Vehicle Tracking with Disjoint Coverage Regions

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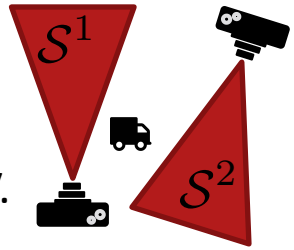
Objective

Incorporate negative information evidence into Bayesian filtering for vehicle tracking

Evidence:

Object present ***outside*** FoV.



Joint FoV

$$\mathcal{S} = \mathcal{S}^1 \uplus \mathcal{S}^2$$

Theory

FoV-dependent probability of detection

$$p_D(\boldsymbol{x}; \mathcal{S}) = p_D(\boldsymbol{x}) \cdot 1_{\mathcal{S}}(\boldsymbol{x})$$

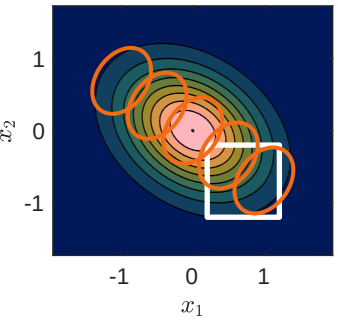
Posterior distribution, conditioned on non-detection

$$p(\boldsymbol{x} \mid \neg D) \propto (1 - 1_{\mathcal{S}}(\boldsymbol{x}) p_D(\boldsymbol{x}))\, p(\boldsymbol{x})$$

