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

(Expanded Topically From Previous Title & Inclusive Thereof)

By:

Howard D. Kent, Armor Development Group, LLC
&
Dr. Ram Narayanan, Penn State University

Contents:

Introduction:

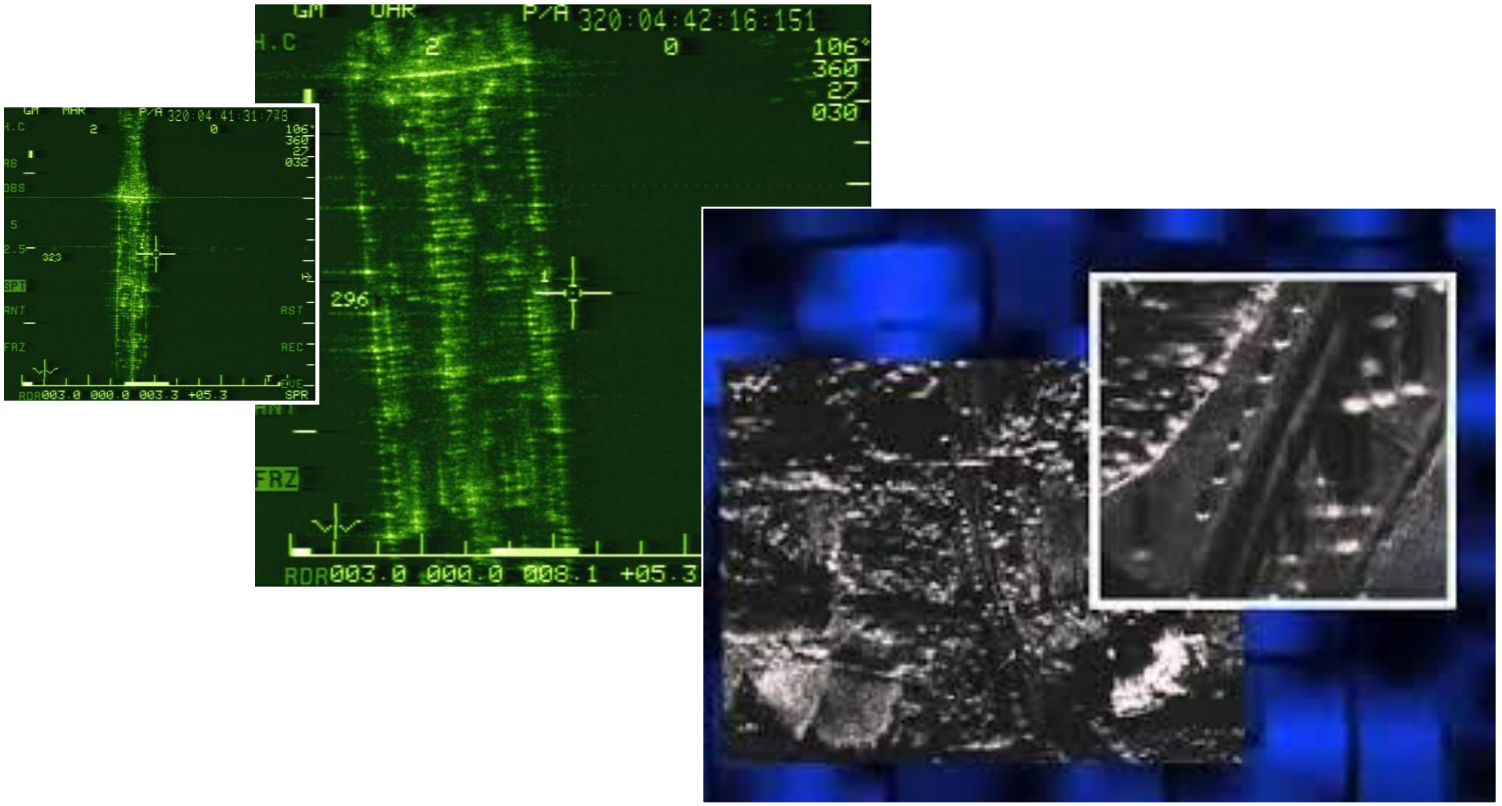
Spurred By Research Into Driverless Vehicles, Radar Technology…And In Particular The Software Behind The Hardware…May Be Adapted To Guide, Protect And Allow Future Soldiers To Overcome Even Advanced Enemies.

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?

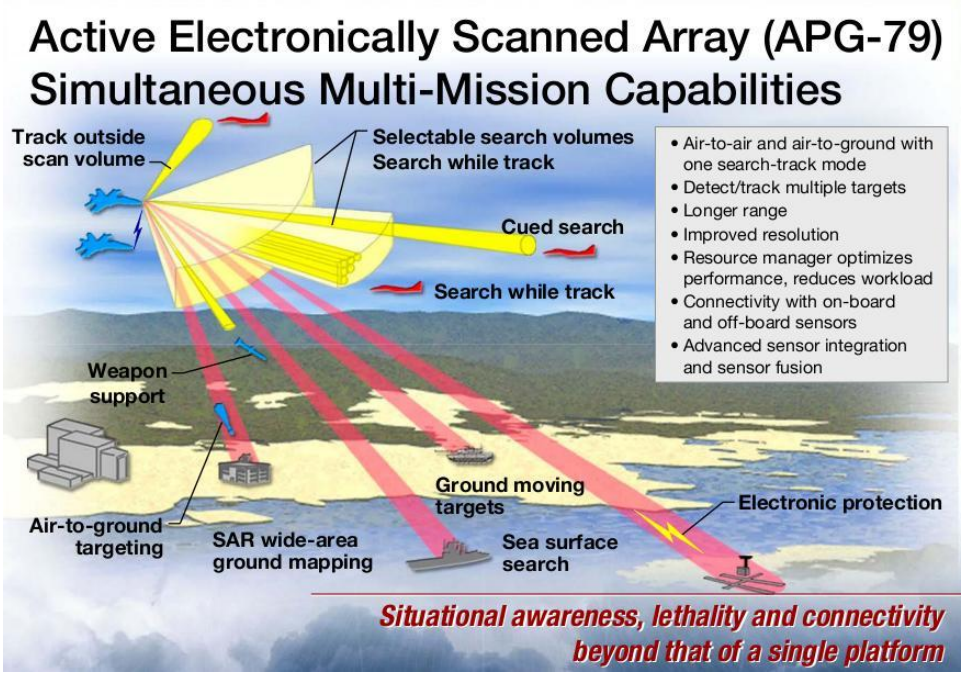
Historical Radar In Fire Control; Large Scale

