Smart Range of Burst fuzes

Real-Time Target Simulator

TNO | Knowledge for business

Rob van Heijster

Contents

- Smart Range of Burst fuzes:
  - Threat: Fast Incoming Attack Craft (FIAC)
  - Multi function fuze against FIAC
  - Threat analysis
  - Necessity for additional function: Range of Burst function
  - Implementation Range of Burst function: MEDEA
- Target simulator
- MEDEA performance
- Conclusions

Threat : Fast Incoming Attack Craft

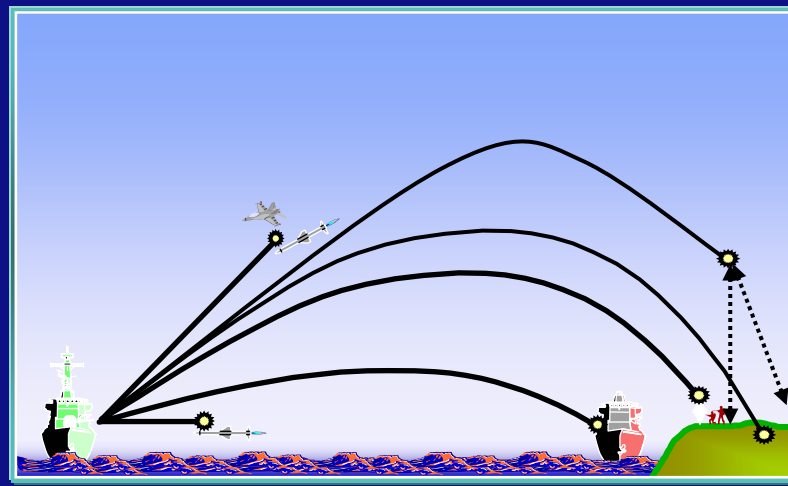
- Fast Patrol Boat
- Terrorist attack

The Washington Post

Terrorist Attack On USS Cole

Current Multi Function Fuzes
Answer to FIAC?

Suitable for	Optimization by:
• Anti Aircraft mode	• Target detection
• Aircraft	
• High diver	
• Sea skimmer	
• Impact mode	• Physical contact
• Surface target (Large, Slow)	
• AP mode	• None
• Land targets	
• Troops / personnel	
• Time mode	• None
• Cargo	
• Troops / personnel	



Threat analysis

MODE	σ	Assume a scenario where 50 rounds are required for 90% kill probability	
		Straight	Weaving
• Height of burst	90 m	50	150
• Time	40 m	15	90
Required time @ 40 rounds/min			
• Height of burst	appr.	75 s	225 s
• Time	appr.	25 s	135 s
Target travel @ 50 km/h (14 m/s)			
• Height of burst	appr.	1000 m	2000 m
• Time	appr.	300 m	1200 m

No suitable mode for FIAC

FIAC characteristics:

- Small
- High speed
- Fast manoeuvring

Available modes:

- Time mode – inefficient due to resulting CEP
- AP mode (HoB) – inappropriate due to resulting high CEP
- AA mode – inappropriate due to low RCS and high clutter
- Impact mode – too low hit probability

