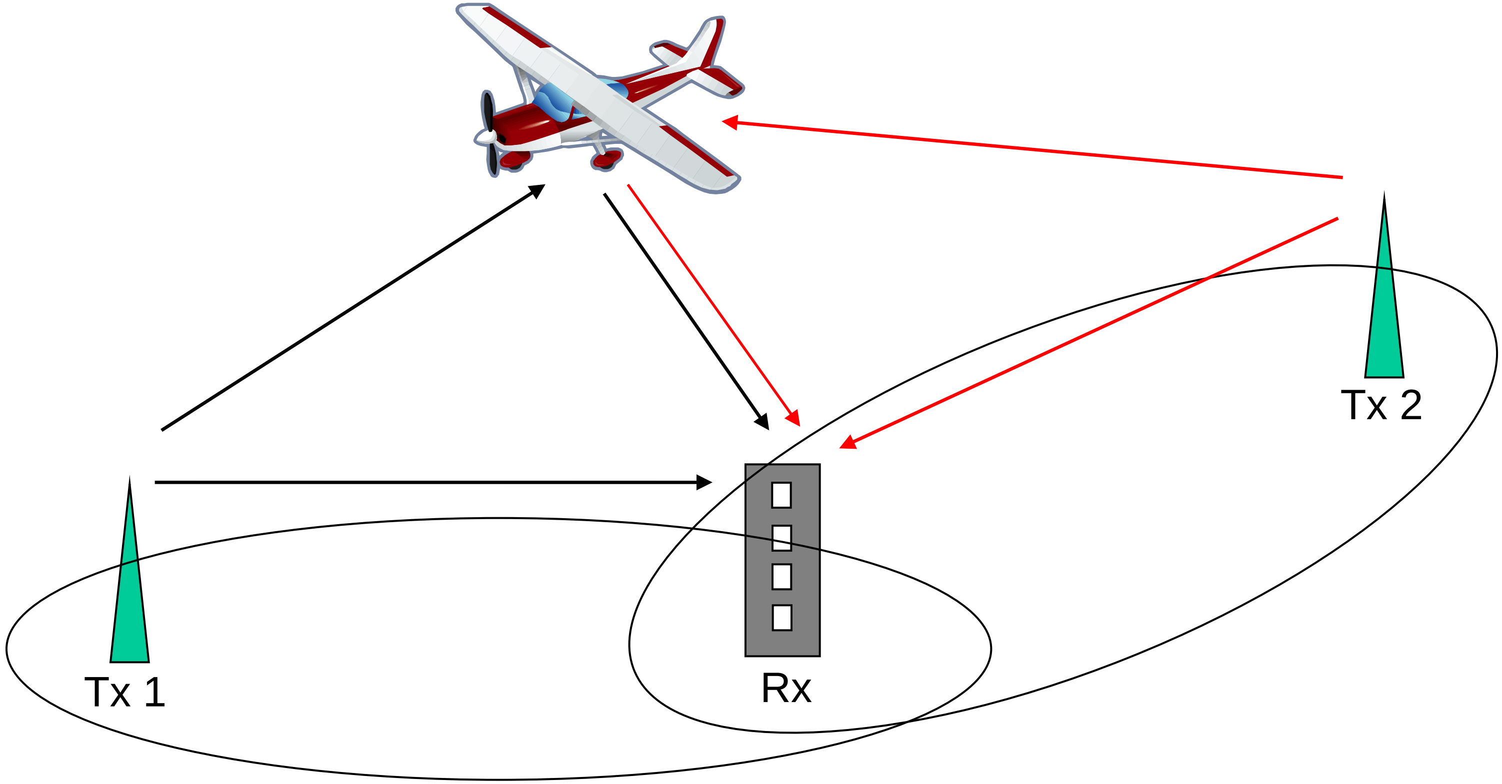
What is passive radar ?