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



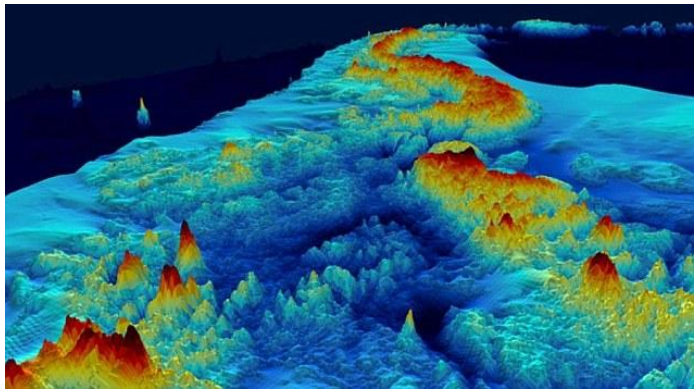
Above, L-R: Raytheon AESA Radar Image Of Bridge, Enlargement, AESA Image Of Terrain, Inset Enlargement Detail.

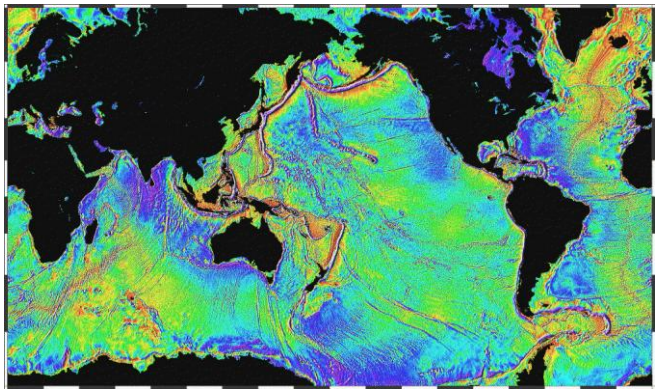
Historical Radar In Fire Control; Large Scale, Continued:



Above, L-R: Raytheon APG-79 AESA Radar, F/A-18 And APG-79, Raytheon AESA Family: Shrinking Size, Greater Capability.

Manipulating Radar Imagery: Precise Maps Of The Earth Exist

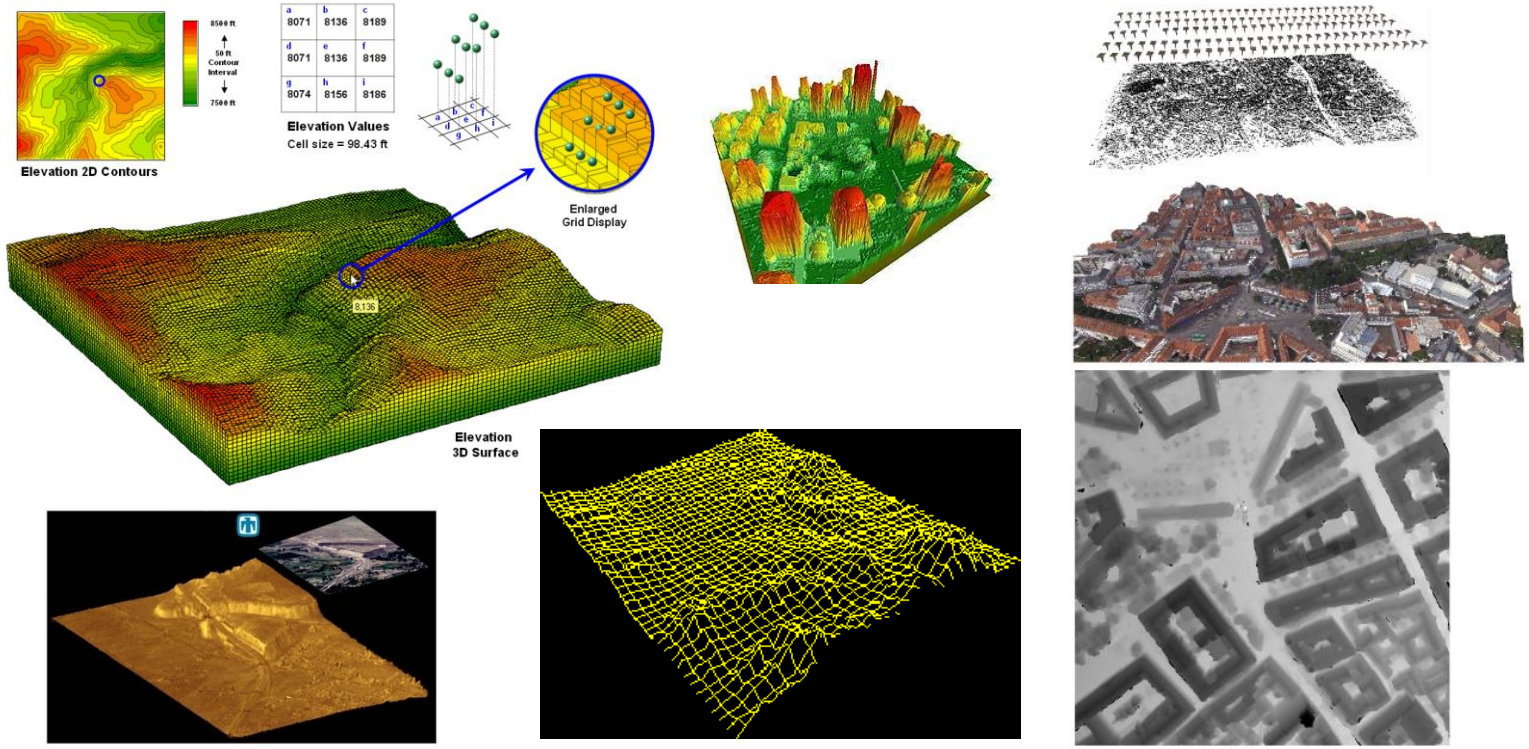




Clockwise From Upper Left: Energy Trends Insider Graphic NYC, NASA Radar Colorized LA Basin, UCSD TOPEX Ocean Radar Image, Daily Mail UK Antarctica Ice Penetrating Radar.