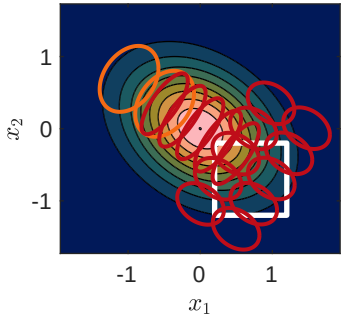
Approach

1. Refine Gaussian mixture pdf at FoV boundaries through recursive Gaussian splitting

Recursion 1

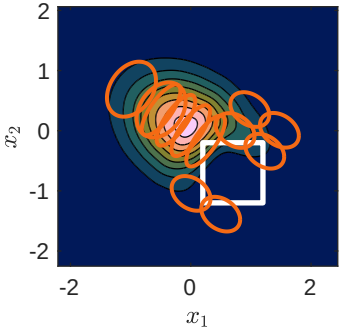


Recursion 2

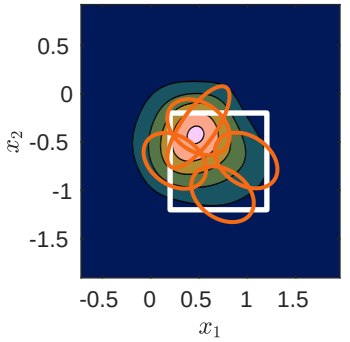


2. Random finite set Bayes update:

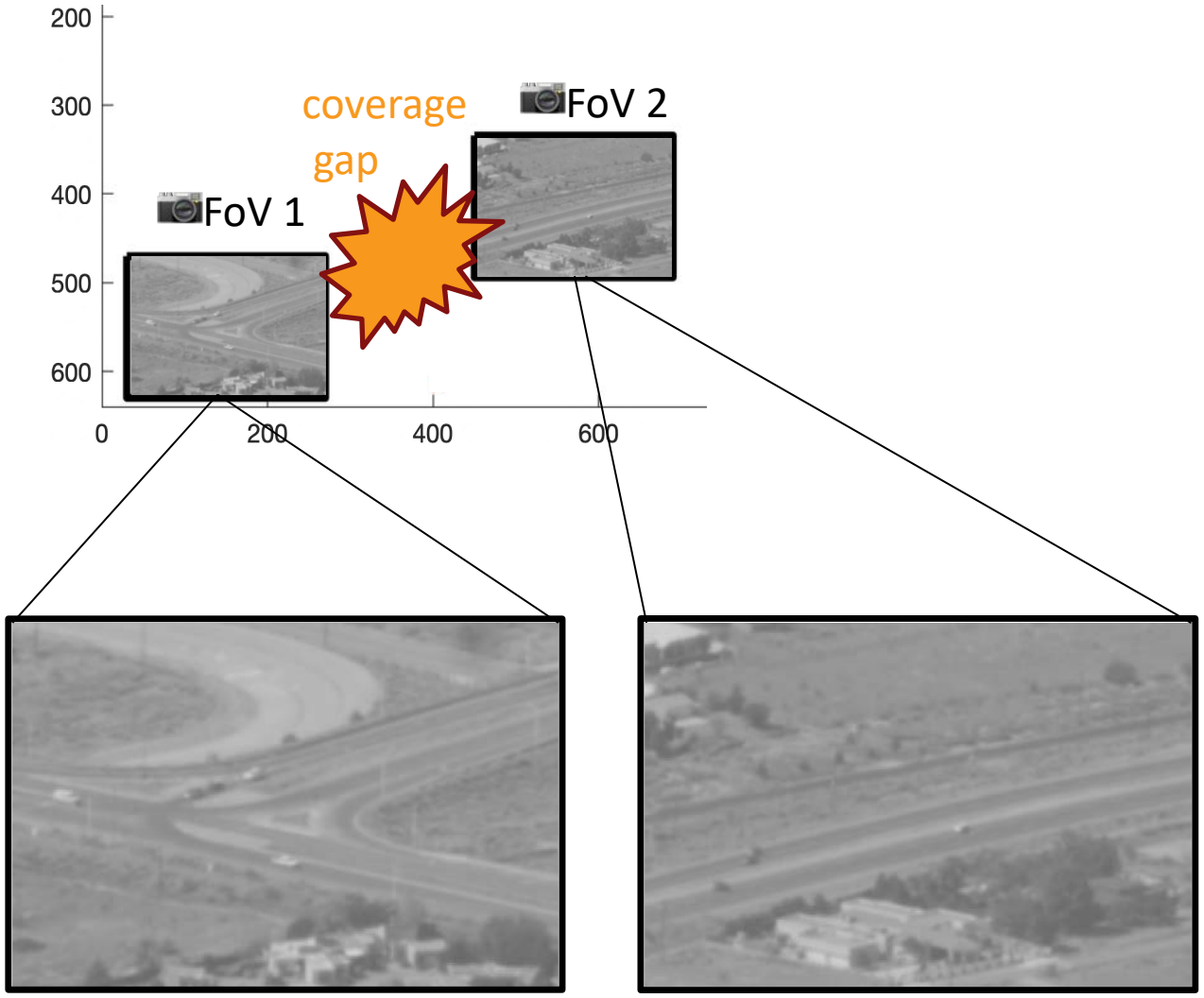
$p(\boldsymbol{x} \mid \neg D)$



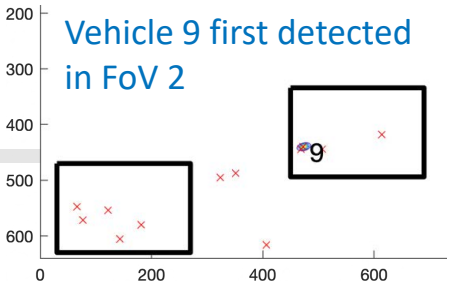
$p(\boldsymbol{x} \mid D)$

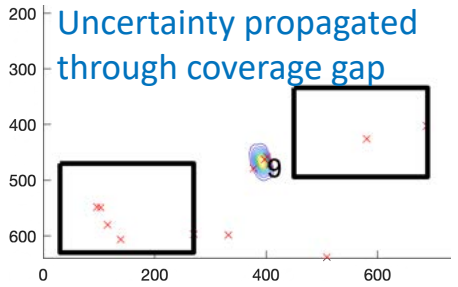


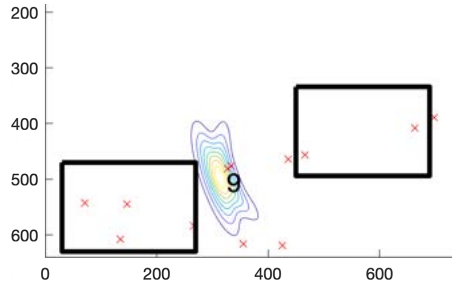
Multi-sensor Multi-vehicle Tracking Example

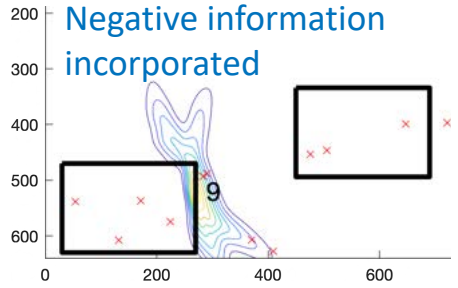


Time









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References

- K. LeGrand and S. Ferrari, "The Role of Bounded Fields-of-View and Negative Information in Finite Set Statistics (FISST)," *2020 IEEE 23rd International Conference on Information Fusion (FUSION)*, Rustenburg, South Africa, 2020, pp. 1-9, doi: 10.23919/FUSION45008.2020.9190174.