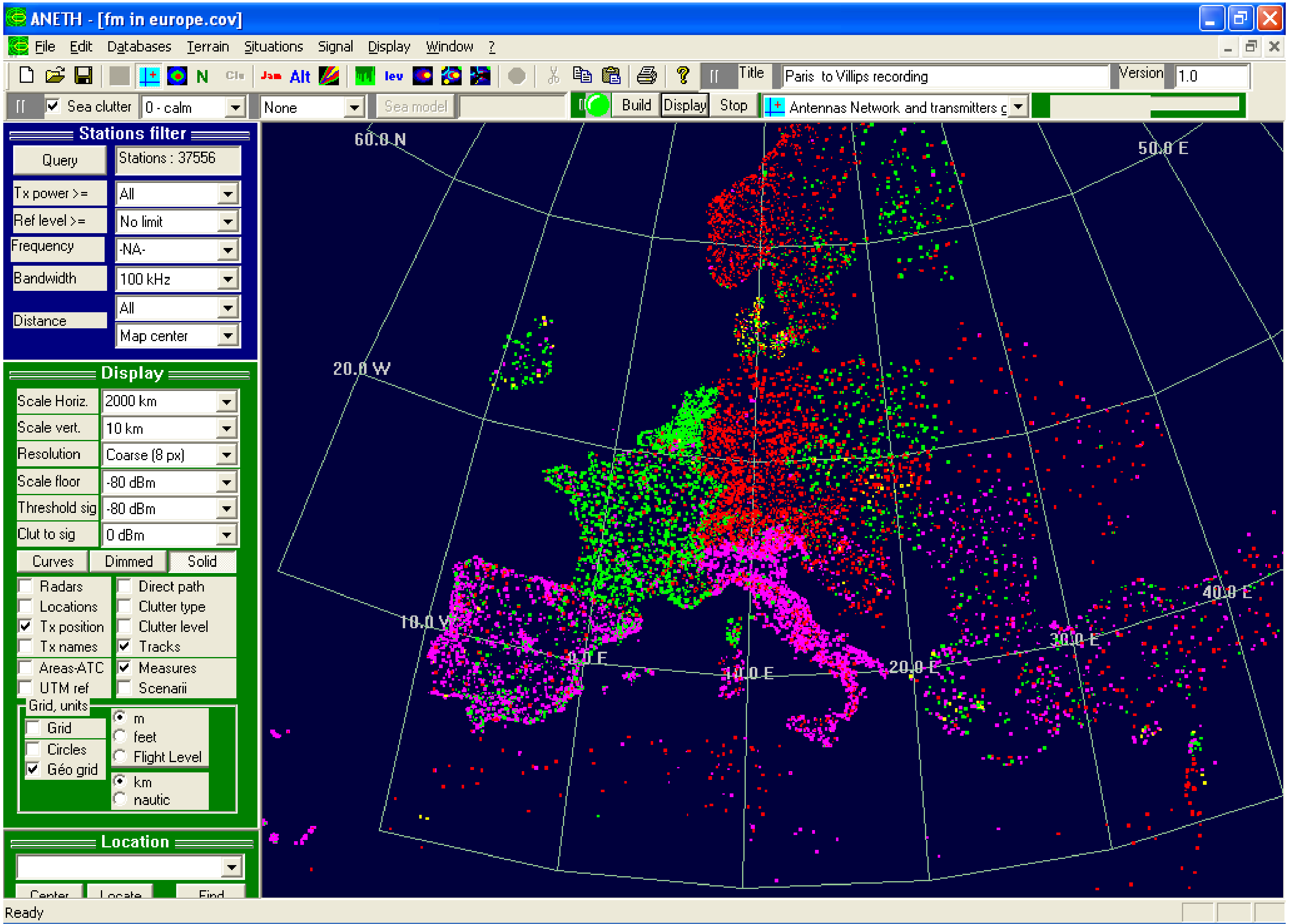
Passive radar is a form of bistatic radar
that exploits illuminators of opportunity



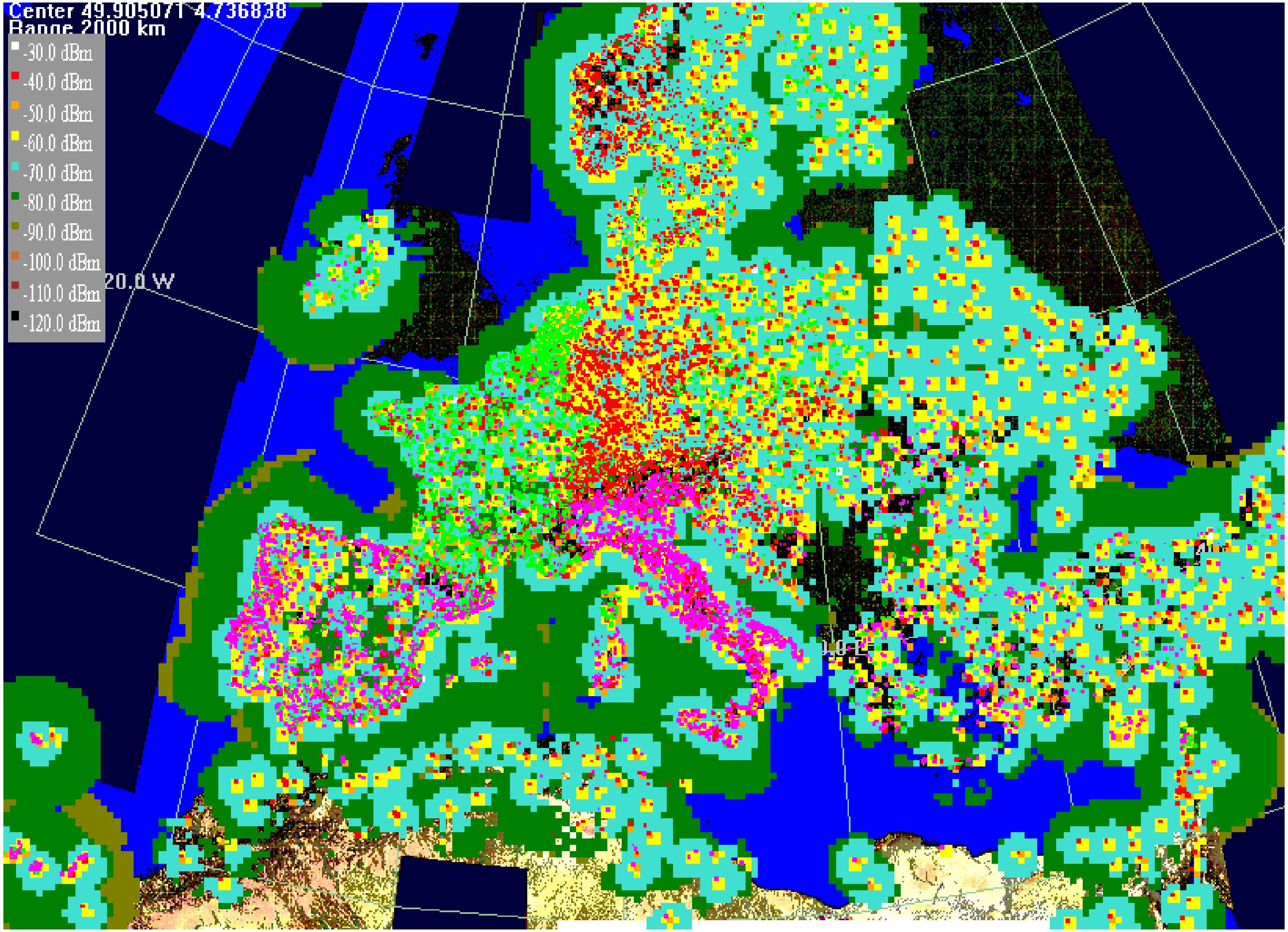
Why passive radar ?

