# HOWITZER DIGITIZATION

**William Key and Yves PATUREL**

**Joint Armaments Conference**

# Digitization of a Howitzer

- Installation of INS Based Digital Orientation System
- Provides Barrel Orientation Parameters Constantly and Accurately
- Provides Howitzer Position
- Presents Operator Friendly Data to the Gun Crew

# TOWED GUN M105

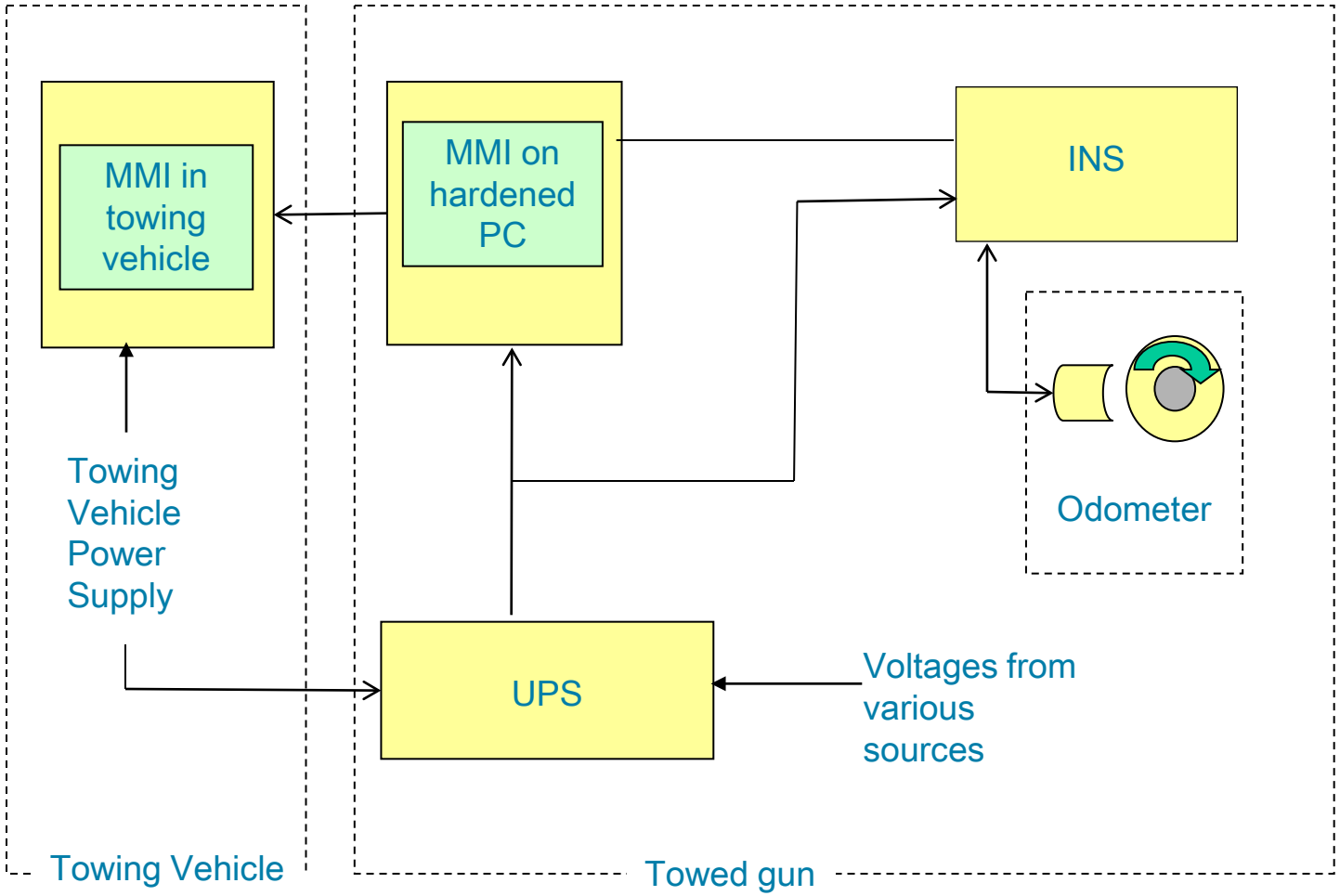
# Digitization of a Howitzer

- Enables Fast operation :
  - Quick alignment
  - Knowledge of position
- Enables Quick angular positioning :
  - Elevation
  - Bearing
- Bottom Line
  - More rounds per minute on Target

