New Generation Artillery Proximity Sensor Application to Naval Fuzes

Max Perrin

52nd Annual Fuze Conference
May 13 – 15, 2008 - Sparks, NV
"Smart Fuzing – Adding Intelligence To Fuzing Solutions"
OUTLINE

- Company Presentation
- Smart Fuzing / Target Detection Issues
- Proximity Fuzing Background
- New Generation Proximity Sensor
- Use in FRAPPE Multifunction Fuze
- Use in Other Fuze Products
- Application to Naval Fuzes
- A global leader in the field of ammunition fuzes and S&A devices

- Full range of products

- Key competences in fuzing technologies, ammunition electronics and micro-technologies

- Located in:
  - Seedorf (Germany)
  - La-Ferté-Saint-Aubin (France)
Product Range and Competences

Artillery

Mortar

Air Bomb

Missile SAD and ESAD

Medium Caliber and Direct Fire

Infantry Grenade

AT, A/G, G/G Rockets

COMPETENCES

- Sensors
  - Signal Processing

- Micro-Technologies
  - Miniaturized Systems

- EFI / ESAD Technology

- Mission Management

- Hard Target
  - Smart Fuzing

- Energetic Materials

- Safety Design

- Design

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  - Miniaturized Systems

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- Design
Smart Fuzing / Target Detection

- Objective: Optimize terminal effect on target whatever the operational configuration is
- Solutions: Use sensors and signal processing to initiate the munition warhead on target at the optimum time

Proximity Fuzing

Post-Impact Fuzing
Objective: Optimize terminal effect

**JUNGHANS provides effective solutions for both applications**

**Proximity Fuzing**

Today, May 15, 10:40 am presentation

**Post-Impact Fuzing**

May 14, 3:40 pm presentation
Proximity Fuze Background

- More accurate
- More ECM resistant
- More flexible
- More functions

Years:
- 1960
- 1985
- 1995
- 2007

Technologies:
- FM CW
- Digital Processing

A JUNGHANS Microtec GmbH / Diehl and Thales Company
New Generation Proximity Sensor

- JUNGHANS T2M has designed and engineered a new state-of-the-art proximity sensor for the new generation artillery multifunction fuze **FRAPPE**.
  
  - FM-CW Microwave Radar Sensor
  
  - Full Digital Signal Processing
New Generation Proximity Sensor
Main Features

- Achieves better detection and discrimination performances

1. Better detection accuracy
   - HOB accuracy whatever the terrain configuration is
   - Possibility to select various HOB

2. Better resistance to jamming and electromagnetic countermeasures
   - thanks to smart digital signal processing:
     - Spectrum analysis
       - Distance analysis (height of burst)
       - + Doppler analysis
     - Extraction of trajectory parameters
     - Analysis of the coherence of the data vs time
       - Tracking of the projectile height (distance) evolution
HOB Measurement – Sensor Signal Processing

Spectrum Analysis

FRAPPE fuze fitted with embedded data recorder

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Application on FRAPPE Multifunction Fuze

- **New Generation Multifunction Fuze**
  - For new 155mm/52 calibre munitions
  - Compliant with IM requirements
  - Compliant with modern gun environments
  - Provide better operational flexibility and better fuzing performances

- **Operating modes**
  - **Proximity**
    Programmable HOB and inhibition time
  - **Post-Impact Delay**
    Programmable delay
  - **Point detonating**
  - **Time**
  - **Inductive setting** according to STANAG 4369 / AOP22
FRAPPE Fuze – Qualification Test Results

- More than 450 FRAPPE fuzes fired in all weapon and environment conditions.
- Qualification tests completed: December 2007
- 150 firings: 100% successful – No failure
- Program Status
  - Initial Production

Ordered by the French Army
FRAPPE Fuze Sensor – HOB tests

Coup N°3 - M107PLT/Frappe LHESA: 8,57m
Application on SPACIDO Fuze

- SPACIDO Course Correction Fuze
  - Artillery 1D Course Correction System
  - Trajectory monitoring with muzzle velocity radar
  - Correction signal sent by the radar to the fuze
  - Course correction by air brake deployment
  - GPS independent

- SPACIDO Fuze integrates
  - FRAPPE Sensor and subassemblies
  - Air Brake device
  - Reception antenna and electronics

- Programme status
  - Validation firings (2007)
  - Full Development Phase
  - ISD 2011
Sensor Application: Mortar Multi Option Fuze

- New Generation Mortar Multifunction Fuze under development by JUNGHANS Microtec for German Army (BWB)

- Operating Modes
  - Proximity
    - Programmable HOB
  - Post-Impact Delay
    - Programmable delay
  - Point detonating
  - Time

- Program Status
  - Full Development Phase
  - Qualification End 2009
Sensor Application: Air Bomb Proximity Sensor

- Nose prox demonstrated in flight
Naval Fuze Sensor Application

- **Purpose:**
  - Adapt the new generation FM-CW sensor to air target detection mission

- **Issue:**
  - Current sensor is designed for surface detection

- **Objectives:**
  - Keep current sensor hardware and architecture
  - Cope with:
    - Sea clutter disturbance
    - Target Radar Cross Section

   Implement specific signal processing software
Target / Clutter Discrimination

- FM-CW sensor actually measures object distances

  Makes possible discrimination between reflected signals: Range gated processing to isolate sea-clutter from valid targets
Sea-Skimmer Detection

Target level / Distance Fuze - target

Time / Trajectory

Surface echoes

Missile target echo

Actual trajectory and target recorded signals

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Sea-Skimmer Detection

- Time / Trajectory
- Target level / Distance
- Fuze - target

Missile target echo
Smart Fuzing – Proximity Fuzing

- JUNGHANS new proximity sensor technology
  - Makes fuzes "smarter"
    - More accurate on target
    - More resistant to counter-measures
    - More flexible to use

For better

Strike efficiency
Operational flexibility

"Smart Fuzing – Adding Intelligence To Fuzing Solutions"
New Generation Artillery Proximity Sensor
Application to Naval Fuzes

Thank You

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