- Good low level coverage
- Passive
- Large number of transmitters
- High location accuracy
- High tracking accuracy
- Spatial diversity
- Frequency diversity
- Low cost
- No addition to spectral congestion
- Counter to stealth
- Graceful degradation
- Fixed transmit antennas
- Complement to existing systems

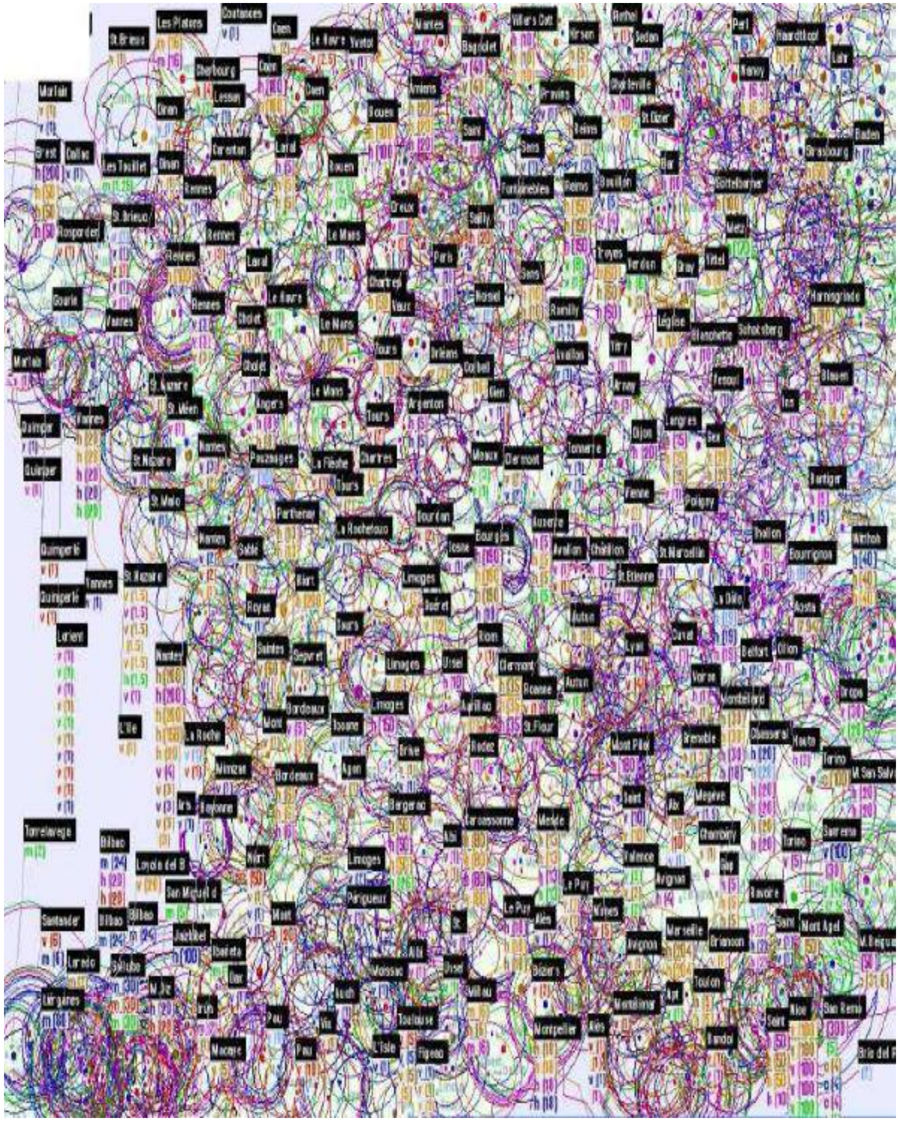
FM transmitter density



FM field


Center 49.905071 4.736838
Range 2000 km
-30.0 dBm
-40.0 dBm
-50.0 dBm
-60.0 dBm
-70.0 dBm
-80.0 dBm
-90.0 dBm
-100.0 dBm
-110.0 dBm
-120.0 dBm
20.0 W

