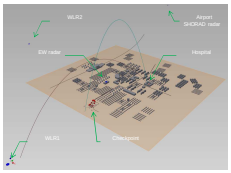
Data fusion for low level air-space

RAM detection, tracking and recognition

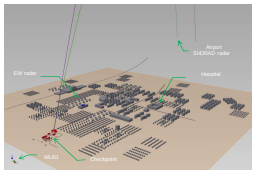
M. Sankowski (BE), J. Lagoutte (TR6) , T. Rutkowski (BE)

Simulation scenario – rockets and mortars

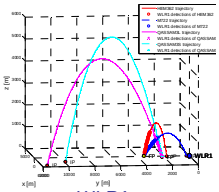
- MOOTW scenario
- Mortars: 60 and 81-mm
- Rockets: Qassam-3
- Weapon Locating Radars (WLR1 and WLR2)
- SHORAD radar (ASR)
- Mortar EW radar
- Vehicles (area near LP)



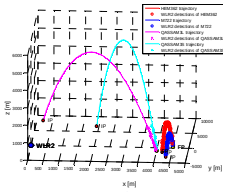
mortar scenario



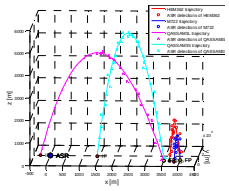
rocket scenario



WLR1



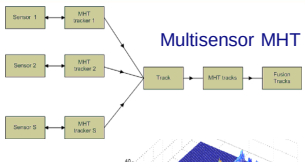
WLR2

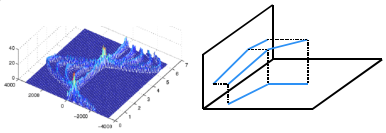


ASR

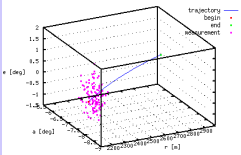
Multisensor track formation of RAM tracks

- Qassam-3 (long)
- Qassam-3 (short)
- False alarms
- Shadowing
- Degraded accuracy of radar measurements
- Two vehicles near LP - unwanted detections





Multisensor 3D Hough transform

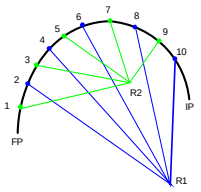


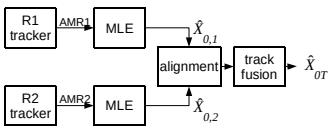
A car „seen" by WLR1

Performance parameter	HT track initator			MHT track initiator		
	WLR1	WLR2	fused	WLR1	WLR2	fused
P_{CT1}	1	1	1	1	1	1
P_{CT2}	1	0.87	1	1	1	1
T_{D1} [s]	0.89	2.1	0.7	1.01	1.84	0.86
T_{D2} [s]	1.67	2.52	1.45	1.05	2.03	0.79
False tracks (avg.)	0.43	3.07	0.27	0.24	1.7	0.17
Mixed tracks (avg.)	0.29	0.43	0.29	0.07	0	0.1

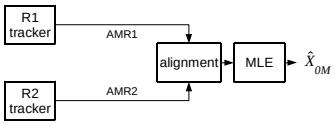
Measurement and track fusion using batch filters

- Radars R1 and R2 provide sequences of measurements AMR1 and AMR2
- Sequences can be:
  - processed separately and then fused (track fusion approach)
  - aligned and processed together (measurement fusion)



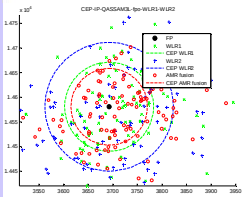


track fusion

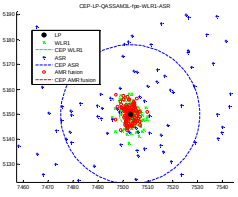


measurement fusion

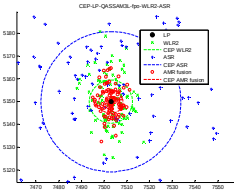
FP and IP Circular Error Probable estimates



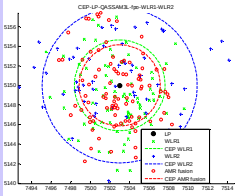
LP: WLR1 + WLR2



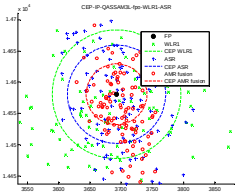
LP: WLR1 + ASR



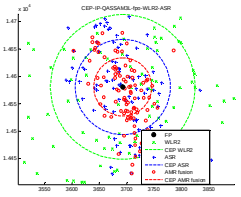
LP: WLR2 + ASR



IP: WLR1 + WLR2



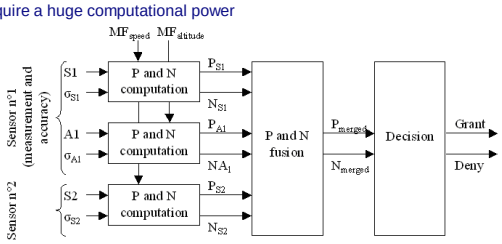
IP: WLR1 + ASR



IP: WLR2 + ASR

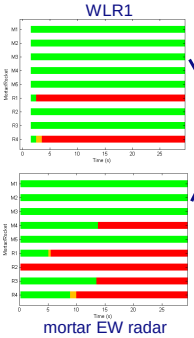
Mortar and Rocket recognition : principles

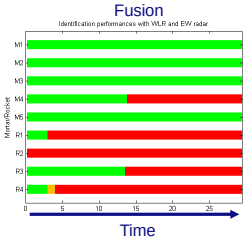
- Different methods to merge decisions classification:
  - Probability theory (Bayes)
  - Evidence theory (Dempster-Schafer)
  - Possibility theory (Fuzzy logic) ← Choosen for D-FUSE
    - Error rate control
    - Performance robust to error measurements
    - Possibility of no decision
    - Not require a huge computational power

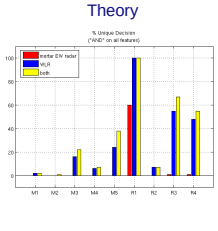


Mortar and rocket recognition : performances

- Fusion of features measured by different sensors:
  - Range
  - Radial speed
  - Apogee
  - Initial velocity
  - Flight time
  - (context data can be added)







- **Better recognition performance**
- **Faster decisions of recognition**

Target type in the scenario : M1 – 60-mm mortar

The R&T Project D-FUSE (Data Fusion in Urban Sensor Networks) is contracted by the European Defence Agency on behalf of Members States contributing to the Joint Investment Programme on Force Protection

For information contact: miroslaw.sankowski@pit.gda.pl, julien.lagoutte@thalesgroup.com