

Software to Generate 3-Dimensional Displays of Inverse Synthetic Aperture Radar Data

Jack Jones, John G. Bennett and Roger Evans
**U.S. Army Tank-automotive and Armaments
Command**

Ground Target Modeling and Validation Conference
18-20 August 1998
Houghton, Michigan

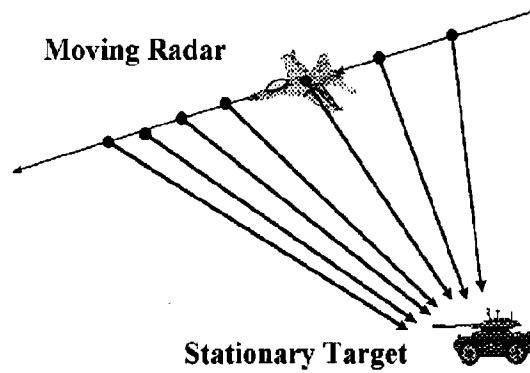
Summary

- The Problem
 - Identifying Scatterers
- Introduction to ISAR
 - Principle of Operation
 - Geometry
- Software
- Example
- Conclusions & Plans

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 18 AUG 1998		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE Software to Generate 3-Dimensional Displays of Inverse Synthetic aperture Radar Data				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Jones, Jack; Bennett, John G.; Evans, Roger				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) US ARMY TACOM 6501 E 11 Mile Road Warren, MI 48397-5000				8. PERFORMING ORGANIZATION REPORT NUMBER 16207	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S) TACOM TARDEC	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S) 16207	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 10	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

