and the measurement noise $\|\mathbf{R}\|$ is large we get:

- a filter that adapts quickly to changes.
- a filter that adapts slowly to changes.
- we cannot select $\|\mathbf{Q}\|$ and $\|\mathbf{R}\|$ ourselves since they depend on the real system.

Check all that apply.