# Digitization Package

- INS Based Navigation System
- Power Supply pack with batteries
- Hardened PC
- Smart User Interface (MMI)

# Typical Digitized Gun



# Digitization Package Functional Requirements

- Performance (minimum)
  - Heading:  0.1 deg (secant latitude),
  - Attitude:  0.1 deg roll, pitch
- No moving parts
  - Fiber Optic Gyro (FOG) or Ring Laser Gyro (RLG) Sensor
  - Optical
- Very low weight components (less sensitivity to shocks)
  - FOG or RLG INS
  - Similar Weight

# Digitization Package Functional Requirements

- Power Supply Pack
  - Gun Mounted Power Source
  - 12 hour operation min without external power
- Electronics
  - Low Power Consumption
  - Shock Hardened
- Temperature management
  - Extreme Temperature Range High and Low
  - No External Cooling Fans

# Digitization Package Functional Requirements

- Hardened Computer
  - Shock resistance (shock mounted)
  - >400 g in 4 millisecond nominal
- Waterproof
  - IP 66 Waterproof Requirement Minimum
  - 30 min direct spray without leaking
- Display
  - Readable in direct sun conditions
  - Touch Screen MMI

# Digitization Package Functional Requirements

- No limited lifetime components
  - "Use Before Date"
  - Acronym "USD"
- Definition of USD
  - Failure of Key Component prior to Computed MTBF
  - Unscheduled Failure
- MILHB 217 MTBF Example
  - MTBF FOG and RLG similar - 40,000 hrs nominal
  - USD RLG IMU  7,000 to 10,000 hrs operational
  - USD FOG IMU  >85,000 hrs operational

# Digitization Package Operational Requirements

- Good Shock Management
- High Reliability (hundreds or thousands of rounds will be fired)
- Full Performance Before and After Firing
- No Long or Complex Setup
- Operator Friendly

# Shock Management Functional Requirements

- Shock Survivability
  - System Must Not be Disabled by Shock
  - Survive Unlimited number of Shocks
- Inertial system
  - Retain Position Memory
  - Ready to Shoot After Recoil
- Orientation System Mounted Directly on Gun
  - Subjected to very high shocks (> 400 g)

# Shock Management Issues

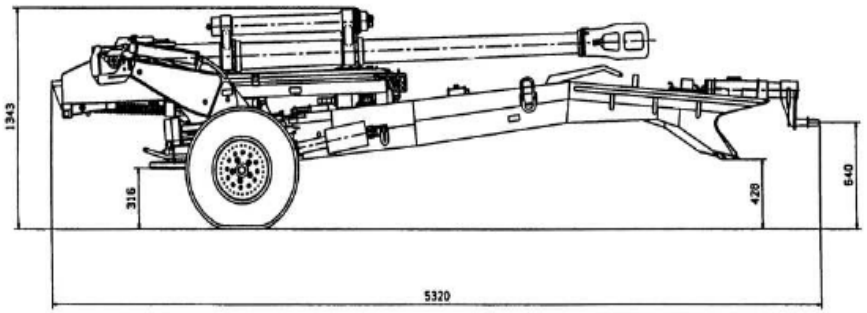
- COTS Solution
  - Mounting trays with Isolators
  - Maintain shock to lower levels
- Compliant Isolators
  - Limit Shock Loading
- Isolators must be stable
  - No Variability after Repeated Shocks and/or Time