New mode required with lower CEP

TNO Answer to FIAC threat: Range of Burst mode

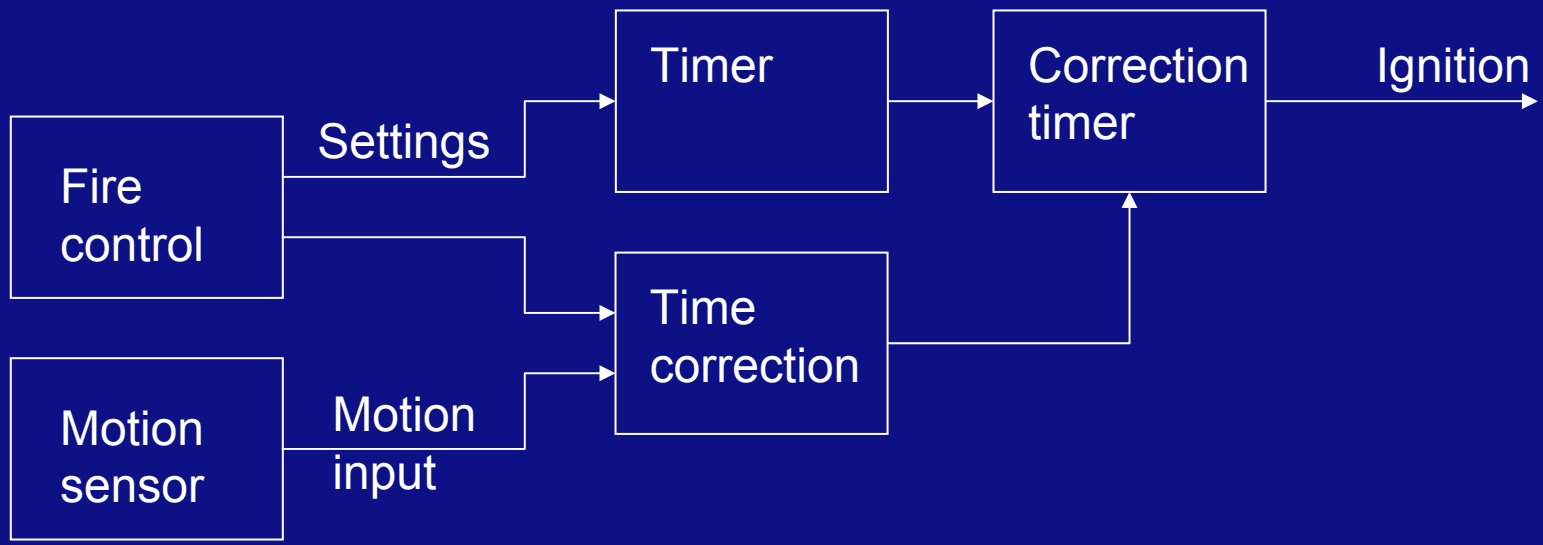
Range of Burst mode

- Burst at given horizontal range to gun
- Improved range estimation fuze
- CEP reduction for
  - Elevation point errors
  - Air density errors
  - Muzzle velocity errors
  - …

Range of Burst operating principle

Operating principle is corrected time mode

- Calculation of time correction
  - Based on trajectory deviation
    - Based on motion sensor



Range of Burst mode implementation: MEDEA multi function fuze

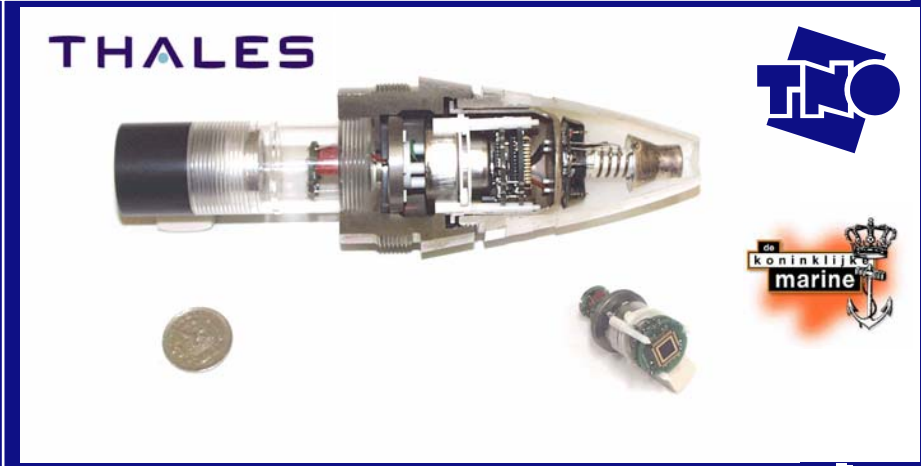
MEDEA =
Multifunctional
Extended range
Digital
Electronic
Artillery fuze

Objectives

- Multi function fuze
  - Fast patrol boats FIAC
  - Bombardment role
  - High diver & Aircraft
  - Sea skimmer
  - Super Quick / Post impact delay
  - Time