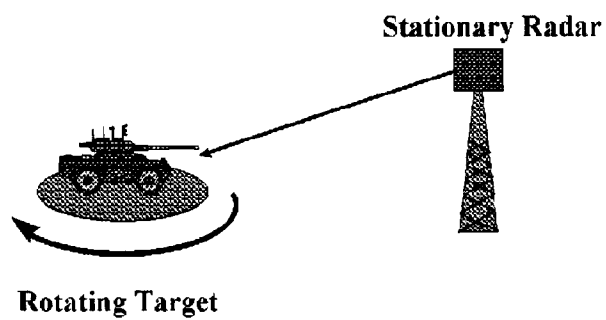
SAR

Synthetic Aperture Radar

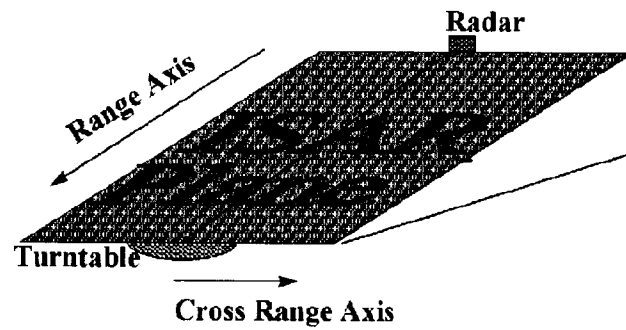


ISAR

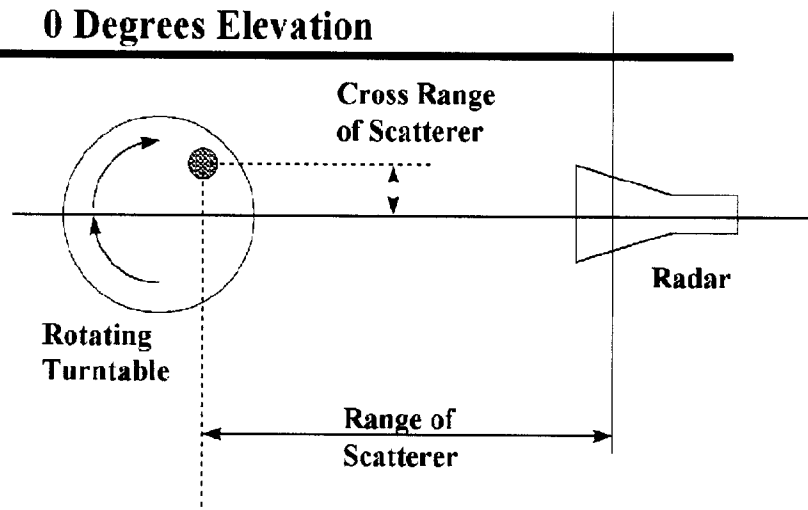
Inverse Synthetic Aperture Radar



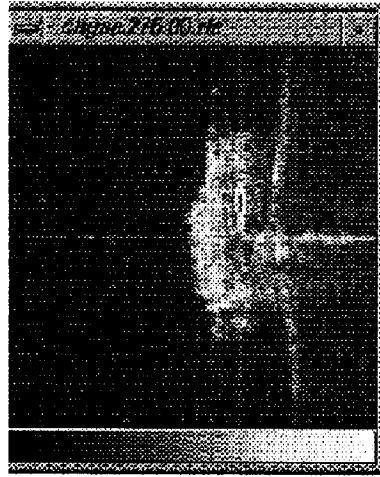
The ISAR Plane



Top View of ISAR for 0 Degrees Elevation



Typical ISAR Image



Location of Scatterers by ISAR

- Range
 - Distance from Radar
 - Calculated from time of flight of echoes
- Cross Range
 - Distance Left or Right from Vertical Plane Defined by Turntable Axis and Vector from Radar to Turntable
 - Calculated From Doppler Shift of Echoes Caused by Rotation on the Turntable

Angular Positions of Radar and ISAR Viewer

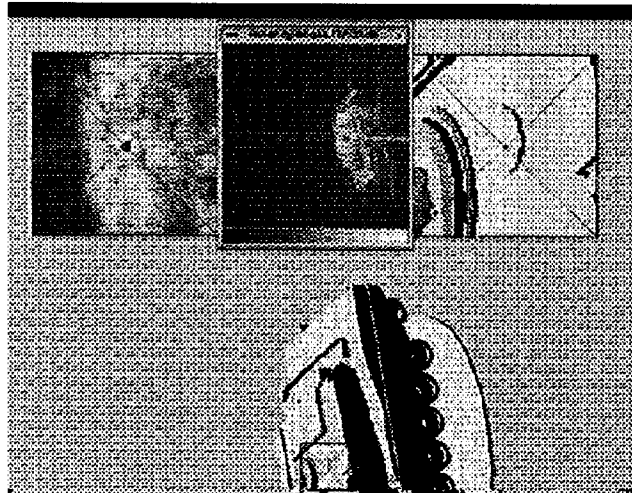
Elevation

$$\theta^{ISAR} = 90^\circ - \theta^{Radar}$$

Azimuth

$$\alpha^{ISAR} = 180^\circ - \alpha^{Radar}$$

2-D Location of Hot Spots



3-D ISAR Visualization Software

- Operates As a Stand Alone Program, not as a (Faceted Region Editor) FRED utility
- Written in C using SGI GL
- Display Windows
 - ISAR Movie Window
 - CAD Model from ISAR Point of View
 - Textured CAD Model from Arbitrary Point of view

3D Mapping of ISAR Data

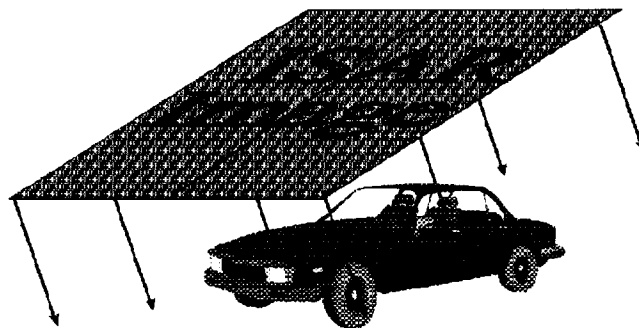
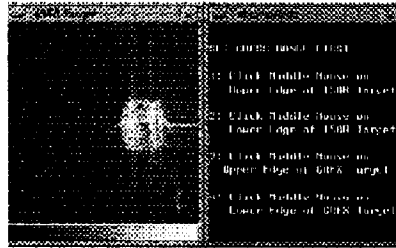


