Weapon Mounted Radar Integration To Fire Control, Situational Awareness & DSMAC Navigation Techniques

(Expanded Topically From Previous Title & Inclusive Thereof)

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Contents:

3. Introduction
4. Historical Radar In Fire Control: Large Scale
6. Manipulating Radar Imagery
13. The Problem(s) Weapon Mounted Radars Can Solve
14. Shrinking Radar Technology
22. Conclusions
23. Recommendations
Introduction:

Spurred By Research Into Driverless Vehicles, Radar Technology…And In Particular The Software Behind The Hardware…May Be Adapted To Guide, Protect And Allow Future Soldiers To Overcome Even Advanced Enemies.

Radar Is **A Direct Measurement Technique** Which Offers Precision In Terrain Matching, Mapping And Synthetic Vision. No Other Method Can Provide The Functions Which Fighter Aircraft Enjoy In A Single Package; Ground Mapping, Moving Target Identification, Precision Ranging, Track-While-Scan, Continuous Wave Illumination, RF Surveillance & Electronic Attack.

Imagine Having These Capabilities And More On Every Squad Weapon?
Historical Radar In Fire Control; Large Scale

NOTE: Previously Radar Imaging Of This Resolution Required A Large Aircraft...

Above, L-R: Raytheon AESA Radar Image Of Bridge, Enlargement, AESA Image Of Terrain, Inset Enlargement Detail.

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Active Electronically Scanned Array (APG-79)
Simultaneous Multi-Mission Capabilities

- Air-to-air and air-to-ground with one search-track mode
- Detect/track multiple targets
- Longer range
- Improved resolution
- Resource manager optimizes performance, reduces workload
- Connectivity with on-board and off-board sensors
- Advanced sensor integration and sensor fusion

Situational awareness, lethality and connectivity beyond that of a single platform

Manipulating Radar Imagery: Precise Maps Of The Earth Exist

Manipulating Radar Imagery, Continued: Terrain Models

Precise Measurements Of Point-By-Point Altitude In Layers Which Are Then Modeled:

Manipulating Radar Imagery: In The Beginning There Was DSMAC

**Digital Scene Matching Area Correlation** On Tomahawk Cruise Missile…Matched Radar Satellite Map To Over Ridden Course And Adjusted In 2-D Orientation.

Left To Right: FAS.org DSMAC, SPIE Digital Library DSMAC Overhead Map Orientation Course Correction.
Manipulating Radar Imagery, Continued: Overhead To Side View

Overhead Imagery May Be Converted To Side View Silhouette For Horizon Matching With Reference Image Converted To Match Deformed Image By Accelerometer Leveling

Above, L-R: US Government Manhattan Satellite View, Stockshots.com NY Skyline Silhouette, SPIE Digital Library Deformed Image Scene Matching Algorithms Useful For Matching Ground Level View To Overhead Map Location, Advance Over DSMAC.
Manipulating Radar Imagery, Continued: Recognizing Urban Terrain

Visible Image Software Recognizing Shapes & Representing Map Locations In 3-D Views:

Manipulating Radar Imagery, Continued: Recognizing Natural Terrain

SAR Image Software Recognizing Shapes & Representing Map Locations In 3-D Views:

Clockwise From Upper Left: Birmingham University Photographic Terrain Matching, TerraSAR – TandemX Satellite Bistatic SAR Image, PSU Digital Line Map, University Of Texas Triangular Fractal Line Contour Map (Uncolorized).
Manipulating Radar Imagery: The Potential For Fire Control

Radar Synthetic Vision & Through Wall Detection Of Human Targets:

The Problems Weapon Mounted Radars Can Solve:

1) No Light And Barrier Penetrating Imagery For Situational Awareness
2) Moving Target Detection & Weapon Identification For Targeting
3) GPS Denied Navigation Via Digital Scene Matching Area Correlation
4) Rangefinding By Accelerometer Angle Sighting & Area Correlation
5) Real Time Windage And Range Correction Via Bullet Tracking
6) Incoming Fire Source Detection With Range, Bearing & Angle
7) Radar Illumination Warning Of Detection & Guidance Beams
8) Radio Direction Finding & Signal Identification Of Enemy Emitters

NOTE: In Fact, The Only Negative Is RF Emissions In Active Modes…
Shrinking Radar Technology Examples:

Commercial & Military Electronics Miniaturization As Applied To Radar Technology:

Clockwise From Upper Left:

Rifle Scale Imaging Radar:
Shrinking Radar Technology Examples, Continued:

Miniaturization & Shaping Of Active Electronically Steered Arrays From Ship To Rifle Size:

Shrinking Radar Technology Examples, Continued: Seeing Fire

“As If Every Round Fired Actually Was A Visible Tracer, Both Incoming & Outgoing”

Clockwise From Upper Left: Vietnam Battle Scenes UK Daily Mail (Top Row, Green Overlay Ibid.), Raytheon FireFinder Radar Flat Plate AESA Artillery Locator, Raytheon FireFinder Map Overview, Video Game “God’s Eye View” (CSGOHelp.com Image).
Integrating Firearms To Radar Technology: Radar Electronics Require Insulation

Clockwise From Upper Left: ADG “Lewis Gun” Forend Thermal Shroud, ADG Under Forend Thermal Conduit, Concept Group INSULON Encapsulation (200C for 8 Hours), Concept Group INSULON, ADG Electronic Cladding Examples.
Shrinking Radar Technology Examples, Continued: Automotive

Sophisticated Commercial MTI Radars Scaled For Weapon Mounting:

What Autonomous Cars Actually See Is Similar To What A Soldier Might Need:

Shrinking Radar Technology Examples, Continued: PSU Research

University Research Focusing On Display Techniques For Complex Radar Return Information:

Clockwise From Upper Left: PSU Surface & Terrain Models, PSU SAR Image vs. Graphic Representation, PSU Bistatic SAR Interferometry Technique Of Mapping, PSU Problems Encountered With Monostatic SAR Imagery.
Shrinking Radar Technology Examples, Continued: Through Wall Plus

Through Wall & UXB Location, High Speed Weapon Guidance With Small Scale Radars:

Conclusions:

- Radar For Soldier Navigation, Detection & Targeting Is Coming
- Fighter Aircraft-Like Performance On A Firearm Is Possible
- Greater Precision Is Achieved Via Radar Vs. Camera Means
- Full EM Spectrum Tactical Exploitation Is Becoming Practical
- Preparing For Data Sharing & Operational Doctrine Should Begin
- Commercial Technology May Be Co-Opted For Military Purposes
Recommendations:

- Adapt Commercial Technology Hardware & Software Developments
- Lay Integration Framework With Powered, Fiber Enhanced Data Bus
- Prepare The Location With Electronic Thermal Barrier Technology
- Focus On Display & Tactical Information Presentation Methods
- Develop Covert Operation & Passive Surveillance Techniques
- Integrate Radar Mapping, Geo-Location & Ranging Functions
Credits:

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