13:33:21 OCA PAD AMENDMENT PROJECT HEADER INFORMATION 06/12/96

Active

Project #: E-21-594 Cost share #: Rev #: 7
Center # : 10/11-6-P5126-0A0 Center shr #: OCA file #:
Work type : INST
Contract#: NGT-50903 Mod #: ADMINISTRATIVE Document : GRANT
Prime #: Contract entity: GTRC

Subprojects ? : N CFDA: 43.002
Main project #: PE #: N/A

Project unit: ECE Unit code: 02.010.118
Project director(s):
GASIEWSKI A J ECE (404)894-2900

Sponsor/division names: NASA / HEADQUARTERS/WASHINGTON, DC
Sponsor/division codes: 105 / 002

Award period: 920701 to 951231 (performance) 960229 (reports)

Sponsor amount	New this change	Total to date
Contract value	0.00	66,000.00
Funded	0.00	66,000.00
Cost sharing amount		0.00

Does subcontracting plan apply ? N

Title: OPTIMIZATION OF PRECIPITATION RETRIEVAL ALGORITHMS FROM PASSIVE MICROWAVE...

PROJECT ADMINISTRATION DATA

OCA contact: Anita D. Rowland 894-4820

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Sponsor issuing office

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NASA HEADQUARTERS
ACQUISITION DIVISION
WASHINGTON, DC 20546

Security class (U,C,S,TS) : U ONR resident rep. is ACO (Y/N): N
Defense priority rating : N/A N/A supplemental sheet
Equipment title vests with: Sponsor GIT
"USE OF FUNDS FOR PURCHASE OF EQUIPMENT IS NOT PERMITTED."
Administrative comments -
UPDATE DELIVERABLE SCHEDULE

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

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NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 07/09/96

Project No. E-21-594_____ Center No. 10/11-6-P5126-0A0_

Project Director GASIEWSKI A J_____ School/Lab ECE_____

Sponsor NASA/HEADQUARTERS/WASHINGTON, DC_____

Contract/Grant No. NGT-50903_____ Contract Entity GTRC

Prime Contract No. _____

Title OPTIMIZATION OF PRECIPITATION RETRIEVAL ALGORITHMS FROM PASSIVE MICROWAVE

Effective Completion Date 951231 (Performance) 960229 (Reports)

Closeout Actions Required:	Y/N	Date Submitted
Final Invoice or Copy of Final Invoice	Y	_____
Final Report of Inventions and/or Subcontracts	Y	_____
Government Property Inventory & Related Certificate	N	_____
Classified Material Certificate	N	_____
Release and Assignment	N	_____
Other _____	N	_____

Comments_____

_____

Subproject Under Main Project No. _____

Continues Project No. _____

Distribution Required:

Project Director	Y
Administrative Network Representative	Y
GTRI Accounting/Grants and Contracts	Y
Procurement/Supply Services	Y
Research Property Managment	Y
Research Security Services	N
Reports Coordinator (OCA)	Y
GTRC	Y
Project File	Y
Other _____	N
_____	N

NOTE: Final Patent Questionnaire sent to PDPI.

E-21-594
#1

Final Status Report
for
NASA Grant NGT-50903
Graduate Student Research Program Fellowship

Optimization of Precipitation Retrieval Algorithms from Passive Microwave Measurements

Submitted by:
Professor Albin J. Gasiewski
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May 24, 1996

NASA grant NGT-50903 provided support for the graduate work of Ms. Gail M. Skofronick-Jackson at the Georgia Institute of Technology from July 1, 1992 through September 30, 1995. During this time Ms. Skofronick-Jackson worked in the GT School of Electrical and Computer Engineering's Laboratory for Radio Science and Remote Sensing (LaRRS) under the guidance of Professor Albin J. Gasiewski. The original goal of her work was to develop optimal precipitation parameter retrieval algorithms applicable to multichannel passive microwave imagery observed from space. Specifically, this was to be accomplished using computer simulations of the mapping and retrieval process, including the effects of spatial filtering, sensor noise, and geophysical scene variability. Optimal nonlinear retrieval algorithm development was identified as a major goal of this work.

Ms. Skofronick performed forward radiative transfer calculations to synthesize multispectral brightness temperature maps of a tropical squall from 3-dimensional microphysical storm cell data. Her simulation included several channels proposed for the NASA/ESA Multispectral Imaging and Mapping Radiometer (MIMR), specifically, 6.0, 10.7, 18.7, 22.3, 37.0, and 89.0 GHz. During this process Ms. Skofronick identified a commonly-made modeling error regarding the number of hydrometeor phases used in radiative transfer modeling. Her work showed corroborated the use of a five phase model in the description of the hydrometeor field.