Map of emitters in France with power > 1 kW



Courtesy: Thales

Applications

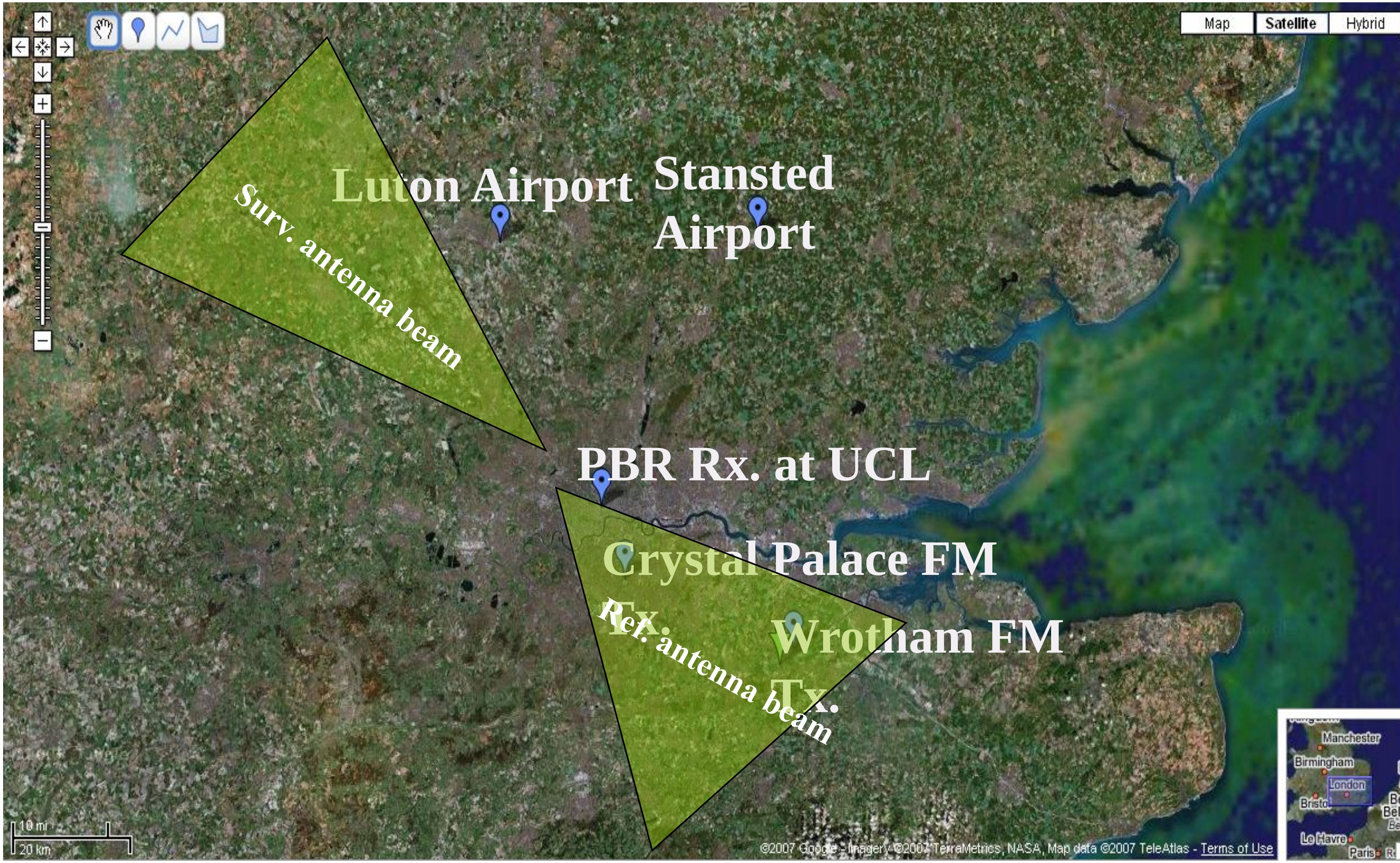
- Defense and Security

  - ❑ Air Defence
  - ❑Protection of sensitive sites (nuclear power stations, World summits, oil decks, etc)
  - ❑ Coastal surveillance (illegal Immigration, smuggling, etc)
  - ❑ Operations outside theatre
  - ❑ Projection of security in operations of stabilization or assertion of peace
  - ❑ Air-traffic control
  - ❑ Naval surveillance
  - ❑ Integration with existing systems
  - ❑ Protection of airports