Manipulating Radar Imagery, Continued: Terrain Models

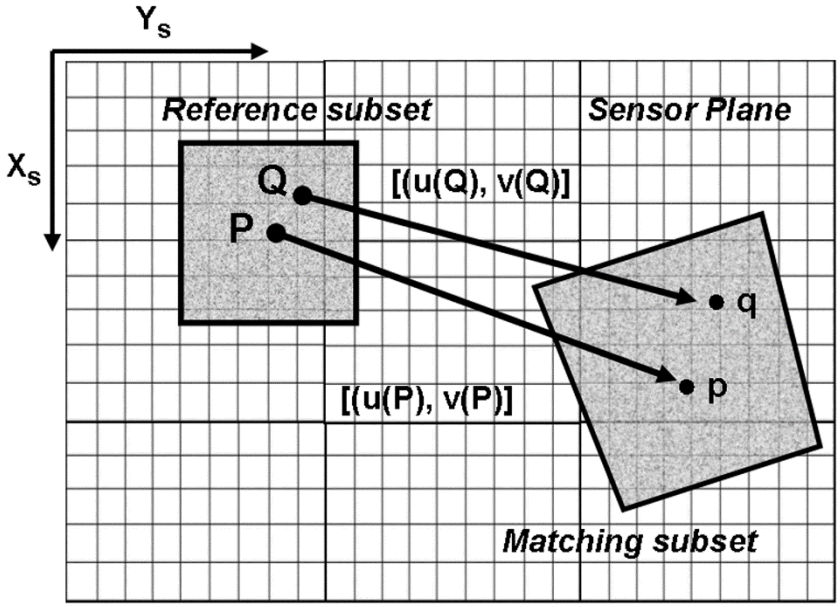
Precise Measurements Of Point-By-Point Altitude In Layers Which Are Then Modeled:



Clockwise From Upper Left: Innovativegis Point Cloud Map, KidsGeo.com Graphic, Aerial.ICG.TTUGraz.ATMultiview, Hunter College Terrain Wire Frame, Sandia National Laboratories Terrain Model And Visible Image Comparison.

Manipulating Radar Imagery: In The Beginning There Was DSMAC

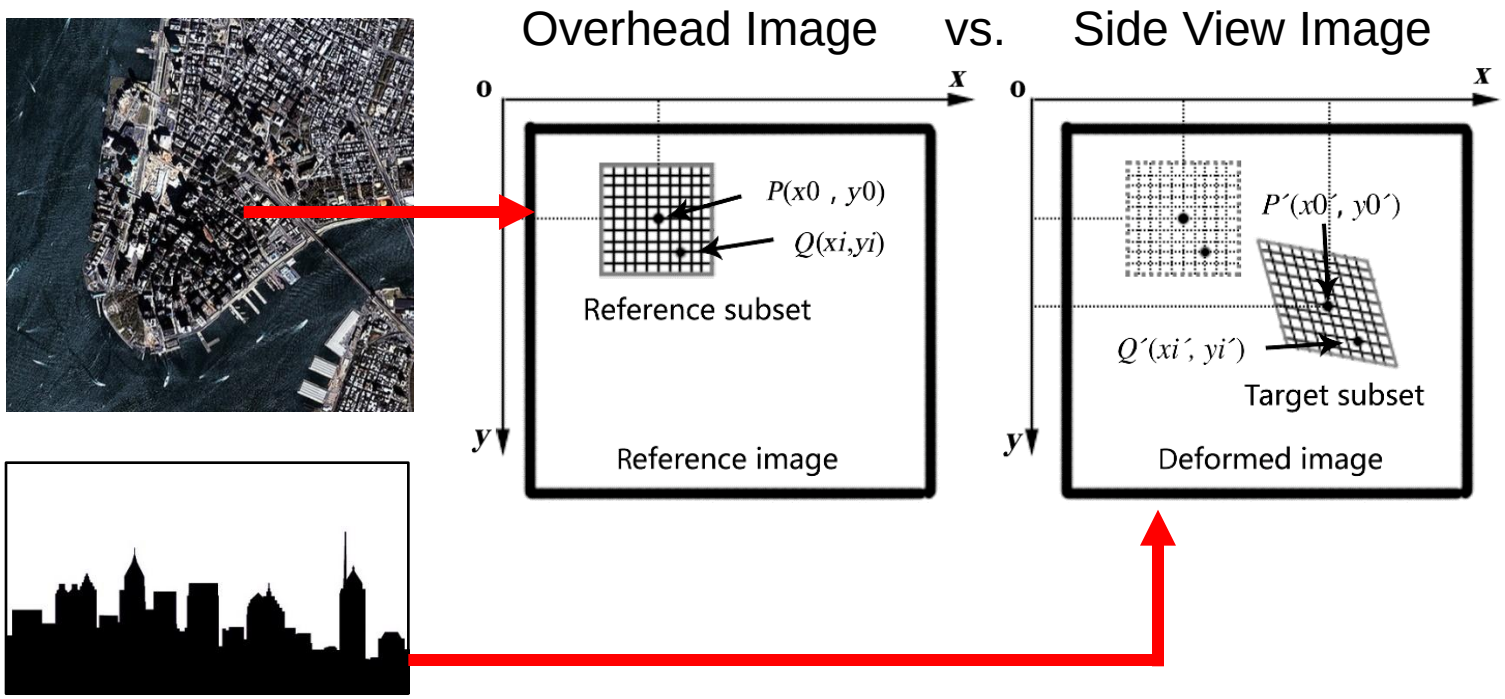
Digital Scene Matching Area Correlation On Tomahawk Cruise Missile…Matched Radar Satellite Map To Over Ridden Course And Adjusted In 2-D Orientation.



Left To Right: FAS.org DSMAC, SPIE Digitial Library DSMAC Overhead Map Orientation Course Correction.

