Multifunctional Sensors for Air Defence
Daniele Guiducci - Air Defence Systems Marketing
Multifunctional Sensors for Air Defence

- Multifunctional Radar Architecture and AESA Technology
- Key capabilities of multifunctional radars and AESA Technology
- Selex ES family of multifunctional radar systems
- Conclusions
Multifunctional Radar Architecture
Multifunctional Radars

Tasks

System able to provide simultaneously the following main functions:
Multifunctional Radars

Task allocation

### Surveillance Functions
- Air surveillance
- Surface surveillance
- IFF Interrogation (option)

### Tracking Functions
- Threat evaluation
- Dedicated tracking:
  - High Priority Tracking
  - Low Priority Tracking
- Track While Scan (TWS)

### Firing Functions
- Dedicated tracking for active missile guide
- Missile Up-Link
- Gunfire Support

### ECCM Functions
- Wide band high frequency agility
- Automatic Least Jammed Frequency Selection
- Side Lobe Blanking (SLB)
- Jammer detection
- Track On Jammer (TOJ)
- Side Lobe Cancellation (SLC)
- Main Beam Cancellation (MBC)

### ATBM Functions
- ATBM on Cueing
- ATBM Autonomous
Multifunctional Architecture

Scheduler and antenna

- **Scheduler** for a real-time allocation of the time/energy budget to the different activities (search, tracking, auxiliary, ...) according to the current operative scenario
- **Antenna** with azimuth and elevation scanning capability \((\pm \text{Az}, \pm \text{El})\)

Variable dwell time & Variable data rate with constant mechanical antenna rotation rate (60rpm)

EACH PART OF THE RADAR IS DESIGNED TO ADAPT ALGORITHMS TO THE SCENARIO
Key capabilities of multifunctional radars and AESA Technology
Adaptive update rate

Tracking

According to the Threat Evaluation results, different priorities and tracking with different refresh rates are assigned to the threat:

- **HPT** (High Priority Tracking) for close and fast targets
- **LPT** (Low Priority Tracking) for slow targets
- **TWS** (Track While Scan) with the Operative Mode update period

More power and highest refresh rate for dangerous threats
Dedicated target tracking

Dedicated Tracking

No specific Engagement Mode required

• Dedicated Tracking for dangerous threats in all the operative modes
  • Max updated rate (High Priority Tracking)
  • Tracking waveform optimization according to:
    • Target kinematics and Received SNR
    • Estimated clutter
  • Threat Evaluation Re-assessment every track update
• Track While Scan (TWS) only for less dangerous threats
In case of fading multi-beam activity is performed to improve track maintenance.

External designation (2D and 3D) activities may require more than one task with different beam pointing directions, all in the same scan in a rapid sequence.
Scanning Technique

Multifunctional Vs 3D

**Multifunctional Pencil Beam**

- Search directions scanned one by one with pencil beam
- 60 rpm

**3D Stacked beam**

- Search directions scanned simultaneously defocusing TX beam
- 20 rpm

<table>
<thead>
<tr>
<th></th>
<th>Multifunctional Pencil Beam</th>
<th>3D Stacked Beam</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time on Target/Waveform</strong></td>
<td>Optimized for each beam</td>
<td>Fixed</td>
</tr>
<tr>
<td><strong>Surveillance Data Rate</strong></td>
<td>Selected for each beam</td>
<td>Fixed</td>
</tr>
<tr>
<td><strong>Tracking Data Rate/Track Initialization</strong></td>
<td>Adaptive</td>
<td>Fixed</td>
</tr>
<tr>
<td><strong>Resistance to Jammer</strong></td>
<td>Beam to beam diversity</td>
<td>One frequency for all beams</td>
</tr>
</tbody>
</table>

*) all numbers shown are an example
Gunfire support

- Multifunctional radars are also able to manage several Gunfire Support windows, regardless of the surveillance operative mode.
- Dedicated radar activities updated as HPT task without affecting the detection performance.

**Surface tracking with maximum update rate**

- **On Position**
  (3D position, time of intercept)
- **On Track**
  (Track number)

GUNFIRE SUPPORT

FCS BACK UP
Tactical functions

C-RAM Capability

Operative mode or additional task for Weapon Location and Fire Control

- Two dedicated C-RAM modes
  - Rotating antenna for 360° coverage
  - Fixed antenna for 90° coverage with improved detection
- High refresh rate for low Warning Time against RAM threats
- Launch Point estimation and Impact Point estimation with outstanding accuracy
Dedicated tracking for active missile guidance

Multifunctional radars support full performance of modern medium range SAM-systems including those armed with active missiles

Embedded Up-Link for missiles
AESA technology
High Reliability - Graceful Degradation

• **Absence of TWT** and related High Voltage

• **Graceful degradation** related to the active full phased array antenna (**water cooled**). The radar sensor can operate with several TRMs out of order, allowing the mission to be fulfilled with only a graceful degradation of the performance.

**AESA antenna**
Graceful degradation

**Traditional 3D RADAR**
NO Graceful degradation
Active Electronically Scanned Array (AESA)

**TRANSMIT/RECEIVE MODULES**

- RF
- Power supply & digital control
- Plug-in modules

**ACTIVE ROW PLATE**

- DC/DC
- Cooling outlet
- RCL

© 2014 Selex ES S.p.A. – All rights reserved
Selex ES Multifunctional AESA Radar Family
**KRONOS® Multifunctional Radars**

**Evolution**

KRONOS® is a solid-state **Multifunctional Radar family** for **Surveillance** and **Multiple Fire Control** missions, equipped with an Active Electronic Scanning Antenna (AESA).

- **PASSIVE KRONOS (EMPAR)**
- **KRONOS GRAND NAVAL (MFRA)**
- **KRONOS NAVAL**
- **KRONOS LND**
- **KRONOS GRAND**

C band TRMs
Active full phased array

2003
KRONOS® radars are tailored to different missions and applications:

- **KRONOS NAVAL** is the Naval Version intended for use on ships starting from 400 tons

- **KRONOS MFRA** is the Naval Version intended for use on ships starting from 1700 tons

- **KRONOS LAND** is the mobile version housed in a single, autonomous 20-ft ISO shelter, C4I embedded

- **KRONOS GRAND** is a search and fire control radar for air and missile defense