Characteristics

- Multi caliber
- Programmable
- Insensitive to EMI
- Digital processing



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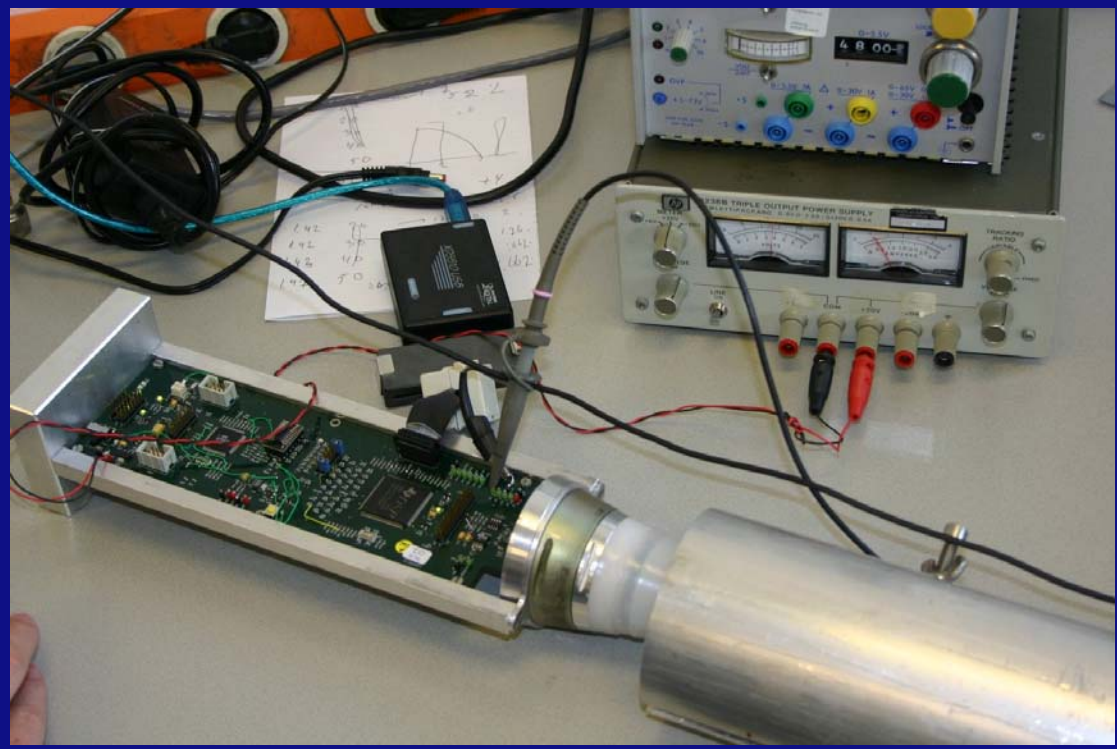
Target simulator

Suitable for

- Anti Air mode
  - High divers
  - Aircraft
  - Sea skimmers (including sea clutter)
- Anti personnel mode / Height of burst mode