Manipulating Radar Imagery, Continued: Overhead To Side View

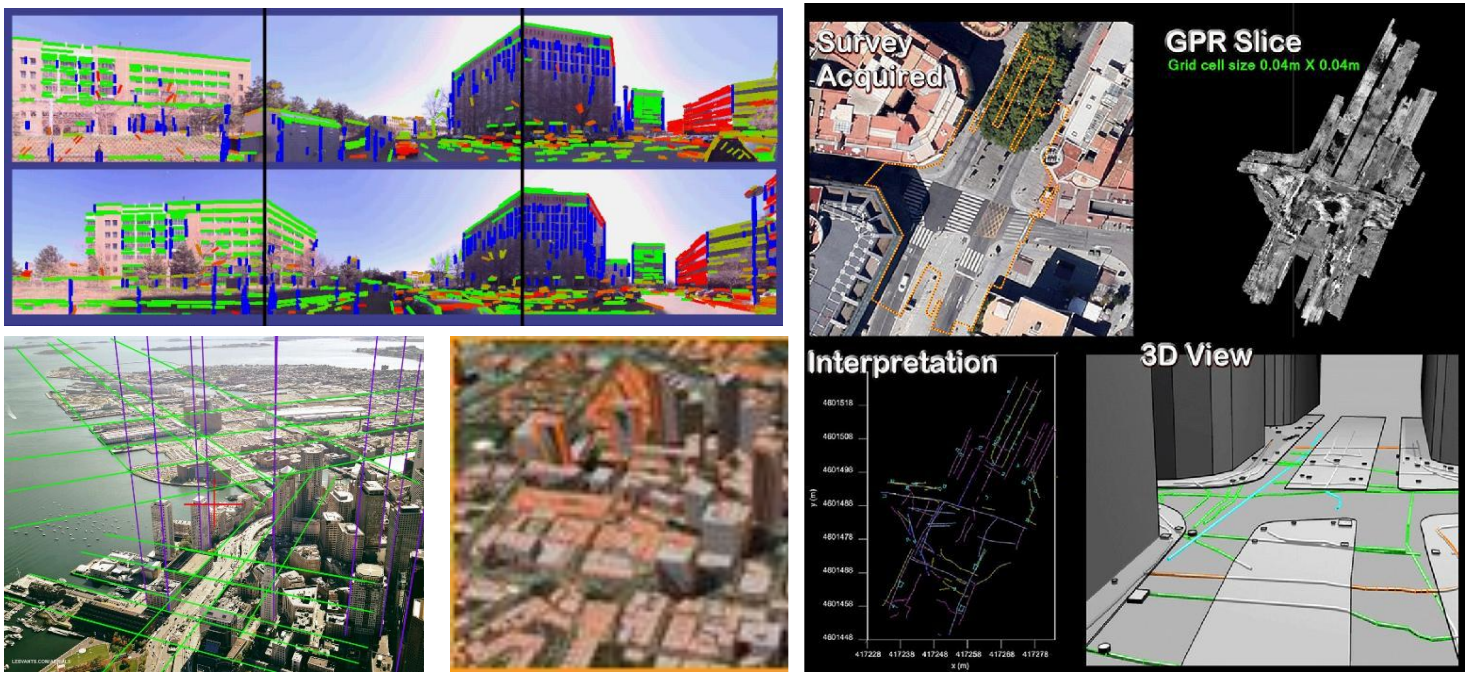
Overhead Imagery May Be Converted To Side View Silhouette For Horizon Matching With Reference Image Converted To Match Deformed Image By Accelerometer Leveling



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

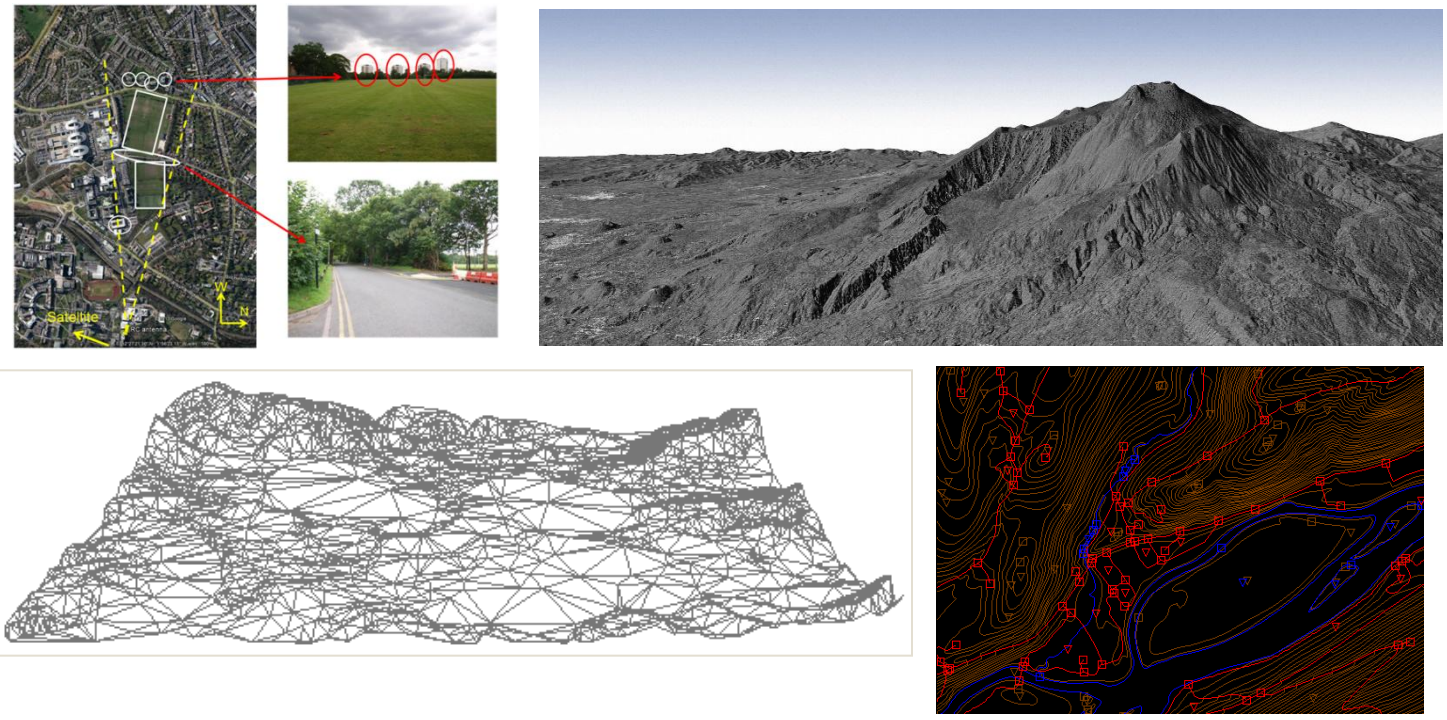
Visible Image Software Recognizing Shapes & Representing Map Locations In 3-D Views:



Clockwise From Upper Left: MIT Digital Photography Scene Matching, GPR Survey.com Radar Image Interpretation, 3DCity.com Graphic Of Deformed Image Edge Recognition, Autodesk View Match Software Line Pattern Recognition.

