Probability hypothesis density filter

- Algorithm for multi-sensor multi-target tracking
- Unknown number of targets,
- Includes both filtering and data association,
- Propagates the posterior intensity, a first order statistical moment of an RFS.

Gaussian Mixture PHD

The posterior intensity
\[ v_{k|k}(x) = \sum_{i=1}^{J_{k|k}} w_{k|k}^{(i)} N(x; m_{k|k}^{(i)}, P_{k|k}^{(i)}) \]
calculated by the PHD filter can be viewed as a spatial intensity map over the concentration of fixed objects.

A random finite set (RFS) is a set with a random number of stochastic states variables
\[ X_k = \left\{ x_k^{(1)}, \ldots, x_k^{(N_x,k)} \right\}. \]
Each state represents the position of a stationary point object
\[ x_k^{(i)} = [x^{(i)}, y^{(i)}]^T. \]

Algorithm

Time Update:
\[ v_{k+1|k}(x) = v_{S,k+1|k}(x) + v_{\beta,k+1|k}(x) + \gamma_{k+1}(x), \]
\( v_{S,k+1|k} \) is the intensity of the RFS containing the predicted and surviving states.
\( v_{\beta,k+1|k} \) is the intensity of the RFS spawned by the targets with previous state \( x_k|k \in X_k|k \).
\( \gamma_{k+1} \) is the intensity of the birth RFS \( \Gamma_{k+1} \).

Measurement Update:
\[ v_{k|k}(x) = (1 - p_D) v_{k|k-1}(x) + \sum_{z \in Z_k} v_{D,k|k}(x|z). \]
A state \( x \in X \) is detected with probability \( p_D \).
The Gaussian components \( N(m_{k|k}^{(i)}(z), P_{k|k}^{(i)}) \) of the updated intensity \( v_{D,k|k}(x|z) \) are calculated using the UKF.