

Introduction

- Tracking of ground targets is more challenging than air-targets because of
 - higher target density
 - high clutter and
 - low visibility.
- Prior information like road maps can enhance the tracking performance.

On-road/Off-road Targets

- Targets of interest mostly stay on the roads whose maps are available.
 - On-road target models are highly constrained.
- However,**
- Digital maps might lack some road segments.
 - Drivers might violate traffic rules.

- Targets can move off-road.
 - ⇒ Use multiple models: One constrained to roads (on-road), second unconstrained (off-road).

Existing Multiple Model PFs

Bootstrap Multiple Model PF (BS-MMPF):

- Consider discrete (model) and continuous variables as a single state.

Problem: Number of particles for each model are determined according to posterior model probabilities.

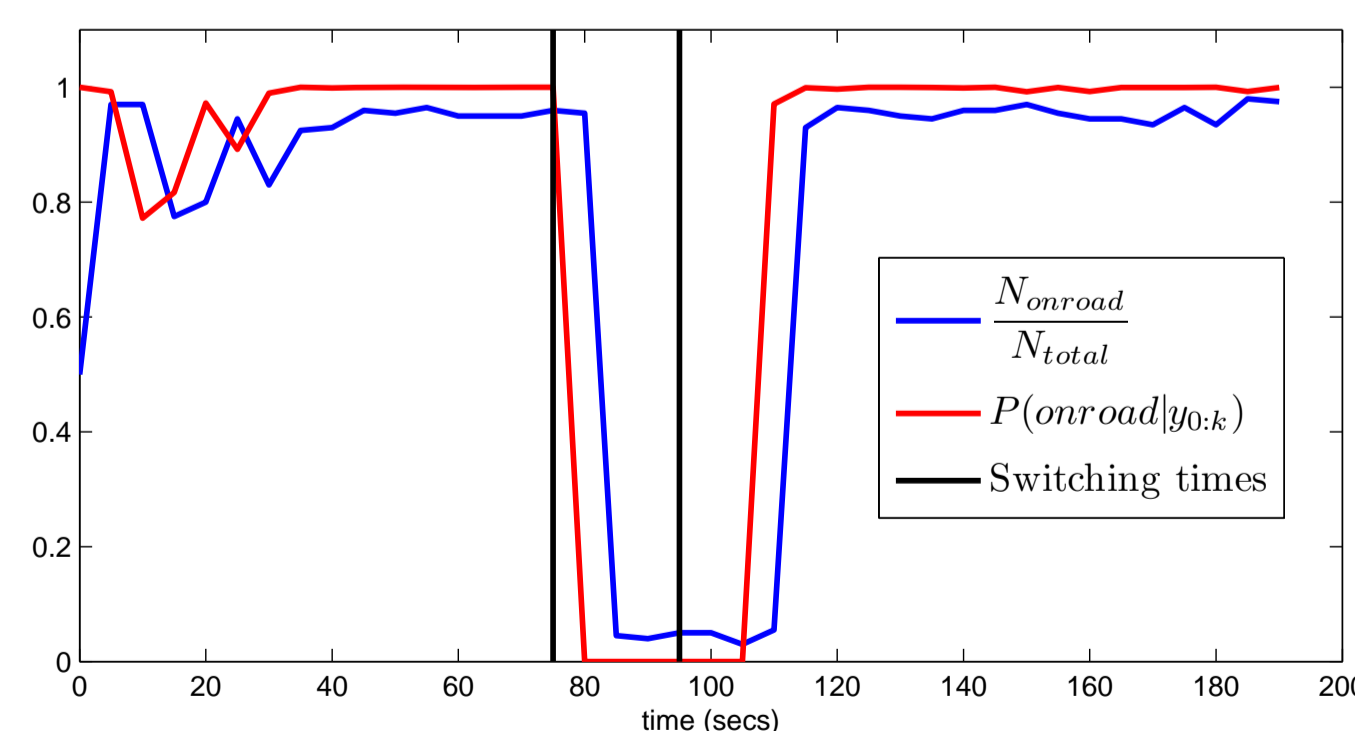


Figure 1: Posterior model probabilities vs. Ratio of number of particles for BS-MMPF.

Consequence: Models are not represented well during the switchings.

IMM-PF

- Proposed by Boers and Driessen in 2003.
- Uses a predetermined number of particles for each model.
- Mixes the results of two separate particle filters.
- It is applied to on-road/off-road target tracking in this study.