Manipulating Radar Imagery, Continued: Recognizing Natural Terrain

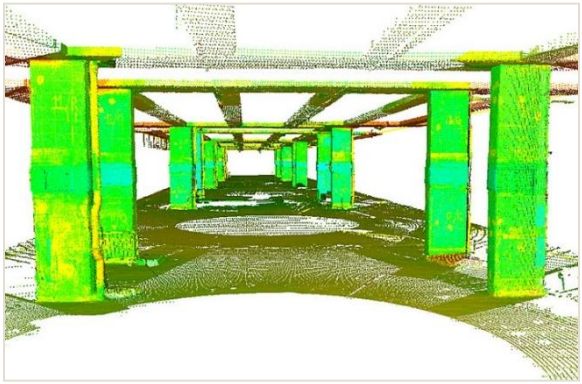
SAR Image Software Recognizing Shapes & Representing Map Locations In 3-D Views:

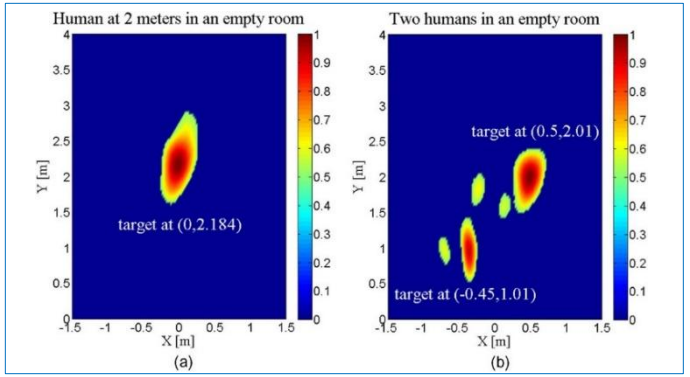


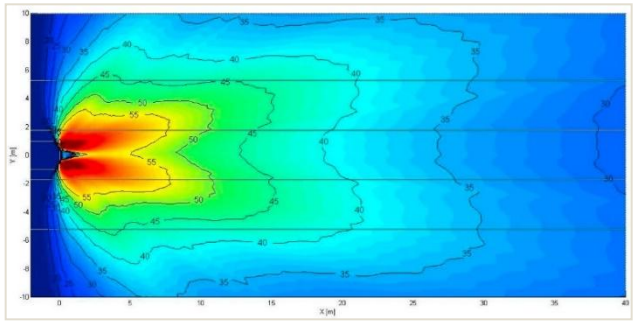
Clockwise From Upper Left: Birmingham University Photographic Terrain Matching, TerraSAR – TandemX Satellite Bistatic SAR Image, PSU Digital Line Map, University Of Texas Triangular Fractal Line Contour Map (Uncolorized).

Manipulating Radar Imagery: The Potential For Fire Control

Radar Synthetic Vision & Through Wall Detection Of Human Targets:







Clockwise From Upper Left:: Synthetic Vision Interior View By LandScope 3D, SPIE.org Human Through Wall Radar Detection Image, UKDaily.com Simulation Showing Visible Camera Overlay Of Humans, Bosch Radar View.

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:

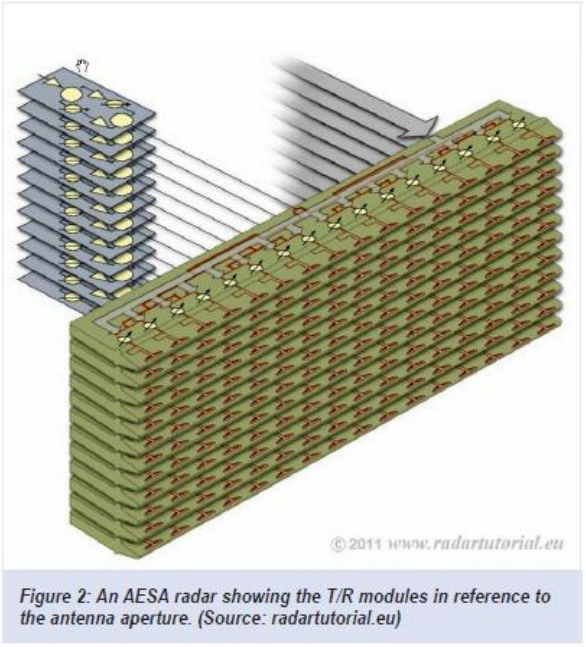
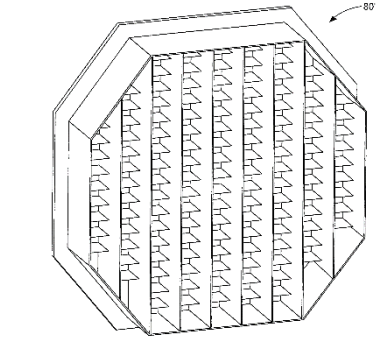
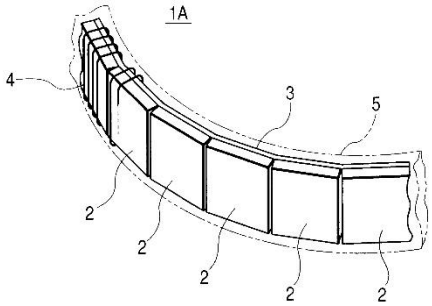
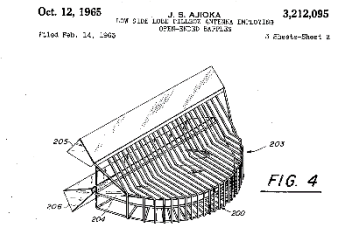
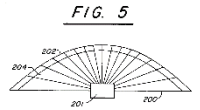


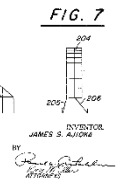
Figure 2: An AESA radar showing the T/R modules in reference to the antenna aperture. (Source: radartutorial.eu)