# Digitization of a 105 mm howitzer - Example

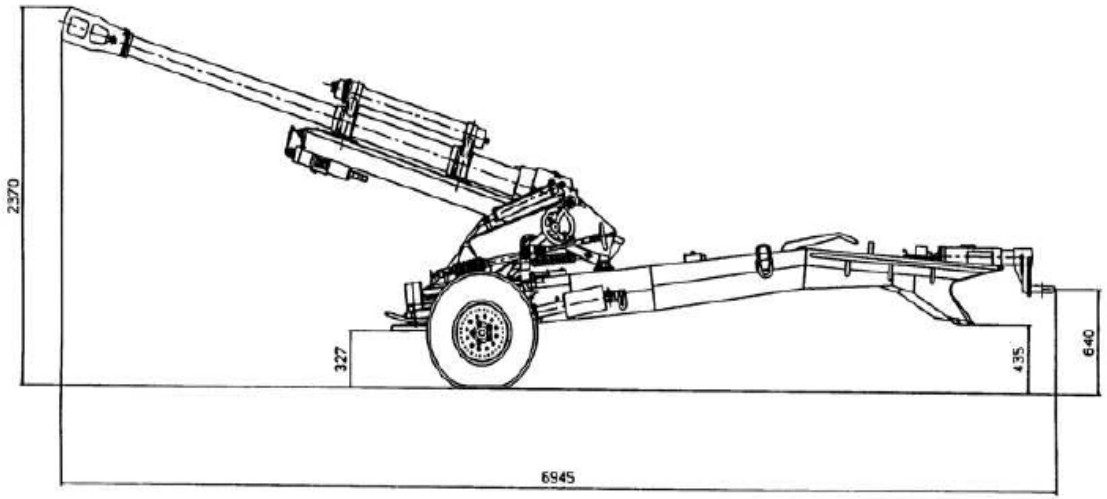
- Program Sponsor
  - Nexter SAS (France)
    - (www.nexter-group.fr)
- Howitzer
  - Nexter SAS
    - 105 mm Lightweight Howitzer
- Orientation System
  - IXSEA SAS (France) www.ixsea.com
    - ADVANS LYRA FOG Inertial Navigation System (INS)
    - Hardened PC
    - LI Ion batteries

# NEXTER Lightweight 105 MM Howitzer

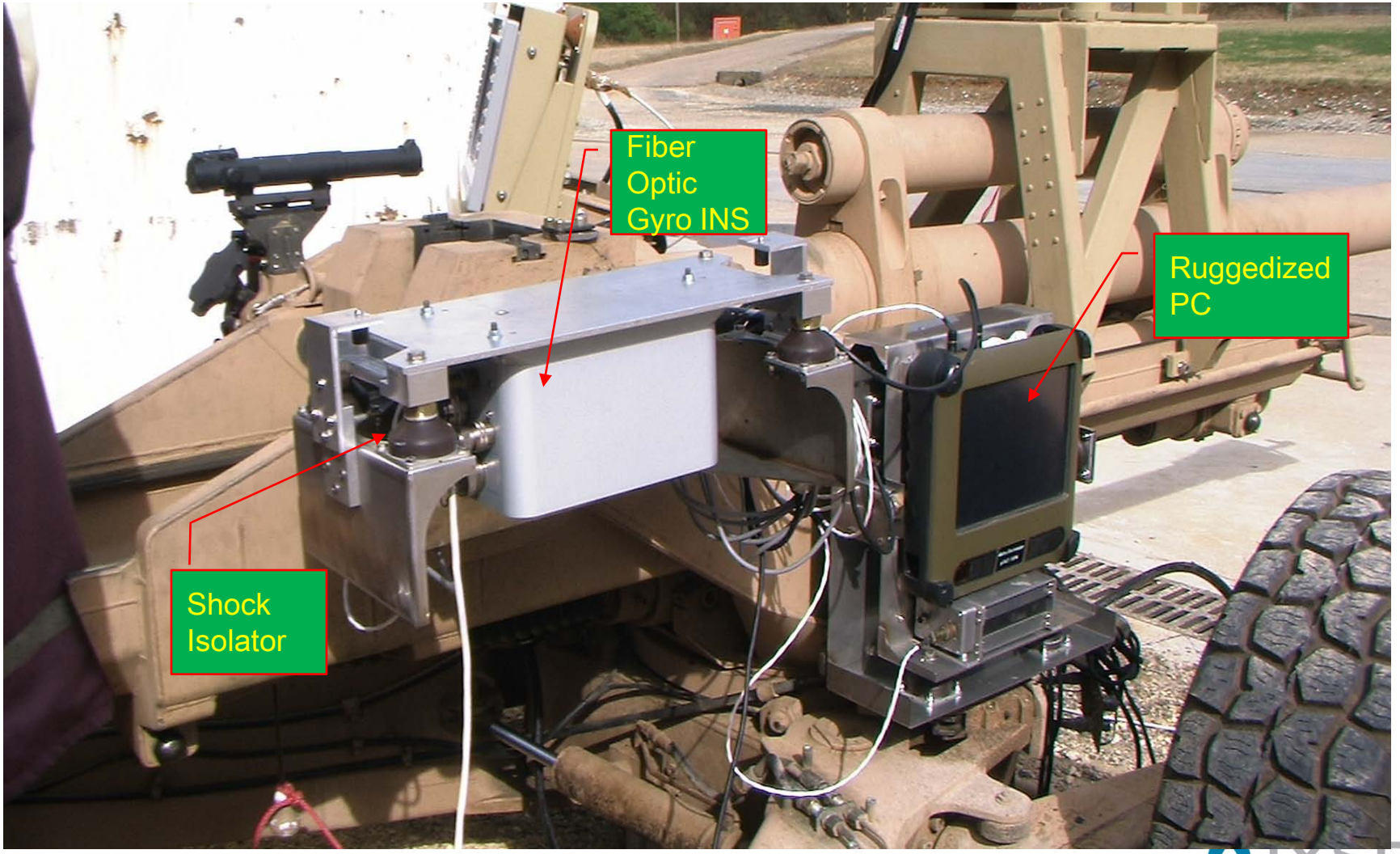
## Normal Travel Mode (folded)