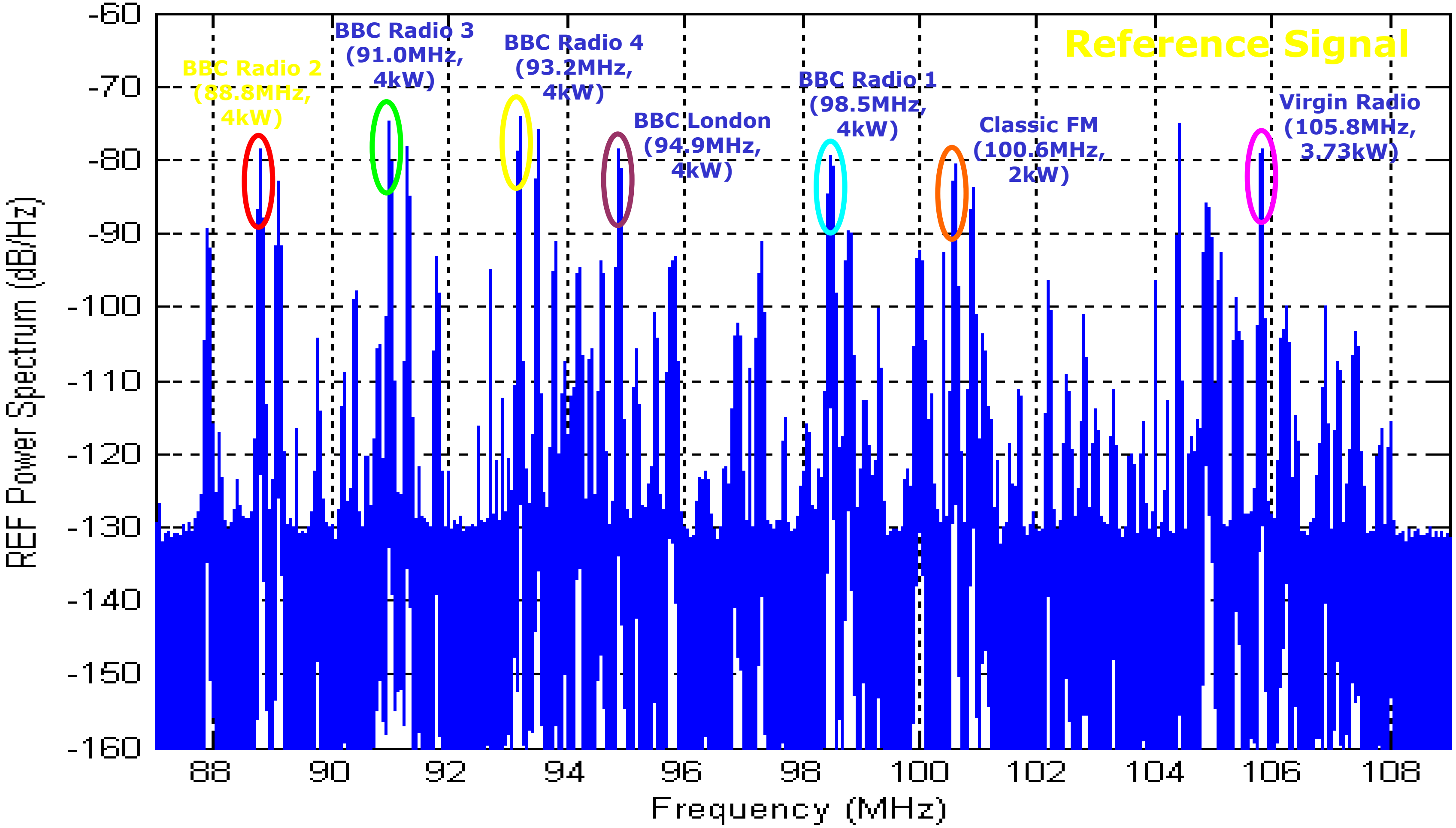
Issues

- No control over the transmitter or transmitted waveform - it is not optimised for radar purposes.
- Direct signal leakage into the surveillance (detection) channel will limit range performance.
- Geometry – Often transmitters are in unfavourable positions.
- Some areas have poor broadcast coverage.
- Easy to jam the receiver if it’s position is known.
- In FM PBR, detection is dependent on programme content.
- Antenna beam-shaping and angular nulling is more difficult at lower frequencies unless an array is used.

Does the achievable performance allow cost effective application?


Map
Satellite
Hybrid
Luton Airport
Stansted Airport
Surv. antenna beam
PBR Rx. at UCL
Crystal Palace FM Tx.
Ref. antenna beam
Wrotham FM Tx.
10 mi
20 km
©2007 Google - Imagery ©2007 TerraMetrics, NASA, Map data ©2007 TeleAtlas - Terms of Use
Manchester
Birmingham
London
Le Havre
Paris

VHF FM band



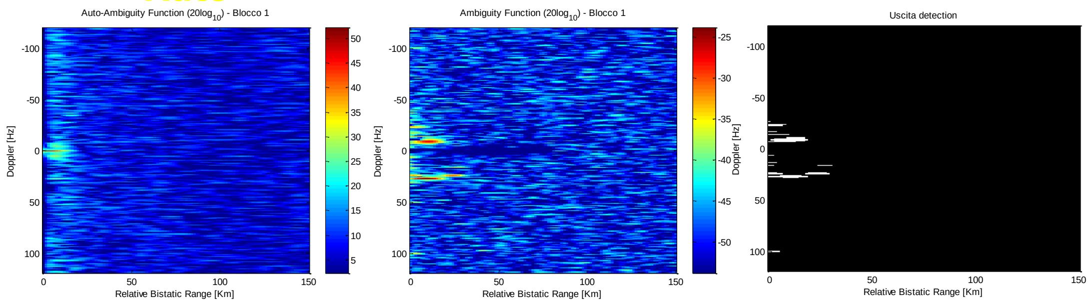
Reference Signal
BBC Radio 2 (88.8MHz, 4kW)
BBC Radio 3 (91.0MHz, 4kW)
BBC Radio 4 (93.2MHz, 4kW)
BBC London (94.9MHz, 4kW)
BBC Radio 1 (98.5MHz, 4kW)
Classic FM (100.6MHz, 2kW)
Virgin Radio (105.8MHz, 3.73kW)
REF Power Spectrum (dB/Hz)
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
88
90
92
94
96
98
100
102
104
106
108
Frequency (MHz)

