

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station

Post #
A-1448

PROJECT INITIATION

Date: July 13, 1972

Project Title: Study of Double-Reflector Scanning Antenna

Project No.: A-1448

Project Director: Dr. D. G. Bodnar

Sponsor: U. S. Army Missile Command

Effective: 28 June 1972

Estimated to run until: December 28, 1972 *

Type Agreement: Contract No. DAAH01-72-C-1057

Amount: \$ 36,332.00

*End work period.

REPORTS REQUIRED: Monthly Cost & Performance Reports; Monthly Progress Letters;
Final Technical Report.

SPONSOR CONTACT PERSONS:

Technical Matters

Mr. Donald W. Babb
Missile Intelligence Agency
U. S. Army Missile Command
ATTN: AMSMI-YPE
Redstone Arsenal, Ala. 35809
Phone: (205) 876-8040/8873

Contractual Matters

(thru GTRI)
Mr. R. J. Whitcomb (ACO)
ONR Resident Representative
Hinman Research Bldg.
Campus

Defense Priority Rating: DC-A2 under IMS Reg. 1.

Assigned to Sensor Systems

Division

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GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station

PROJECT TERMINATION

Date November 27, 1973

PROJECT TITLE: "Study of Double-Reflector Scanning Antenna"

PROJECT NO: A-1448

PROJECT DIRECTOR: D. G. Bodnar

SPONSOR: U.S. Army Missile Command; Redstone Arsenal, Alabama

TERMINATION EFFECTIVE: 2-28-73 (Contract Expiration)*

CHARGES SHOULD CLEAR ACCOUNTING BY: 2-28-73

*Final Report submitted 11-7-73

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GEORGIA INSTITUTE OF TECHNOLOGY
EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

2 August 1972

Department of the Army
Missile Intelligence Agency
U. S Army Missile Command
Redstone Arsenal, Alabama 35809

Attention: Mr. Donald W. Babb, AMSMI-YPE

Reference: Contract DAAH01-72-C-1057

Subject: Monthly Contract Technical Status Report No. 1 Covering the
Period 28 June to 31 July 1972.

Dear Mr. Babb:

This is the first monthly progress summary under this subject contract and covers the period 28 June to 31 July 1972.

Modifications to an existing digital computer program were started to permit pattern calculations to be made for Schwarzschild antennas. Debudding of the modifications was starting and is nearing completion.

Graphical ray tracing techniques were tried as a parallel effort to the computer analysis. It was found that the graphical procedure is totally inadequate for determining feed point location due to small but significant errors in constructed ray paths.

A technical review meeting between Mr. Donald Babb and Mr. Robert Priddy of MIA and Dr. Richard Johnson, Mr. Robert Goodman, Jr., and Dr. Donald Bodnar of Georgia Tech was held on July 26, 1972 at Georgia Tech.

Evaluation of scanning performance will be started during the forthcoming report period.

Respectfully submitted,

D. G. Bodnar
Project Director



GEORGIA INSTITUTE OF TECHNOLOGY
EXPERIMENT STATION 225 North Avenue, Northwest · Atlanta, Georgia 30332

A-144-8

10 October 1972

Department of the Army
Missile Intelligence Agency
U. S. Army Missile Command
Redstone Arsenal, Alabama 35809

Attention: Mr. Donald W. Babb, AMSMI-YPE

Reference: Contract DAAH01-72-C-1057

Subject: Monthly Contract Technical Status Report No. 3 covering
the period 1 September to 30 September 1972.

Dear Mr. Babb:

This is the third monthly progress summary under this subject contract and covers the period 1 September to 30 September 1972.

During this report period, the calculation of radiation patterns from Schwarzschild and Cassegrain antennas was continued. The antennas which are being investigated have dimensions and shapes similar to those of the antenna discussed with MIA. The ESL antenna, for which Georgia Tech has dimensional information, is among those antennas being examined.

An analysis of the monopulse aspects of the system was initiated during this month. The reflector and sub-reflector parameters are known to have significant influence on such monopulse characteristics as crossover depth and sum and difference pattern sidelobes. Cassegrain monopulse systems have found widespread application in this country as tracking systems; therefore, standard design techniques for these antennas will be examined in great detail.

The operation manual for the ESL antenna was received by Georgia Tech during this report period. This manual contained numerous measured patterns which will be used for comparison purposes in the ongoing computer analysis of the ESL antenna.

The study of scanner types which might be applicable to this system continued through this period.

Mr. Donald W. Babb
10 October 1972
Page 2

During the forthcoming report period, the computer analysis of the ESL antenna and other double reflector antennas will continue. The investigation of monopulse performance will continue at least through the next report period. Also a parallel plate version of a Cassegrain system will be designed during this period. This antenna which may be fabricated economically will provide experimental support for computer predictions.