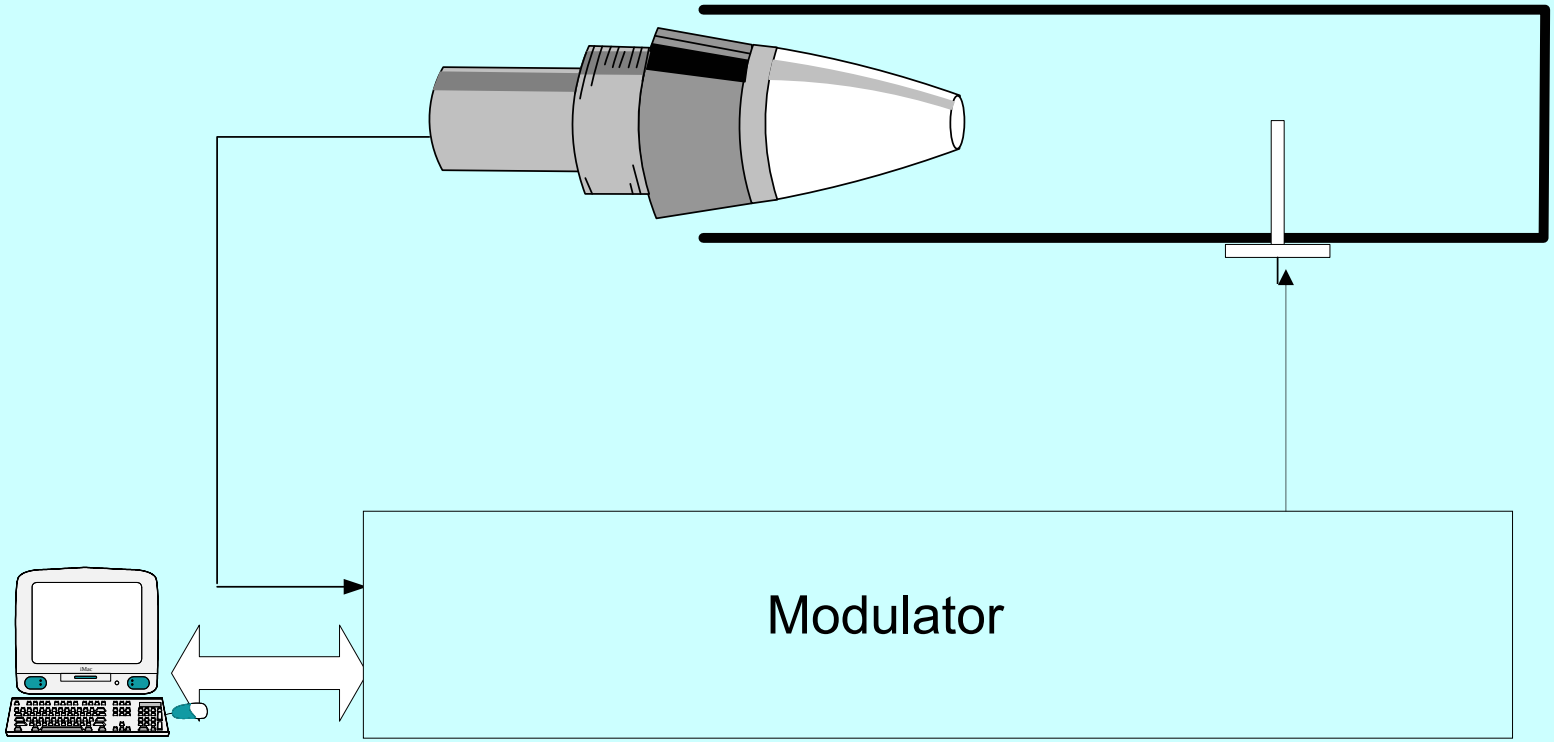


Target simulator principle

Function:
- Amplitude and phase controlled reflection
- Amplitude and phase control by digital signal generation
- Synchronized to fuze FMCW transmission

Advantages:
- Distance converts to frequency offset (@ FMCW)
- Radar Cross Section converts to amplitude of reflection
- Multiple targets possible
- Full height range
- Sea clutter simulation
- Hardware in the loop simulator
- Both development and production testing