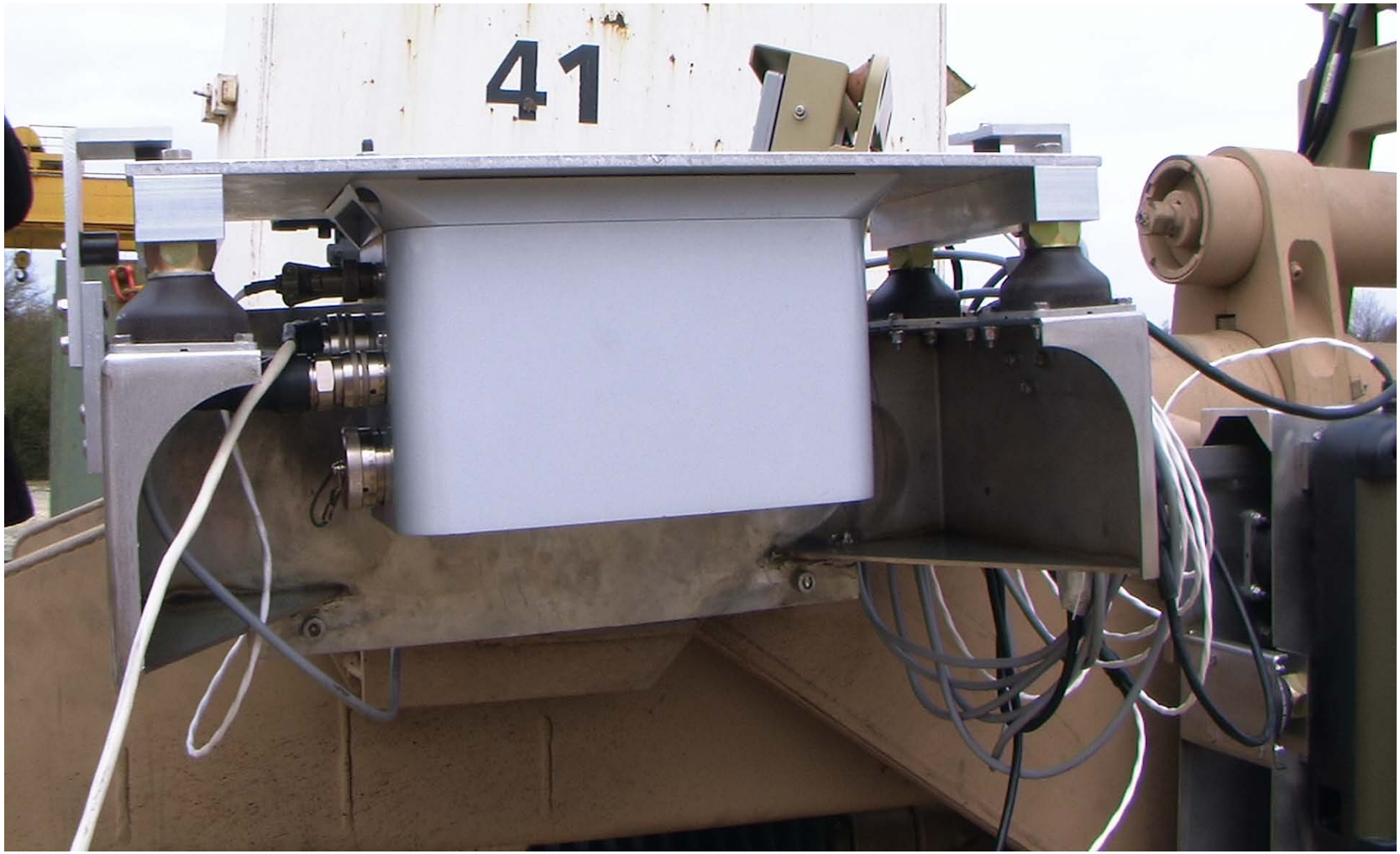

## Emergency Travel Mode



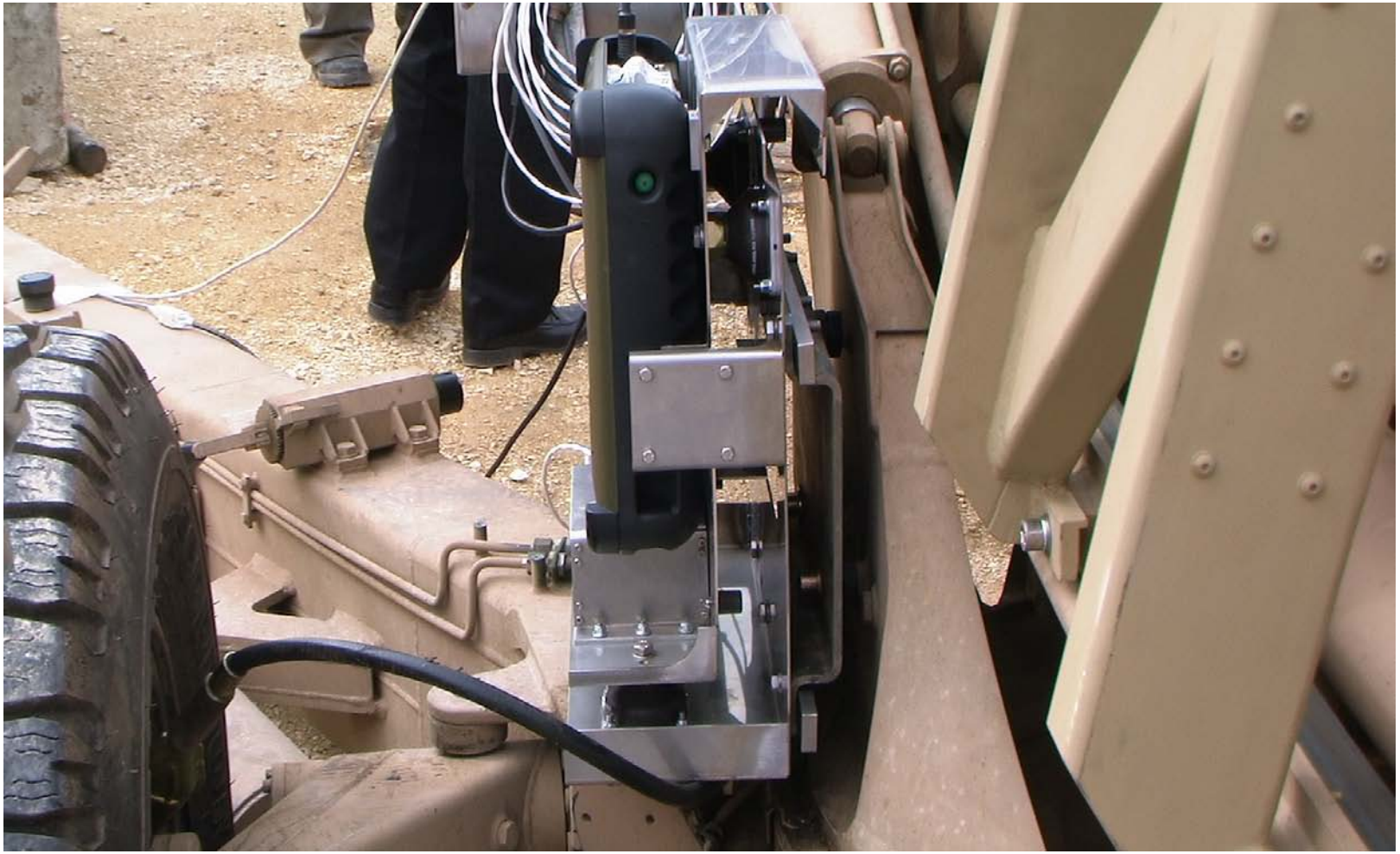
# Nexter 105 mm Installation for Validation Trials



# Fiber Optic Gyro (FOG) Shock Mount Installation



# Ruggedized PC Shock Mount Installation



# Ruggedized PC Man Machine Interface (MMI)


- Mounted on Shock Mounted Fixture
- Contains Wi-Fi Interface
- High Light Power for Full Sunlight Readability
- Cover for UV Protection when Not in Use

