

Final Report

AFOSR Contract FA9550-04-C-0034

Summary: Design of a narrowband vs. wideband experiment was conducted as proposed. The system was operationally tested and a great deal of data was gathered and provided to the Air Force. This data suggests the future viability of such a wideband system. We also proposed the future testing protocol, by which the project can be brought to a higher level and hopefully transitioned into production.

Primary Accomplishments:

1. The design of the system was accomplished in the first few months of the contract. Major changes to the design included the exclusion of a circulator for the system, in lieu of a dual antennae system. This was due to the inability of any commercially available circulator to adequately isolate the receiver from the transmit pulse, endangering the receiver to catastrophic failure due to overload.
2. The initial building of the system and test range began shortly after the design phase. Major issues included the interface of the system with the oscilloscope, the isolation of the antennae's from the platform, and the building of the experimental test track. All of these issues were addressed in Summer 2004, approximately. Numerical simulations of the proposed work was also conducted.
3. Significant theoretical research into the design of a wideband fully polarized SAR system was also conducted in the Summer of 2004. In addition, the calculation of electromagnetic returns was also inspected and significant results were uncovered. Publications supporting these accomplishments are listed below.
4. The final building of the system was delayed due to the timing of the delivery of the oscilloscope. This digital oscilloscope is central to the project due to its ability to digitize incoming signals at a rate of 25-50 ps. The oscilloscope was delivered in the Fall of 2004. In addition, a mechanical boom was rented and the system was mounted on the boom. A trailer was rented to house the equipment next to the boom, and testing of the system followed. Initial tests were conducted in the October-November timeframe of 2004. Initial data was transferred to the Air Force. An initial site visit was conducted by AFOSR in November of 2004, with very positive feedback.
5. A "complete" data set was taken on one day, December 16 of 2004. This data included 700 files from 7 different locations. The total amount of data which was acquired exceeded 3000 files. This data was presented and analyzed at the annual Air Force Electromagnetics Conference in San Antonio, in January.
6. In late December/early January a decision to halt data collection was made by the Air Force with consultation from Valhalla Technologies. The final few months of

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the contract were spent on surveying the data collection site, to insure the future viability of the data for scientific purposes, and on further data analysis.

7. The data from the project was extensively analyzed and was presented after the contract period at DARPA, on July 29, 2004. A plan to move the project forward was put forward at that time, and the results were very positive.

Reports/Publications:

Shabanov's theoretical Work:

1. A G Borisov, F.J. Garcia de Abajo and S V Shabanov,
Role of electromagnetic trapped modes in extraordinary transmission in nanostructured materials,
Phys. Rev. B 71 (2005) 075408

2. A G Borisov and S V Shabanov,
Lanczos Pseudospectral Method for Initial-Value Problems in Electrodynamics and its Applications to Ionic Crystal Grating
J. Comput. Phys.} (2005) 643-662.

3. A G Borisov and S V Shabanov,
Applications of the wave packet method to resonant transmission and reflection gratings
J. Comput. Phys. 199 (2004) 742-762

On-line electronic preprints

1. Andrei G. Borisov and Sergei V. Shabanov,
Lanczos Pseudospectral Propagation Method for Initial Value Problems in Electrodynamics of Passive Media,
LANL electronic preprint (on-line):
<http://xxx.lanl.gov/abs/physics/0410271>
2. Andrei G. Borisov and Sergei V. Shabanov,
Electromagnetic Pulse Propagation in Passive Media by the Lanczos Method,
LANL electronic preprint (on-line):
<http://xxx.lanl.gov/abs/physics/0410270>
3. Sergei V. Shabanov,
Electromagnetic pulse propagation in passive media by path integral methods,
LANL electronic preprint (on-line):
<http://xxx.lanl.gov/abs/math.NA/0312296>

Additional Reports (Included)

- 1. The report on the target data, January, 2005:**
- 2. Colby Dill's report to the AFOSR E+M conference.**
- 3. Tim Olson's report to the AFOSR E+M conference.**
- 4. Tim Olson's analysis of the data and report.**

REPORT DOCUMENTATION PAGE

AFRL-SR-AR-TR-05-

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1. REPORT DATE (DD-MM-YYYY) 29-10-2005		2. REPORT TYPE Final		3. DATES COVERED (From - To) 15-04-2004 - 15-04-2005	
4. TITLE AND SUBTITLE Narrowband vs. Wideband Radar Experiment: Precursor Data Acquisition				5a. CONTRACT NUMBER FA9550-04-C-0034	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Timothy E. Olson and Colby Dill III				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Valhalla Technologies, LLC 925 N. San Souci DeLand FL 32720				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Office of Scientific Research 4015 Wilson Blvd, Room 713 Arlington, VA 22203-1954				10. SPONSOR/MONITOR'S ACRONYM(S) USAF/AFRL/AFOSR	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT All documents are public record					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT Design of a narrowband vs. wideband experiment was conducted as proposed. The system was operationally tested and a great deal of data was gathered and provided to the Air Force. This data suggests the future viability of such a wideband system. We also proposed the future testing protocol, by which the project can be brought to a higher level and hopefully transitioned into production.					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES 3	19a. NAME OF RESPONSIBLE PERSON Timothy Edward Olson
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER (include area code) 386-747-3416