Target simulator implementation

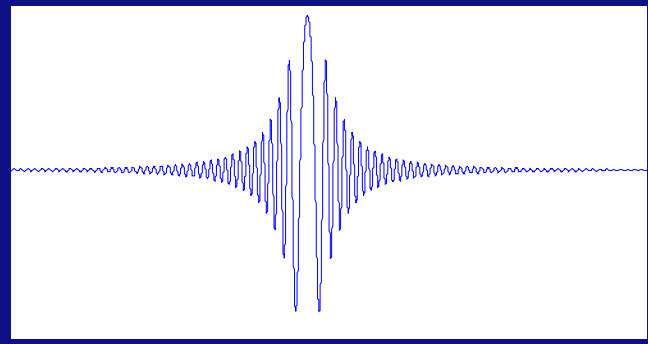


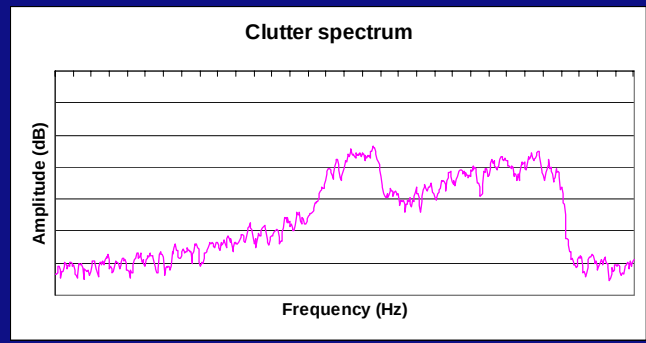
Target simulator signal

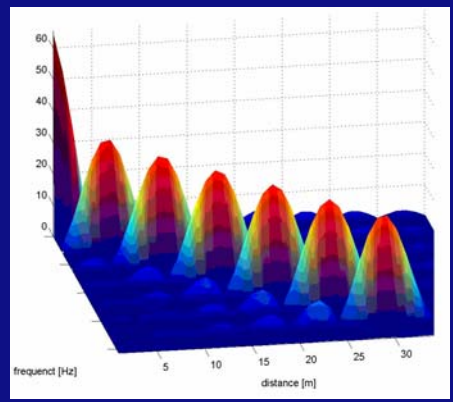
- Aircraft, High diver
  Reduced Doppler frequency and increased signal strength during pass.

- Sea Skimmer
  Clutter peaks at “head on” and “straight below”

- Height of Burst
  Signal strength of harmonics of modulation as function of height

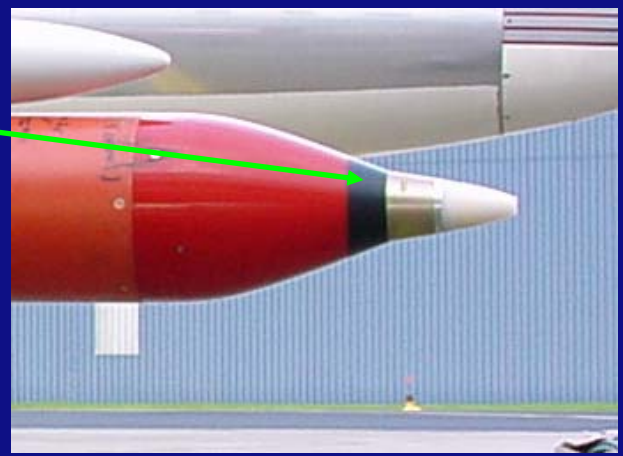






Target simulator
Play back of recorded data (1)

Target simulator
Play back of recorded data (2)