Acquisitions – 11/03/07

88.8 MHz – Crystal Palace

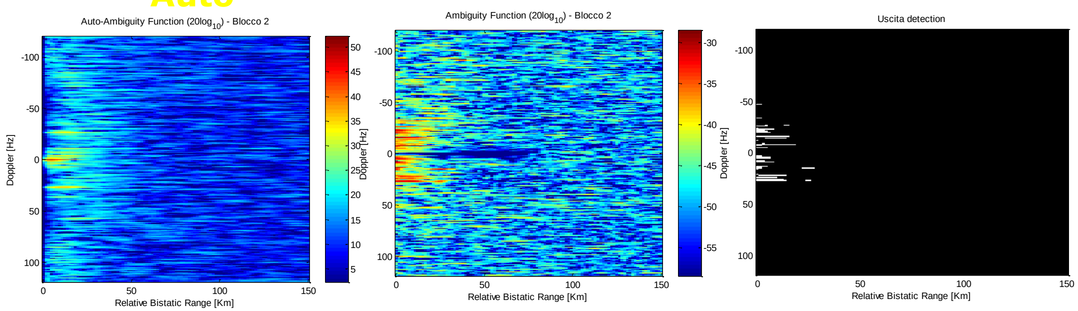
Analysis over the 0-1 sec acquisition

Auto



Analysis over the 1-2 sec acquisition

Auto

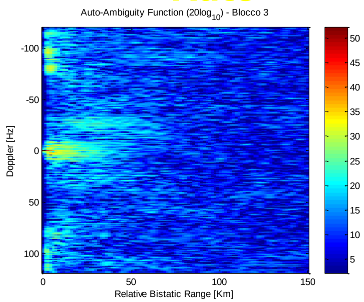


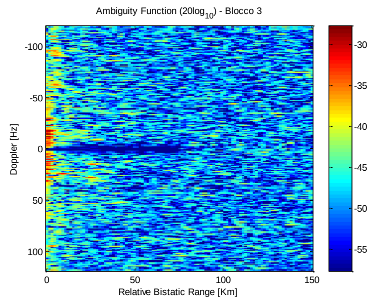
Acquisitions – 11/03/07

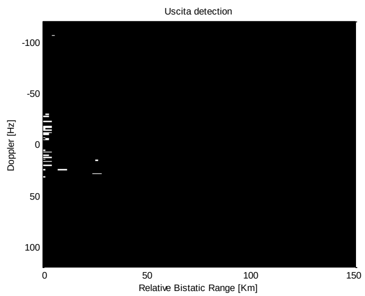
88.8 MHz – Crystal Palace

Analysis over the 2-3 sec acquisition

Auto

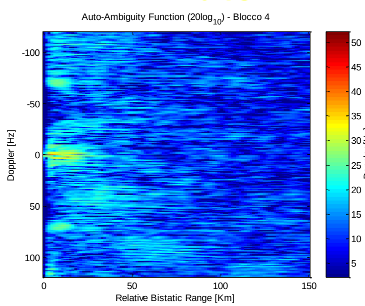


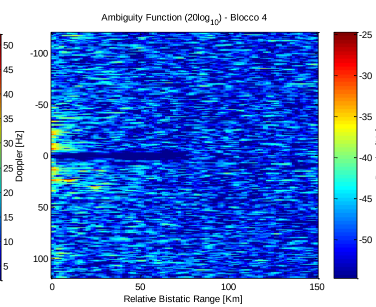


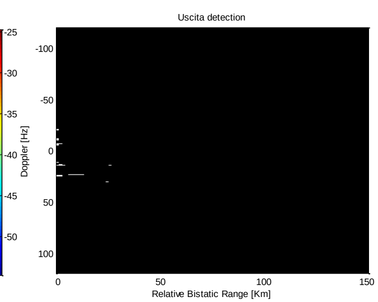


Analysis over the 3-4 sec acquisition

Auto





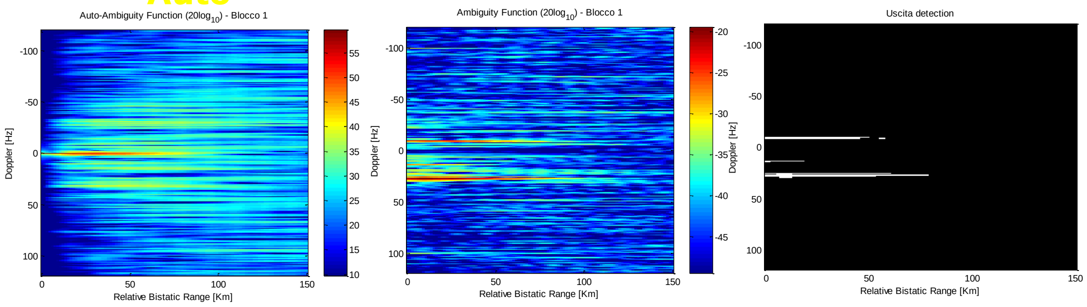


Acquisitions – 11/03/07

91.0 MHz – Crystal Palace

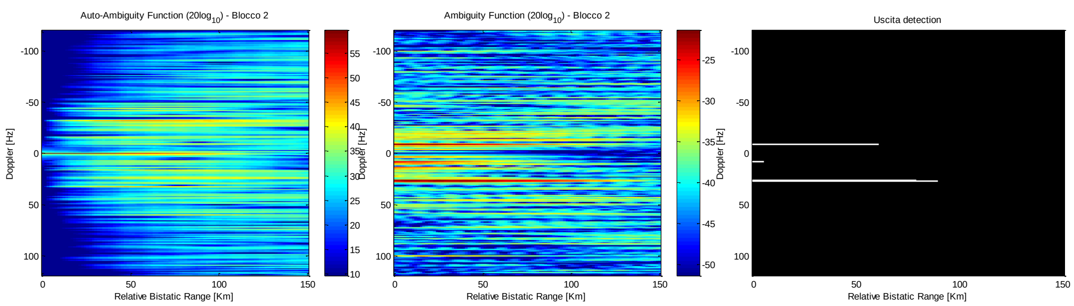
Analysis over the 0-1 sec acquisition

Auto



Analysis over the 1-2 sec acquisition

Auto

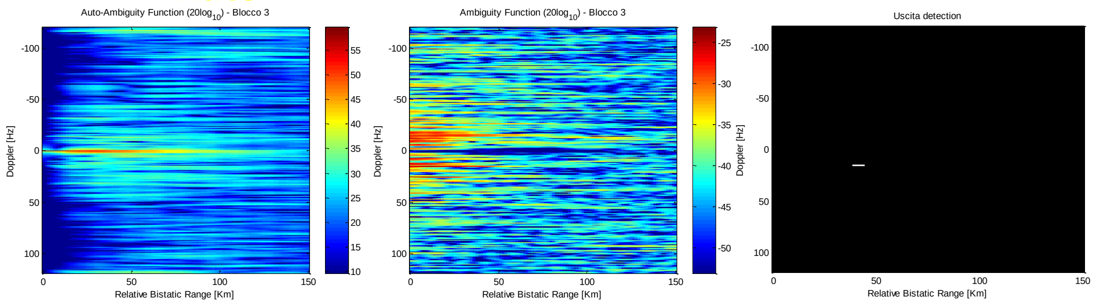


Acquisitions – 11/03/07

91.0 MHz – Crystal Palace

