Demo III Operational Concept
**Title and Subtitle**
Demo III Operational Concept

**Performing Organization Name(s) and Address(es)**
General Dynamics Robotic Systems

**Distribution/Availability Statement**
Approved for public release, distribution unlimited

**Supplementary Notes**

**Abstract**

**Subject Terms**

**Number of Pages**
21
Performance Goals

• Overall System
  – Intelligent, Modular, Open Software Architecture
  – Operable by Troops
  – Total Robotic Vehicle Weight: 2500 lbs
  – Transportable in Theater (e.g., Helo, V-22)
  – Ruggedization Suitable for User Appraisal

• Mobility
  – Day/Night/Limited Adverse Weather (Rain/Dust) Operation
  – Road Following: 40mph in Lane (High Reliability)
  – Cross Country: Speed Appropriate to Terrain & Vehicle
    Dynamics, Up to 20mph (day, dry), 10mph (night, wet)
  – Detect and Avoid All Non-Negotiable Obstacles
  – Towable by HMMWV
  – Mission Duration: 24 hrs

• Communication
  – RF Range: 10-15km using Available Military Frequencies
  – Data Rate: 25kbs/Vehicle

• Planning
  – Four Vehicle Mission
  – Operator Pre-Mission Planning & Intermittent
    Supervision Thereafter
  – Single Seat HMMWV Installable OCU / Non-
    Dedicated Vehicle
  – Planning For:
    • Feature Extraction/Trafficability Assessment
    • Tactical Behaviors
    • Target Hand-Off Among Multiple Vehicles
    • Cooperative Search
  – DTED II (30m) Topographic Database
  – Platoon Convoying

• Control
  – Multi-Threaded Control
  – Highly Modular, 4D-RCS - JAUGS
  – Tactical Behaviors
  – Safely Operable in Mixed Force
    (Mounted/Unmounted,
    Manned/Unmanned)
GENERAL DYNAMICS
Robotic Systems
ISO 9001 Certified

Game Plan

Pacing Technologies

• Perception
• Software Architecture
• Man/Machine Interface

Modeling & Simulation

Technology Development

Test Bed Integration

Alpha  Bravo  III  User Appraisal

99  00  01  02  03

• 20 MPH Cross-country
• 40 MPH on Road
• Day/Night
• Modular Mission Package
Demo III Experimental Unmanned Vehicle (XUV)
DEMO A Configuration
GENERAL DYNAMICS
Robotic Systems

ISO 9001 Certified

XUV DEMO B Configuration
Platform
Platform - Powertrain

- 78 Hp VW Turbo Diesel Engine
- 70 GPM Sunstrand Hydrostatic Pump
- Pump Drive Sized for 4300 RPM and 2500 RPM Engine Speeds
- 15 Cu In Eaton 2-Speed Wheel Motors
- John S. Barnes Mechanical Flow Divider
GENERAL DYNAMICS
Robotic Systems

ISO 9001 Certified

XUV Sideslope Capability
Vetronics - Processing Enclosures

- Mission Execution System
- AM Vision Processing System (Bravo/III)
- AM Processing System
- Spare Enclosure
- RSTA Vision Processing System
- RSTA Processing System
GENERAL DYNAMICS
Robotic Systems

ISO 9001 Certified

Vetronics

AM Sensors

Autonomous Mobility System

GPS Signals

Navigation System

Comm Signals

Comm System

Modular Interconnection System

Electronics 24V Power

Platform I/O System

Platform Actuators & Sensors

Mission Planning System

RSTA Mission Module

RSTA Turret & Sensors
Navigation - Components

- Wheel Encoder
- IRU
- PLGR+96 GPS Receiver
- Inertial Reference Unit (IRU)
- NAV S/W Hierarchy Level (Located in AM World Model Processor)
- Navigation Solution

PLGR Remote Antenna
Autonomous Mobility on the XUV

- DEMO III Vehicle with AM System Exploded
- Demo A, B, III sensors indicated.
Autonomous Mobility on the XUV

Short-Range ~20m
- LADAR
- Stereo CDD/IR
- FOPEN RADAR
- Optical Flow

Mid-Range ~200m
- WideBaseline Stereo
- Motion
- MMW Radar

A-Priori External
- Level 4
- Overhead Ladar

MAP
- Geometry
- Feature/Texture
- Heuristic

Geometric 3D Representation

Scene Classification
- Adaptive
- Statistical Modeling

Perceived 3D Thematic World Map

Intelligent route planning via the perceived map
RSTA on the XUV

WESCAM Model 14QS
- Stabilized Gimbal
- FLIR (Amber Galileo 3-5 μm)
- Laser Ranger
- Color Camera
- Color Spotter Scope

Self Protection Sensors

Elevated Mast Assembly

MVME-2X00-G4 (4)

Vision Preprocessing System

RSTA Processing System

Frame Grabber Acoustic A/D

10 Base T Ethernet

To Modular Interconnect System

RSTA Sensor Integration Plan.

<table>
<thead>
<tr>
<th>AM Sensors</th>
<th>Alpha</th>
<th>Bravo</th>
<th>III</th>
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<tr>
<td>Wescam 14QS Gimbal</td>
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<tr>
<td>Acoustic Sensor Array</td>
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<td>Acoustic Noise Cancellation</td>
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<tr>
<td>Mast Assembly</td>
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</tbody>
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Acoustic Sensors (8 Channels, 4 Reference)
RSTA Mission Module
**Control Heirarchy**

**User Interface**
- Map Data Displays
- Mission Graphics
- Friend/Enemy Icons
- XUV Icons & Data
- Graphical Mission Planning/Editing
- Plan Exec. Controls (multiple levels)
- RSTA reports & image displays
- World Model displays
- Low-level controls & data displays
- Report templates - SITREP - SPOTREP

**Vehicle-level Mission Planning & Simulation**
- Route Planning, Vehicle/Subsystem Simulations and Rehearsals

**OCU/XUV Cooperative Mobility Controller** (Wingman)

**Platoon-level Mission Planning**
- Section Plan Encoding
- Battle Context DB Management
- Situation & Threat Assessment

**Section-level Mission Planning**
- Pre-miss. Task decomposition/assignment
- Group Route/Coverage Planning
- Multi-vehicle plan encoding (optional)

**Vehicle-level Mission Planning & Simulation**
- Route Planning, Vehicle/Subsystem Simulations and Rehearsals

**OCU/XUV Cooperative Mobility Controller** (Wingman)

**AMS**

**RSTA**

**FBCB2**

**Friendly & Enemy Situation Awareness**

**AMS**

**RSTA**

**AMS**

**RSTA**
Operator Control Unit - Hardware

16” diagonal LCD w/ NEMA 12 enclosure
Rugged Keyboard
Multi-position swing arm for LCD
Electronics Box, shock mounted
JAVELIN FIRE AT REDSTONE BY UGV/S JPO