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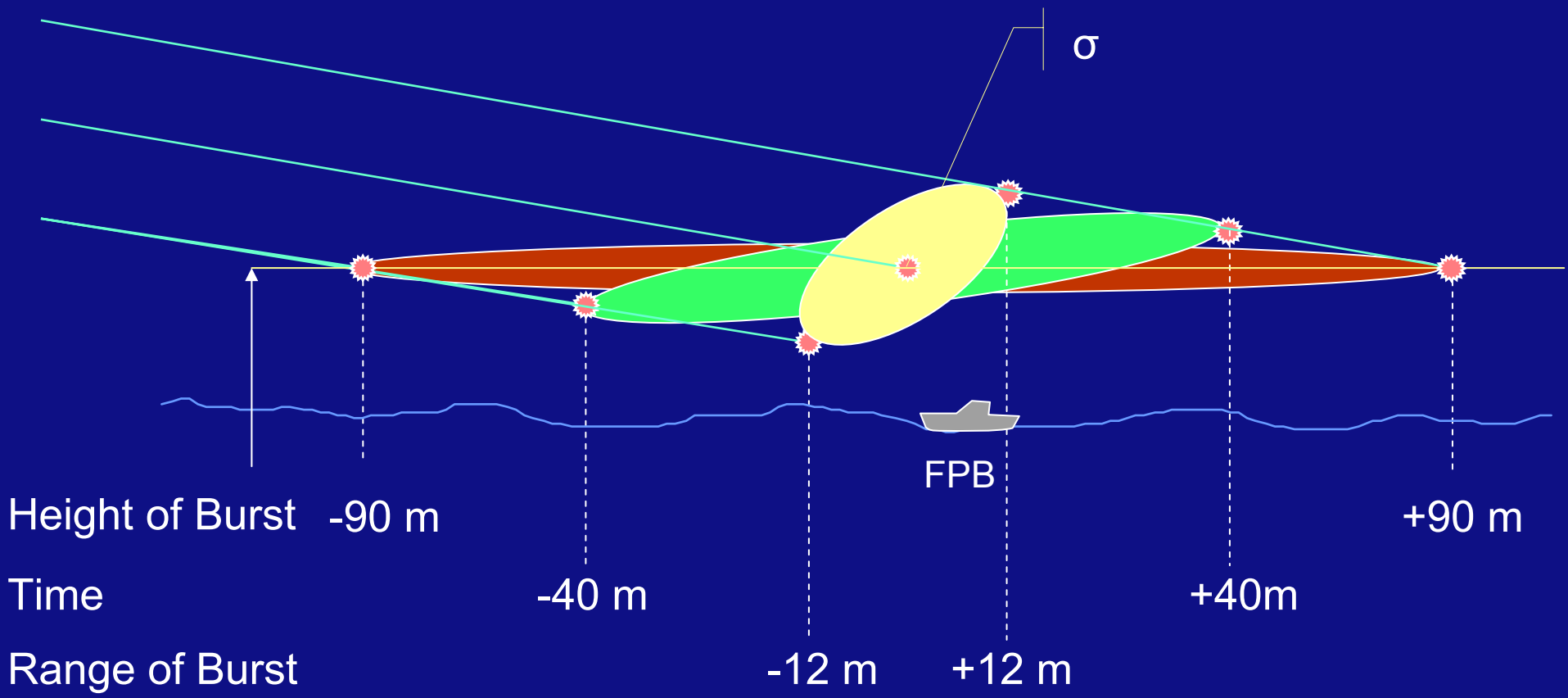