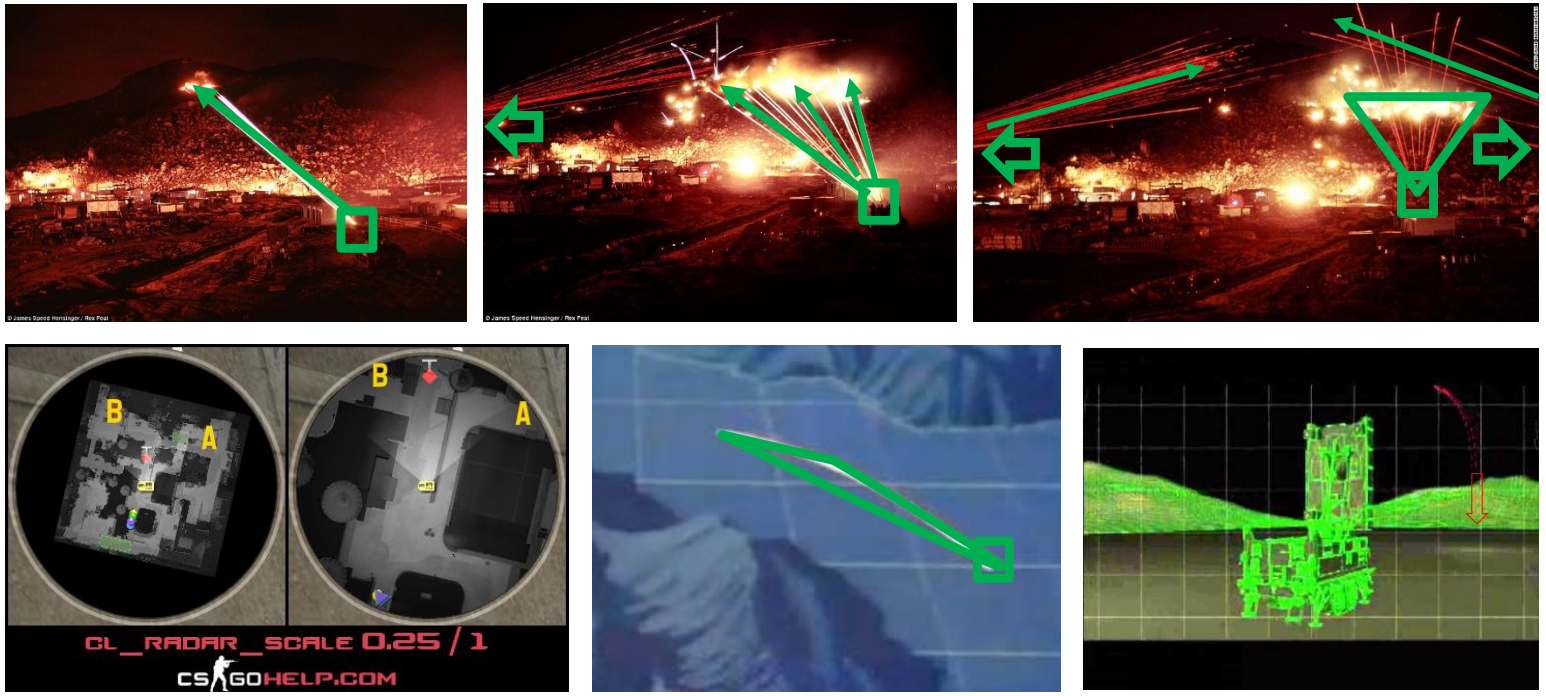




Above, L-R: Radartutorial.eu Graphic Of AESA Array, US Patent 8810448 Octagon AESA, US Patent 3212095 Curved AESA, US Patent 6603441 Curved Compact Antenna Array Design.

Shrinking Radar Technology Examples, Continued: Seeing Fire

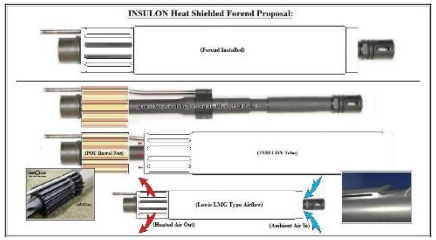
"As If Every Round Fired Actually Was A Visible Tracer, Both Incoming & Outgoing"

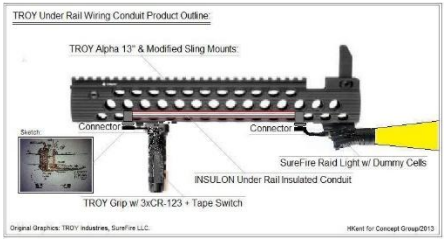


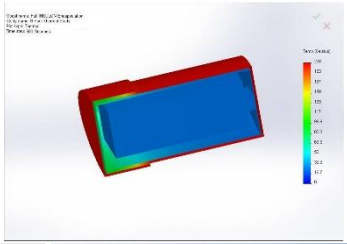
Clockwise From Upper Left: Vietnam Battle Scenes UK Daily Mail (Top Row, Green Overlay Ibid.), Raytheon FireFinder Radar Flat Plate AESA Artillery Locator, Raytheon FireFinder Map Overview, Video Game "God's Eye View" (CSGOHelp.com Image).

Shrinking Radar Technology Examples, Continued: Keeping Cool

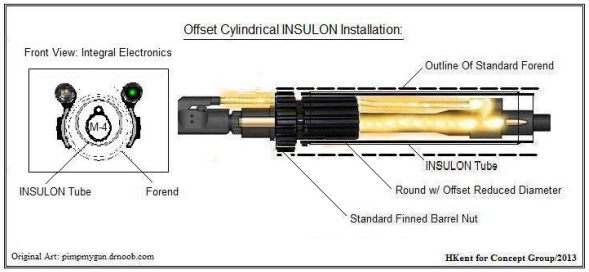
Integrating Firearms To Radar Technology: Radar Electronics Require Insulation