Image Alignment

ISAR
Image



Alignment
Instructions

CAD
Model



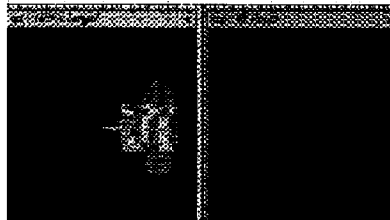
4X
Zoom

Alignment Completed

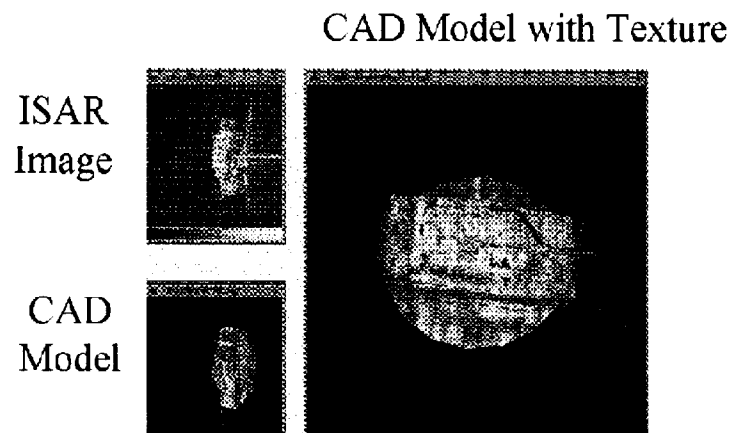
Texture
Image



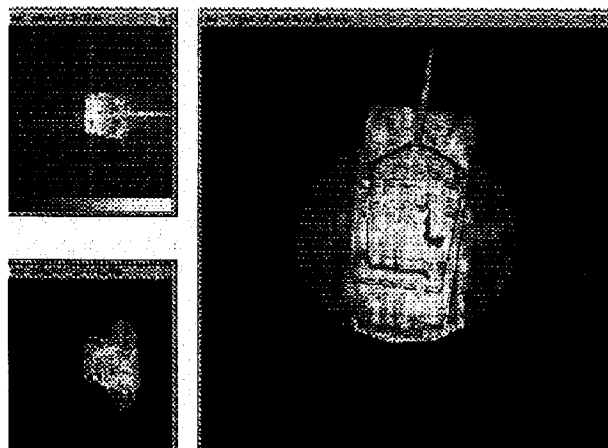
CAD
Model



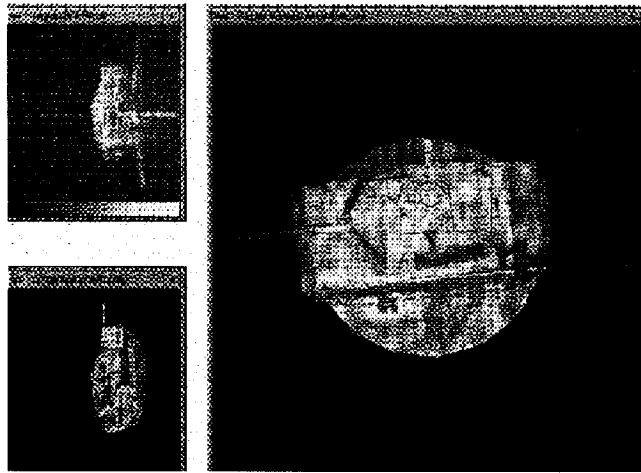
Texture Mapped onto CAD Model



Hot Spot on Turret



Hot Spot on Tracks



Close Up of Track Hot Spot



Conclusions

- The 3-D ISAR visualization software aids in the identification of scattering centers on a ground combat vehicle.

Future Work

- Convert to Open GL
- Operation on a Windows PC
- Multibounce Display from Hot Spots
- Summation of Textures from Several Azimuth Angles