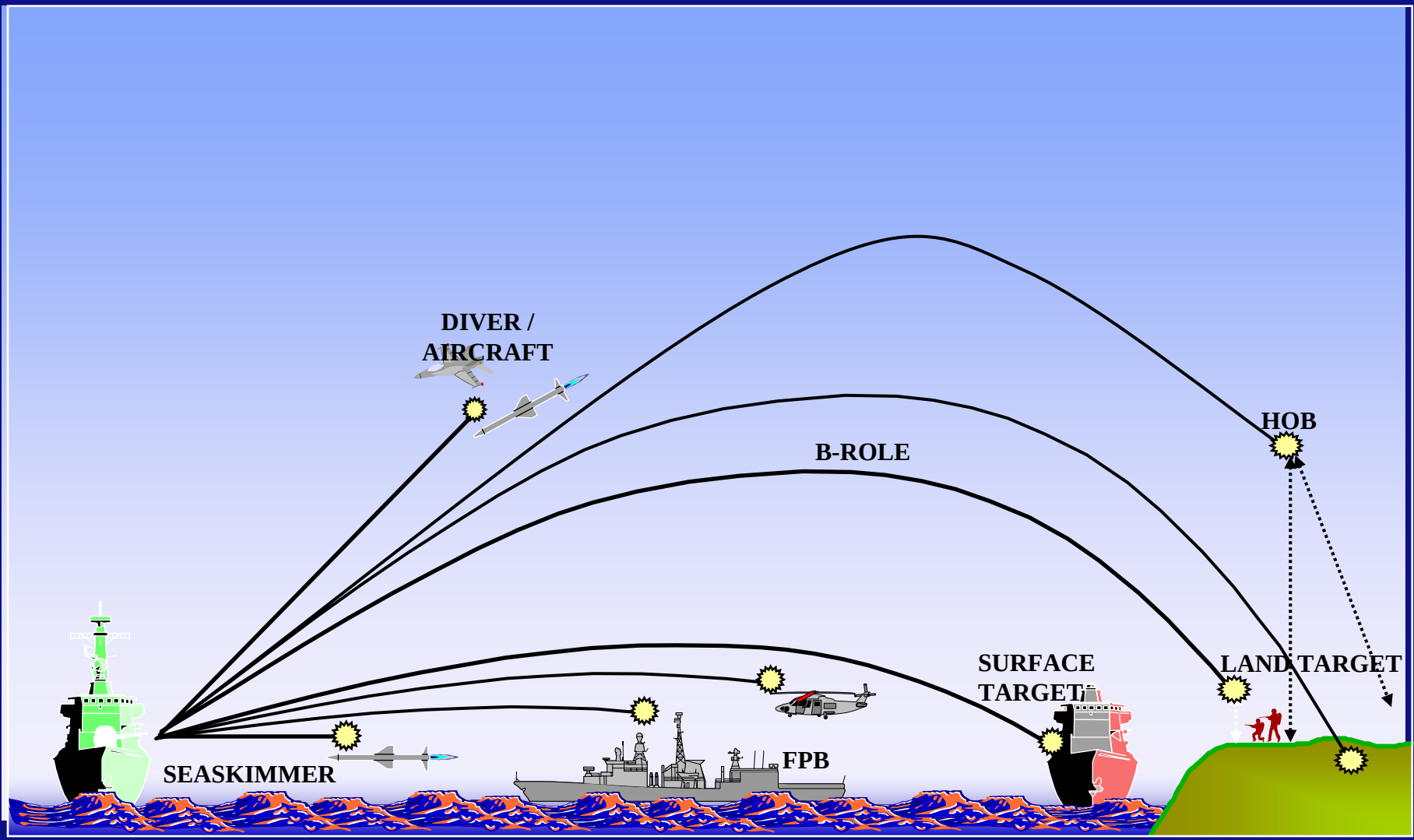
Performance