# Firing Trials

- Gun Outfitted with Orientation System
  - Shock Mounted Equipment
  - Compliant Mounts
- Three Types of Proof Firings
  - Normal Ammunition
  - Overspeed Ammunition
  - Overpressure Ammunition
- Execution of Trials
  - Field Conditions
  - Multiple Firings
  - Each Type Ammunition

# Firing Trials

Nexter 105 mm in Towed Configuration

IXSEA Man Machine Interface

# Firing Trials Installation

# Firing Trials Results

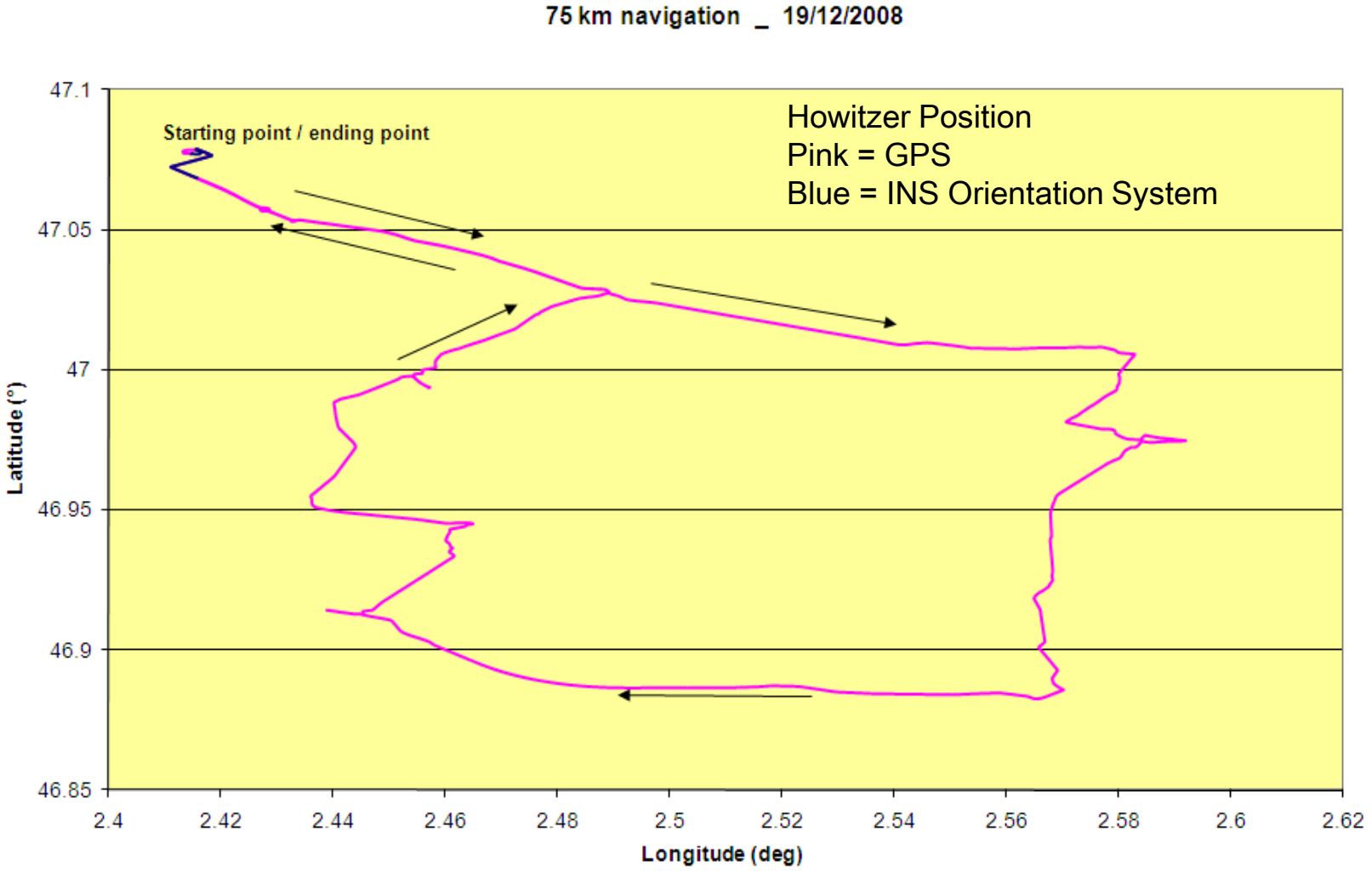
- Performance
  - No interruption of Function During Firing
  - Immediate Readiness for New Firing or move After Firing
  - No Position or Accuracy Degradation Full Rate Fire