Using the synthesized imagery, simulations of the satellite mapping and retrieval process were performed, including the effects of antenna pattern convolution, sampling, instrument noise, and optimal retrieval. A nonlinear statistical retrieval algorithm for rain rate (RR) and integrated ice content (IIC) using supervised nonlinear inversion was developed and tested. The use of Karhunen-Loeve prefiltering prior to retrieval algorithm development was tested. Error statistics using the nonlinear algorithm showed that the KL prefiltering serves to reduce error for retrievals were the geophysical quantity of interest dominates the brightness temperature signature (for example, in

retrieving IIC), but generally not in other cases. Further, the area-averaged error is a strong function of the spatial resolution, which is in turn dictated by the available aperture size of the microwave antenna. For a 1.6 meter diameter aperture (typical of a MIMR-class system), the area-averaged error standard deviation for RR increased by ~220% relative to full resolution imagery. Error standard deviation for IIC increased by only ~49% since IIC is primarily obtained from the high-frequency (and, hence, high resolution) channels.

Significant milestones passed by Ms. Skofronick-Jackson under the support of NASA grant NGT-50903 include:

Ph.D. qualifying examination, Georgia Institute of Technology School of ECE, passed March 1992.
Ph.D. thesis proposal "Iterative Nonlinear Statistical Retrievals of Precipitation Parameters from Simulated Spaceborne Multispectral Imagery," Georgia Institute of Technology School of ECE, accepted November 1994.

Ms. Skofronick-Jackson is completing a draft of her dissertation, of which approximately half has been written. This work is being carried out off-campus, with completion expected in late 1996.

During her residency at Georgia Tech, Ms. Skofronick-Jackson performed the task of LaRRS computer systems manager, administering a system of five computer workstations serving over two-dozen students. Her performance as system manager was exemplary. Upon leaving Georgia Tech in September 1996, she has continued her collaboration with LaRRS by making the synthetic brightness imagery and associated software available for LaRRS use in neural net retrieval studies.

Publications

A summary of publications stemming from NASA grant NGT-50903 follows:

Refereed Journal Publications:

Skofronick-Jackson, G.M. and Gasiewski, A.J., "Nonlinear Statistical Retrievals of Ice Content and Rain Rate Using Passive Microwave Observations of a Simulated Convective Storm," *IEEE Trans. Geosci. Remote Sensing*, vol. 33, no. 4, pp. 957-970, July, 1995.

Gasiewski, A.J., Showman, G.A., and Skofronick, G.M., "Application of Neural Nets to Rain Rate and Integrated Ice Content Retrieval from Simulated Multichannel Passive Microwave Imagery," in preparation, to be submitted to *IEEE Trans. Geosci. Remote Sensing.*

Conference Publications (full paper, refereed):

Skofronick, G.M. and Gasiewski, A.J., "Passive Microwave Precipitation Mapping and Retrieval Simulation," *Proceedings of the 1992 International Geoscience and Remote Sensing Symposium,* vol. 2, pp. 1716-1718, presented at the 1992 IGARSS, Houston, TX, May 26-29, 1992.

Skofronick, G.M. and Gasiewski, A.J., "Passive Microwave Mapping Simulation, Karhunen-Loeve Analysis, and Precipitation Retrievals," *Proceedings of the Topical Symposium on Combined Optical-Microwave Earth and Atmosphere Sensing (CO-MEAS)*, pp. 14-17, presented in Albuquerque, NM, March 22-25, 1993.

Skofronick-Jackson, G.M. and Gasiewski, A.J., "Nonlinear Statistical Precipitation Retrievals Using Simulated Passive Microwave Imagery," *Proceedings of the 1994 International Geoscience and Remote Sensing Symposium*, vol. 3, pp. 1786-1788, presented at the California Institute of Technology, Pasadena, CA, August 8-12, 1994.

Skofronick-Jackson, G.M., and Gasiewski, A.J., "A Statistical Comparison of Calculated Brightness Temperatures with Aircraft-Based Observations from 10 to 325 GHz," *Proceedings of the 1995 Combined Optical-Microwave Earth and Atmosphere Sensing Symposium (CO-MEAS)*, pp. 180-182, presented in Atlanta, GA, April 3-6, 1995.

Skofronick-Jackson, G.M., and Gasiewski, A.J., "A Clean-Based Iterative Nonlinear Statistical Rain Rate Retrieval Algorithm," *Proceedings of the 1995 International Geoscience and Remote Sensing Symposium*, pp. 1898-1900, presented in Florence, Italy, July 10-14, 1995.

Gasiewski, A.J., Showman, G.A., and Skofronick, G.M., "Application of Neural Nets to Rain Rate Retrieval from Simulated Multichannel Passive Microwave Imagery," to be presented at the 1996 International Geoscience and Remote Sensing Symposium, Lincoln, NE, May 27-31, 1996 (invited).