Simulations

- Nearly constant velocity models for on-road and off-road models.
- Bearing only measurements from a UAV.
- Run two particle filters:
 - BS-MMPF: $N = 2000$ particles
 - IMM-PF: $N_{offroad} = 1500$, $N_{onroad} = 500$

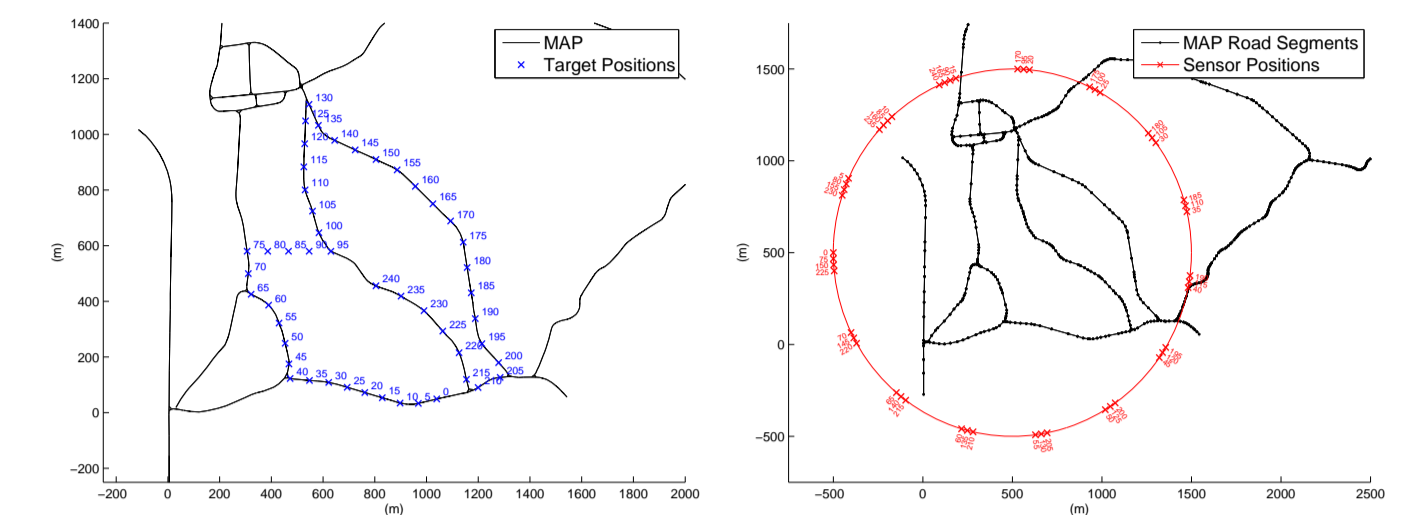


Figure 2: Simulation scenario.

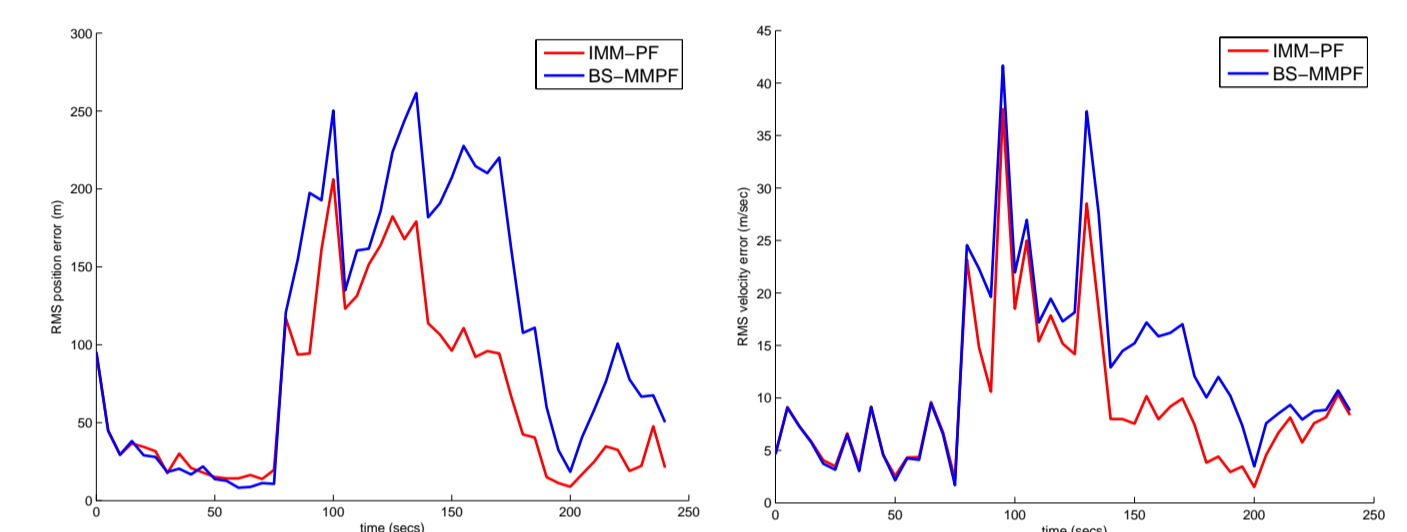


Figure 3: Average estimation errors.

Conclusions

- Usage of off-road models along with restricted onroad models robustifies particle filters.
- Keep a constant number of particles in each mode if sharp switchings are expected.

References

- [1] U. Orguner, T. B. Schön, and F. Gustafsson, "Improved target tracking with road network information," *Proceedings of IEEE Aerospace Conference 2009*, Big Sky, Montana, USA, Mar. 2009.