- Position and Attitude/Heading Reference Accuracy
  - At Gun Placement
  - Full accuracy available

- On-the-Move Position Data
  - Available to Towing Vehicle at all times

# Navigation Tests : INS/GPS Comparison





# Conclusions

- Howitzer Digitization Not Easy
  - No Explanation Required
- Skilled Engineering Required
  - Understanding of the Environment Necessary
- Appropriate Selection of Components
  - Absolutely Necessary
- Test Results
  - System qualified for Howitzer Application
  - Selected Technologies Appropriate for Application

A Star To Steer By

# High Performance Positioning Products


Contact:

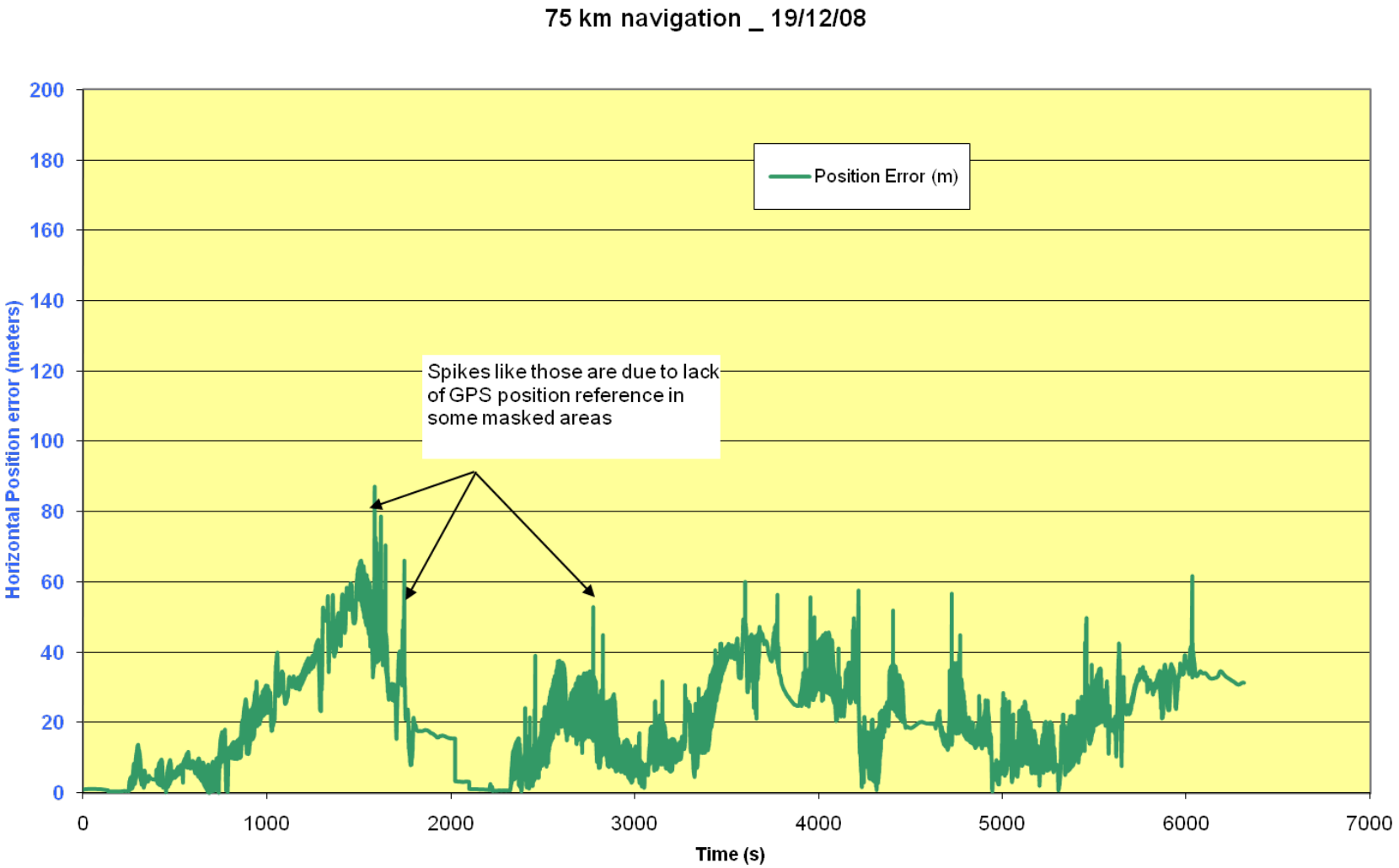
**Bill Key**
**IXSEA Inc**
**Woburn, MA**
**William.key@IXSEAINC.com**