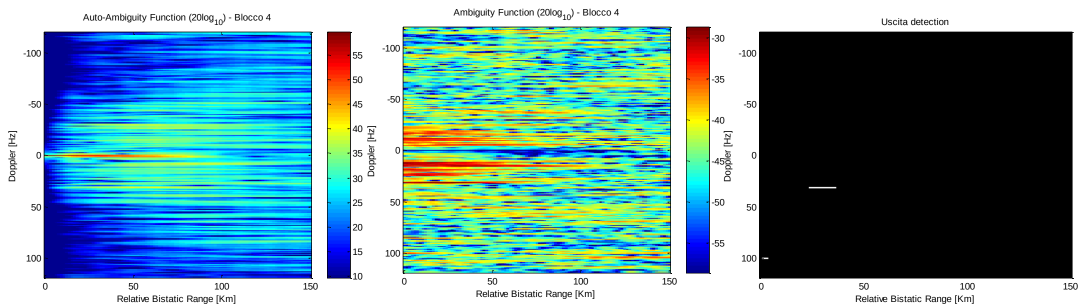
Analysis over the 2-3 sec acquisition

Auto



Analysis over the 3-4 sec acquisition

Auto

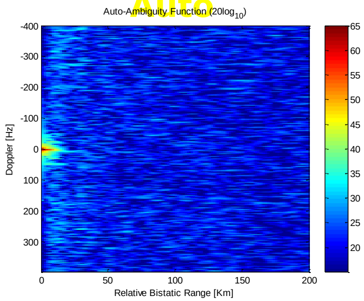


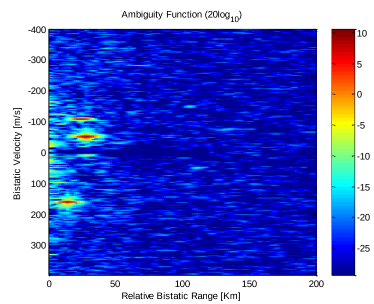
Acquisitions – 25/04/07

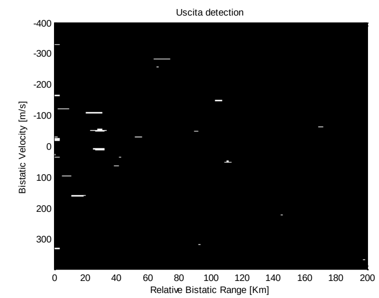
91.3 MHz – Wrotham

Analysis over the 0-1 sec acquisition

Auto

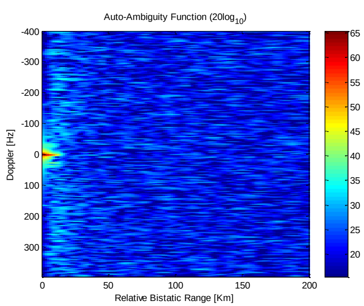


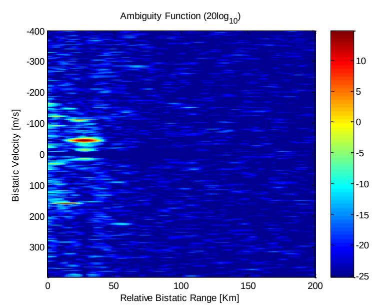


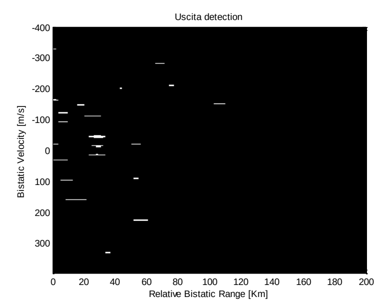


Analysis over the 1-2 sec acquisition

Auto





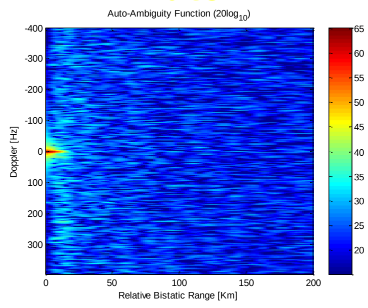


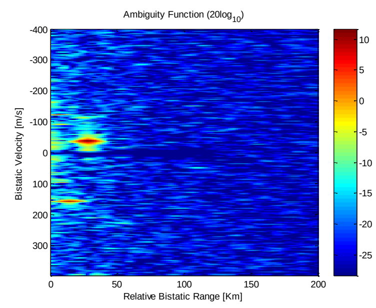
Acquisitions – 25/04/07

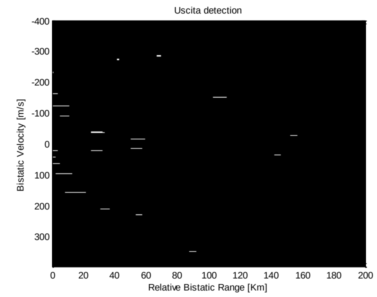
91.3 MHz – Wrotham

Analysis over the 2-3 sec acquisition

Auto

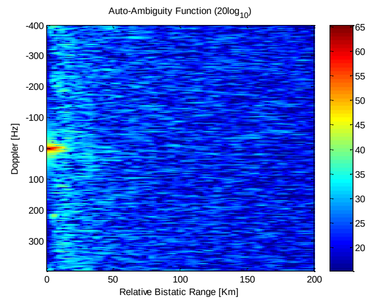


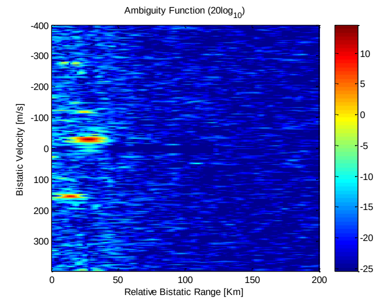


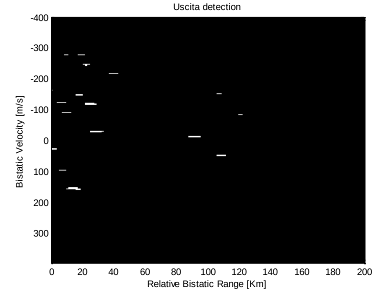


Analysis over the 3-4 sec acquisition