Respectfully submitted,

D. G. Bodnar
Project Director

DGB/nl

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A-1448



ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

18 December 1972

Department of the Army
Missile Intelligence Agency
U.S. Army Missile Command
Redstone Arsenal, Alabama 35809

Attention: Mr. Donald W. Babb, AMSMI-YPE

Reference: Contract DAAH01-72-C-1057

Subject: Monthly Contract Technical Status Report No. 5
covering the period 1 November to 30 November 1972

Dear Mr. Babb:

This is the fifth monthly progress summary under the referenced contract and covers the period 1 November to 30 November 1972.

On 16 November 1972, Messrs. D. G. Bodnar and J. W. Cofer of Georgia Tech visited personnel of the Missile Intelligence Agency to discuss the status of the study being conducted under the referenced contract and to formulate the scope of the study for the remainder of the program.

On 27 November 1972, Messrs. R. M. Goodman, Jr. and D. G. Bodnar visited Eglin AFB, Florida, to measure certain critical dimensions of the ESL antenna. These dimensions will be used during the coming month to calculate the expected performance of the ESL antenna.

Also during this report period, the computer calculation of radiation patterns from Cassegrain and Schwarzschild antennas was continued. The optimum combination of reflector and subreflector diameters and reflector-subreflector spacing which yields scanned patterns having minimum beam broadening and sidelobe degradation is being determined by calculating patterns from a large number of selected test cases.

Since most of the optimum feed paths obtained to date deviate significantly from a circular arc, the radiation from any point on the scanner face will be required to propagate along a direction which is different from the normal to the arc. A scanner having this capability may be built by phasing each individual channel so that the energy adds in-phase along the desired direction. During the coming month, scanner phasing schemes will be postulated and evaluated on the basis of frequency dependence.

The investigation into the monopulse performance of this type of antenna continued through this report period. Such quantities as beam-crossover depth and sum and difference pattern sidelobes are of particular interest. In addition, the ESL antenna's expected monopulse performance will be determined from the dimensions obtained on the 27 November trip to Eglin.

During the forthcoming report period, the computer analysis of double reflector antennas will continue. During this same period, the recently obtained dimensional data of the ESL antenna will be incorporated into the effort to determine the theoretical performance from such a geometry. Also, techniques for implementing frequency-independent scanner phasing will be evaluated.

Respectfully submitted,

J. W. Cofer
Assistant Project Director

Approved:

D. G. Bodnar, Project Director



GEORGIA INSTITUTE OF TECHNOLOGY
EXPERIMENT STATION 225 North Avenue, Northwest Atlanta, Georgia 30332

A-1448

12 January 1973

Department of the Army
Missile Intelligence Agency
U. S. Army Missile Command
Redstone Arsenal, Alabama 35809

Attention: Mr. Donald W. Babb
AMSMI-YPE

Reference: Contract DAAH01-72-C-1057

Subject: Monthly Contract Technical Status Report No. 6
Covering the Period 1 December to 31 December 1972

Dear Mr. Babb:

This is the sixth monthly progress summary under the referenced contract and covers the period 1 December to 31 December 1972.

During this report period, techniques were investigated for phasing individual scanner channels so that the resultant radiation from a cluster of channels would produce a main beam along a direction other than the normal to the scanner face. Such a scanner appears desirable as the result of optimum feed arc studies. A computer simulation of one attractive possibility (adding a different length of oversized waveguide in series with each channel) indicates that a scanner may be built which has a squinted beam whose pointing direction is virtually frequency insensitive. Simplified experiments which will indicate the validity of the computer predictions will be designed and conducted during the forthcoming report period.

The computer determination of the optimum antenna geometry continued through this period. Certain trends in beamwidth and sidelobe magnitudes as a function of main-reflector-to-subreflector ratio and main-reflector-to-focal-length ratio may be detected.

The monopulse investigation also continued through this report period. Sidelobe levels and crossover depths were tabulated for certain horn sizes and mathematical antenna pattern functions. Once the overall antenna parameters have been determined, the monopulse performance corresponding to those parameters may be evaluated.

U. S. Army Missile Command
Attn: Mr. Donald W. Babb, AMSMI-YPE

Page Two
12 January 1973

During the month of January, the evaluation of previously calculated antenna patterns to determine the optimum parameter combination will be completed. Once this selection has been made, a complete family of scanned and monopulse patterns will be calculated. Also, the scanner arc information and the results of the scanner channel phasing experiments will permit the design and layout of a scanning feed mechanism.

Respectfully submitted,

J. W. Cofer
Assistant Project Director

Approved:

D. G. Bodnar
Project Director

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