**Yves Paturel**
**IXSEA SAS**
**Marly, France**
**Yves.paturel@IXSEA.com**

# BACKUP DATA

# Navigation Tests : Horizontal Position

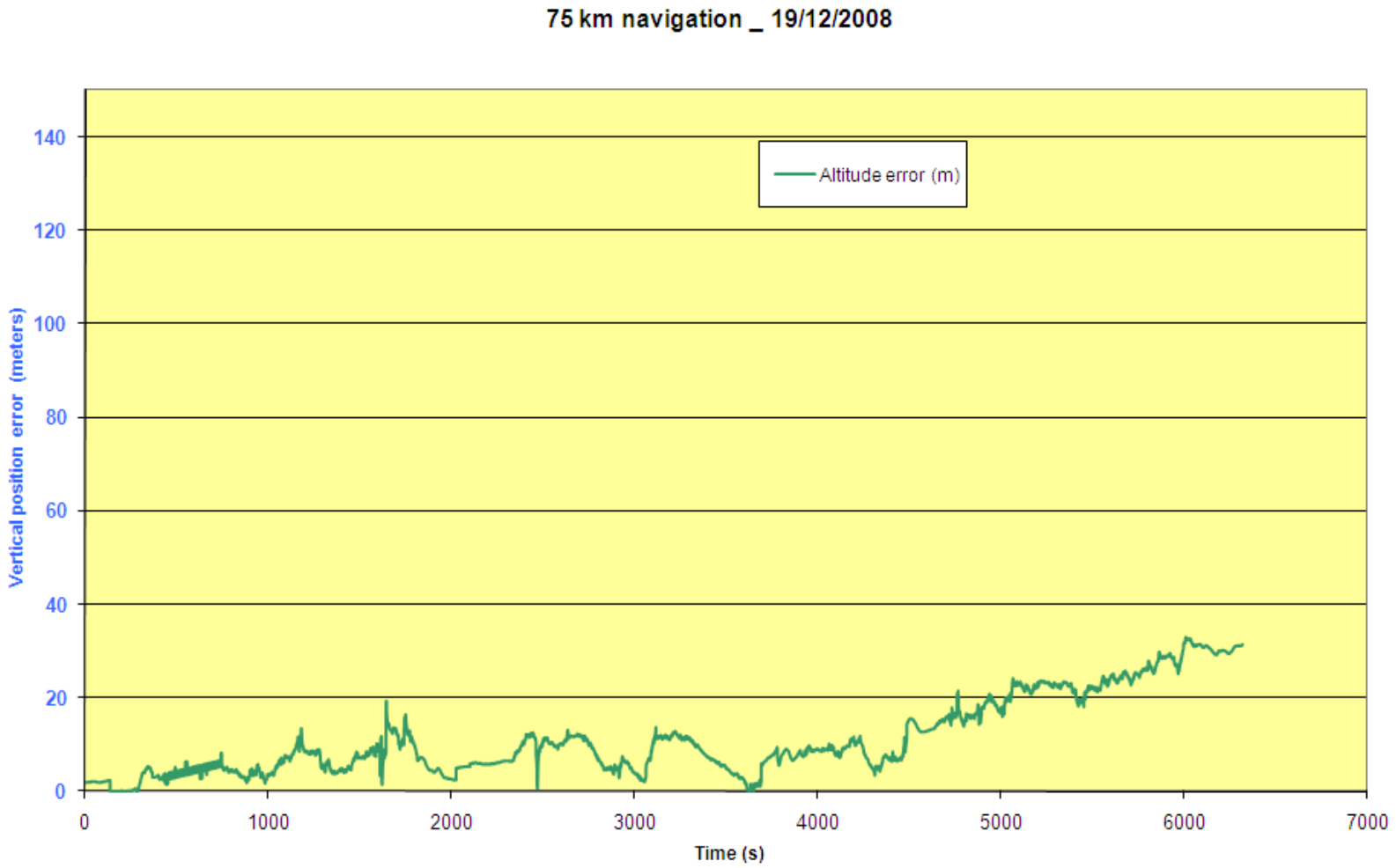





6000 sec = 100 hrs

# Navigation Tests : Altitude






6000 sec = 100 hrs