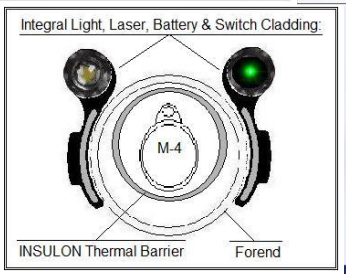


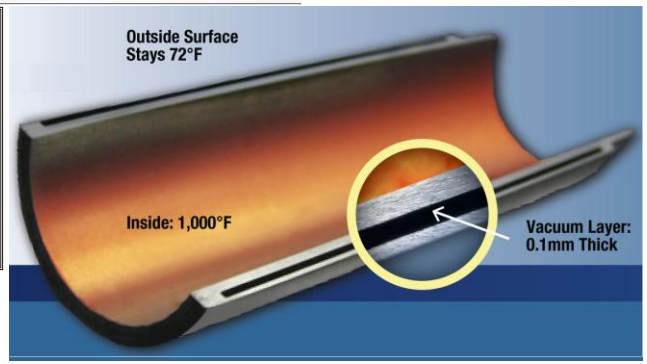




www.conceptgroupinc.com



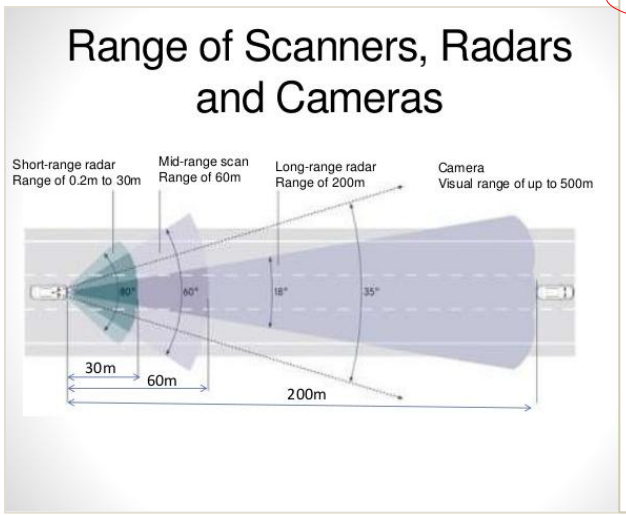


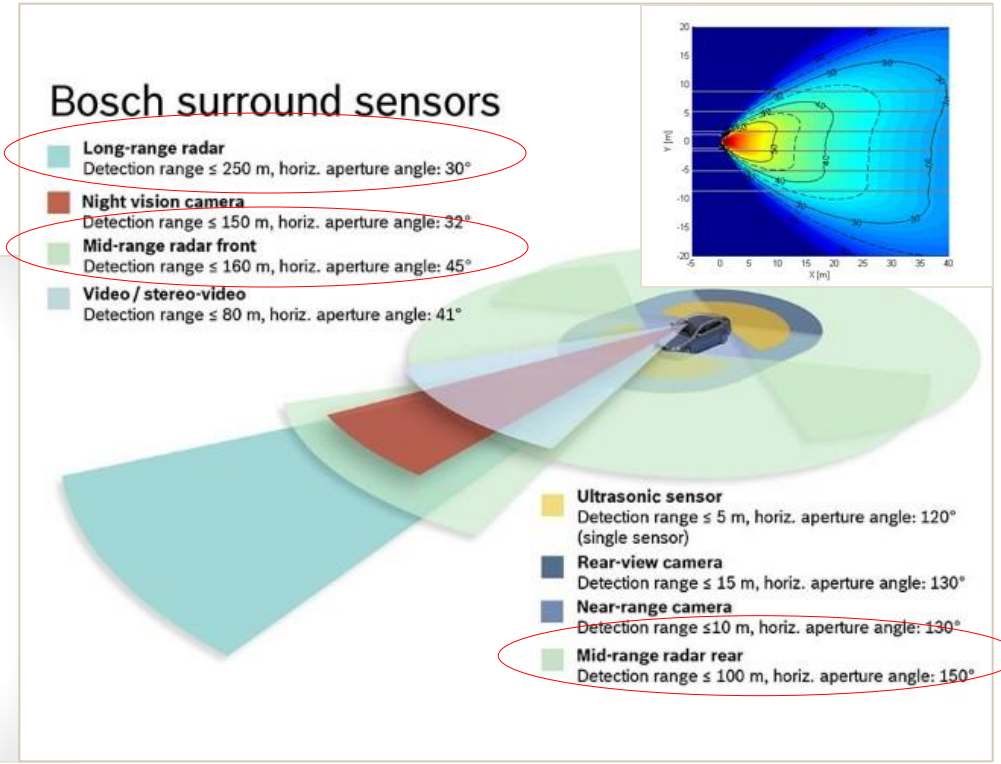


Clockwise From Upper Left: ADG "Lewis Gun" Forend Thermal Shroud, ADG Under Forend Thermal Conduit, Concept Group INSULON Encapsulation (200C for 8 Hours), Concept Group INSULON, ADG Electronic Cladding Examples.

Shrinking Radar Technology Examples, Continued: Automotive

Sophisticated Commercial MTI Radars Scaled For Weapon Mounting:

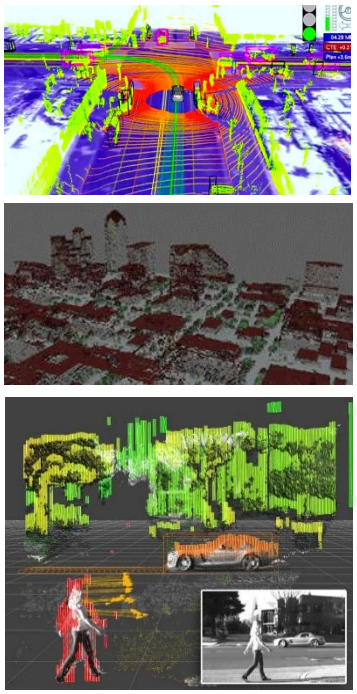


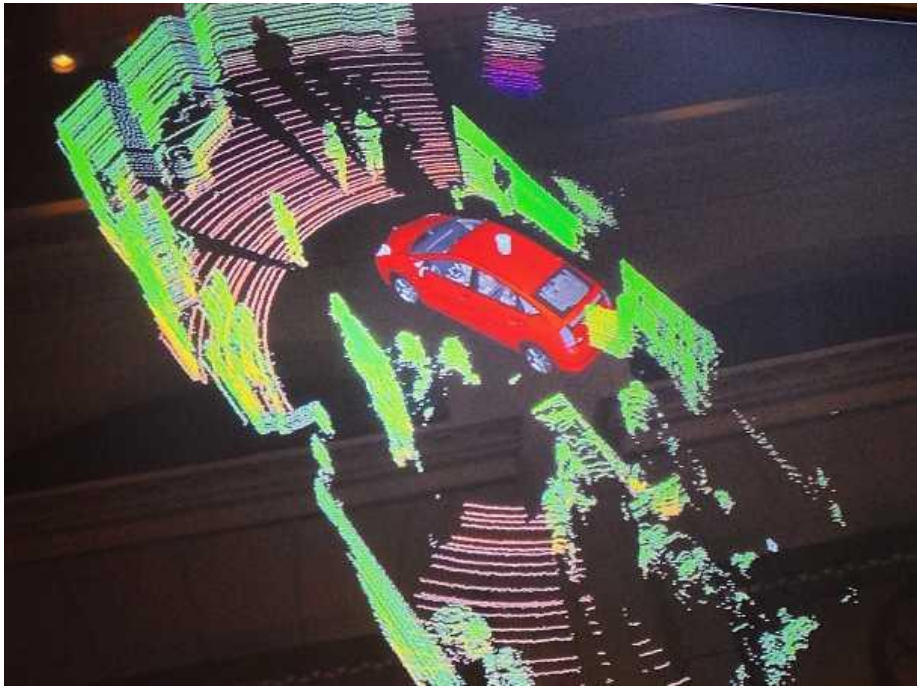


Clockwise From Upper Left: EET.com Automotive Radar, Robert Bosch Long Range Automotive Radar, Robert Bosch Surround Sensors, Inset Frontal Coverage, Autonomous Cars By Ihazn Range Of Scanners, Radars And Cameras.