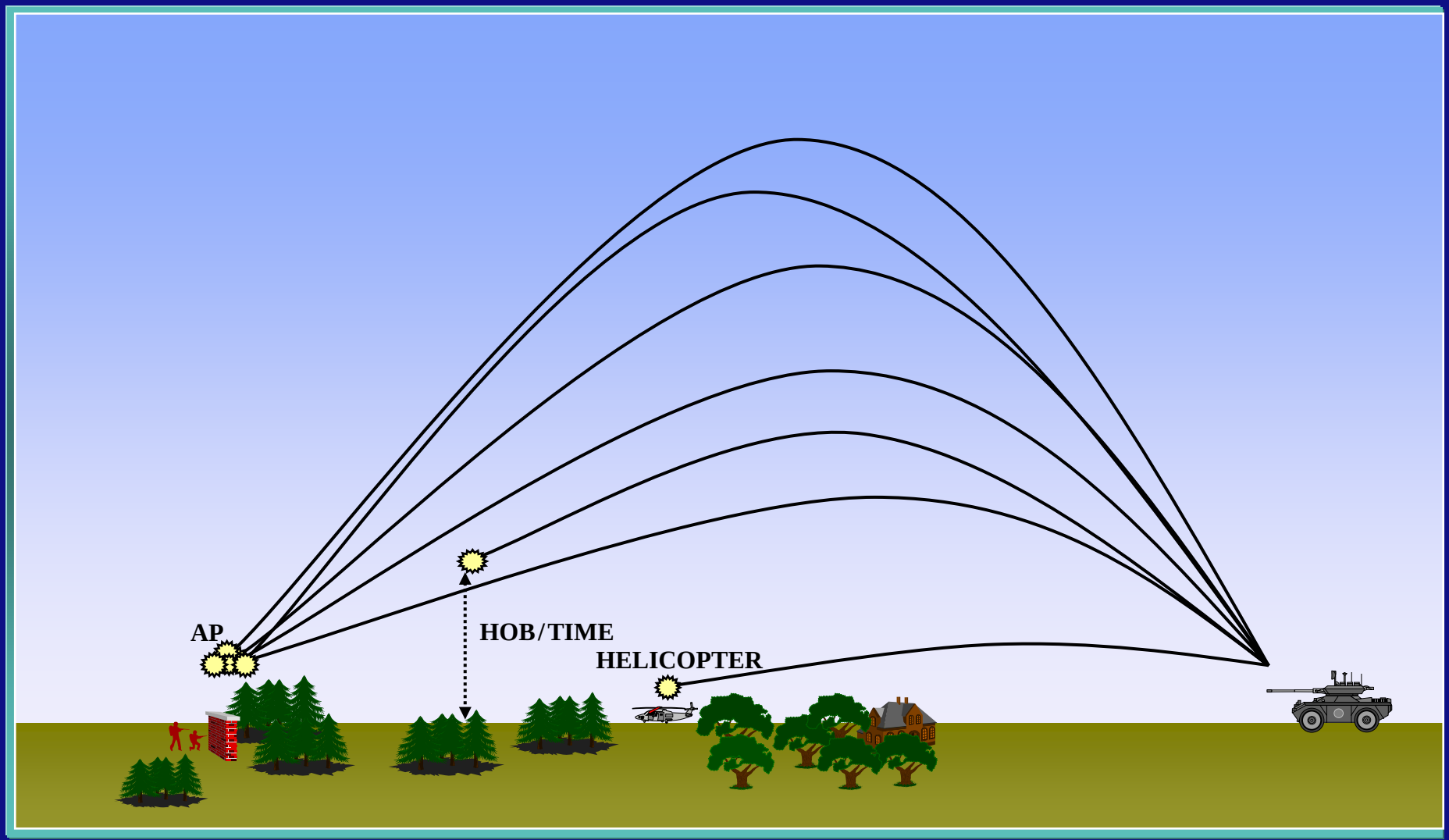
MEDEA performance summary

MODE	σ	Assumed scenario 50 rounds for 90 % P_{kill}	
		Straight	Weaving
• Height of burst	90 m	50	150
• Time	40 m	15	90
• Range of burst	12 m	5	50
Required time @ 40 rounds/min			
• Height of burst	appr.	75 s	225 s
• Time	appr.	25 s	135 s
• Range of burst	appr.	<10 s	75 s
Target travel @ 50 km/h			
• Height of burst	appr.	1000 m	2000 m
• Time	appr.	300 m	1200 m
• Range of burst	appr.	100 m	700 m

MEDEA operational readiness

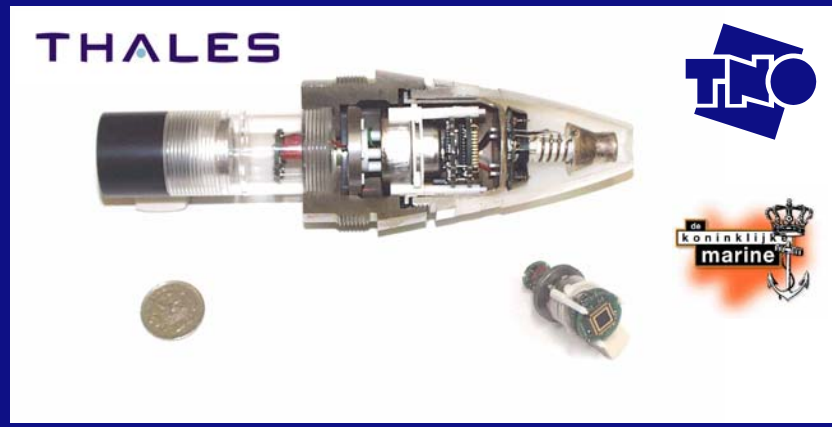


MEDEA Army 155mm operational readiness



Conclusions

- MEDEA Multi Function Fuze suitable for virtually any target type
- MEDEA effective answer to Fast Incoming Attack Craft
  - Minimal number of rounds
  - Short intervention time



- Effective lab-testing of all RF fuzes with target simulator
  - Anti personnel / Height of Burst
  - Anti Air
    - Sea skimmers
    - High Divers
    - Aircraft