Auto

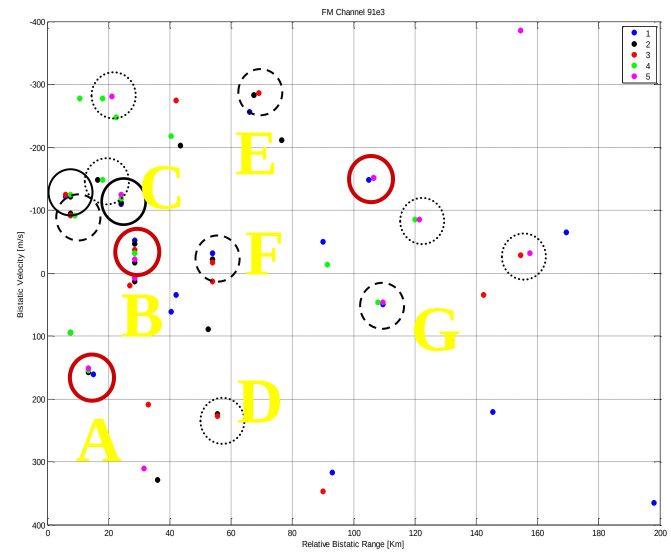






Acquisitions – 25/04/07

Overall Analysis over the 0-5 sec acquisition



SBS-1 Screen
Mode S/ADS-B
Receiver
(Kinetic Avionic)

Summary

- PBR potentially attractive for Air Defence applications
- PBR can provide low cost long range aircraft detection
- Interference must be fully understood and removed
- Impact of time varying waveforms must be taken into account
- Multistatics required for target location
- In principle low cost but to be proven
- Tracking achieved via angle and Doppler
- Target and clutter properties are largely unknown
- High resolution is possible
- Digital netted transmissions offer advantages
- Mobile PBR?

- Thales
  - Simon Watts
  - Andy Stove
- The University of Rome
  - Fabiola Colone
  - Pier Francesco Lombardo
- UCT
  - Mike Inggs
- UCL
  - Karl Woodbridge
  - Hugh Griffiths
  - Daniel O’Hagan
  - James Brown