Shrinking Radar Technology Examples, Continued: Automotive

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

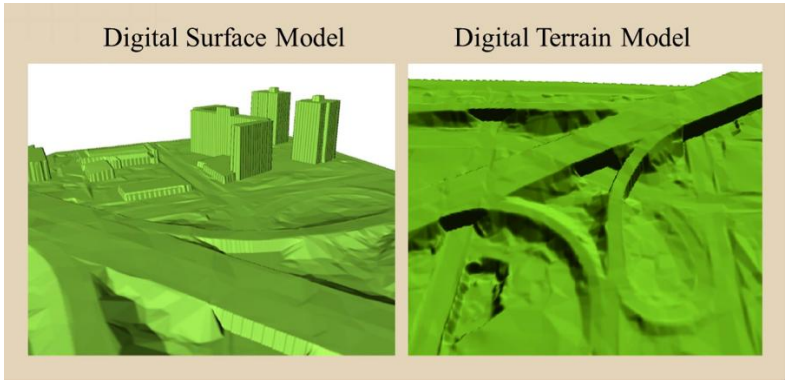


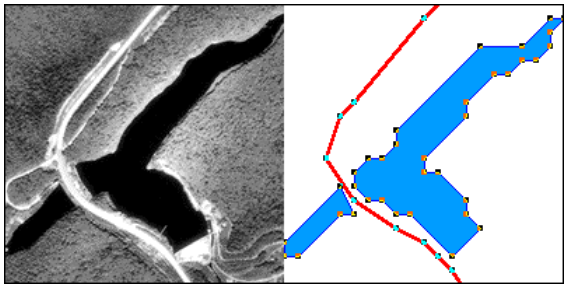


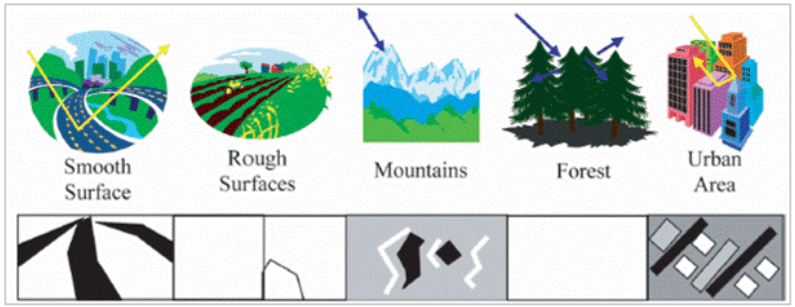
Clockwise From Upper Left: IEEE Google Autonomous Car, Wired How Google Self Driving Car Sees You, Wired Google Radar Image Processing, Geoint Identify Features Of Urban Building Structures In Deformed Image View.

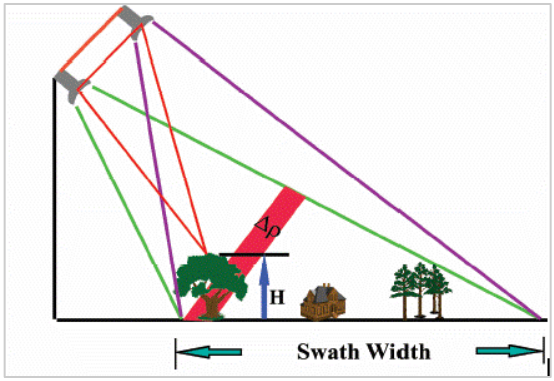
Shrinking Radar Technology Examples, Continued: PSU Research

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





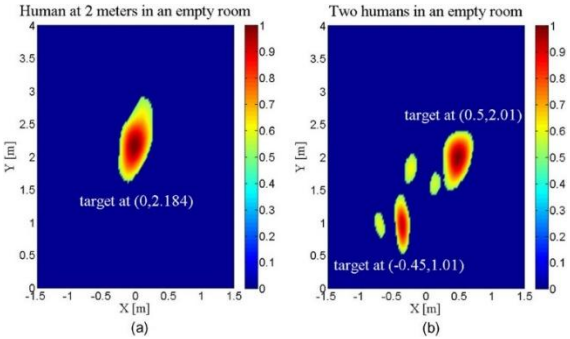


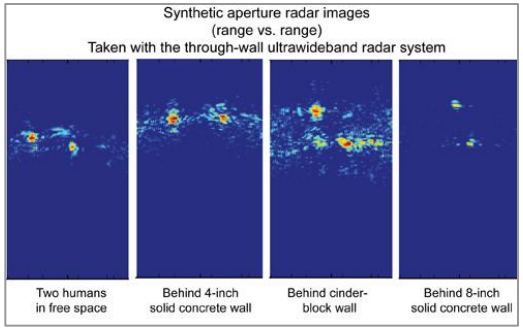


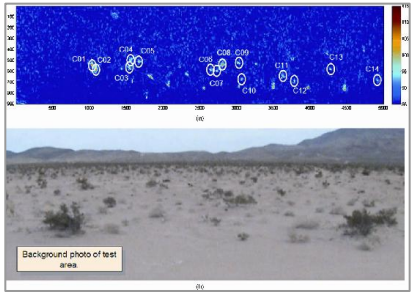
Clockwise From Upper Left: PSU Surface & Terrain Models, PSU SAR Image vs. Graphic Representation, PSU Bistatic SAR Interferometry Technique Of Mapping, PSU Problems Encountered With Monostatic SAR Imagery.

Shrinking Radar Technology Examples, Continued: Through Wall Plus

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







Clockwise From Upper Left: DARPA Wall Penetrating Radar, DARPA Graphic Representation Of Imaging, SPIE Human WPR Detection, Tiny AESA Antennae On Lockheed Martin Interceptor, SPIE UXB Metal Detection, SPIE WPR Image.

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:

POC: Howard D. Kent, CEO, Phone: 818-314-8636, e-Mail: HDKent@socal.rr.com

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With Special Thanks To:

Dr. Ram Narayanan, PhD
Professor of Electrical Engineering
The Pennsylvania State University
Phone: 814-863-2602
E-mail: ram_at_engr_dot_psu_dot_edu
Research Area: Remote Sensing and Space Systems

&
Dr. James Klett