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ANALYSIS TECHNOLOGY

1975 - 1982 SUMMARY REPORT

ANALYSIS & TECHNOLOGY, INC.

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1975 - 1982 SUMMARY REPORT

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ABSTRACT

This summary report reviews the progress of work performed by Analysis & Technology, Inc., for the Naval Ocean Research and Development Activity under contract to the Office of Naval Research. Included are descriptions of the work in each area of study and bibliography of articles and reports published. The projects outlined were supported by ONR Contract N00014-76-C-0043.

TASSRAP MODEL STUDIES

During the Mediterranean ASW Augmentation Program in 1974, several problem areas were identified with an onboard prediction system developed by NUC. A&T was tasked by LRAPP to study the problems. As part of this study, A&T developed an interim computer program which used in-situ environmental data to develop acoustic performance predictions. The use of this program required the expertise of an acoustic analyst.

This interim program was tested aboard the USS SAMPLE during the COMTUEX 4A-76 exercise and KENT BEACON Operation. A&T shipped the computer system to Pearl Harbor and installed it aboard the USS SAMPLE. During the at-sea period, A&T provided an experienced acoustic analyst to operate the computer system and interpret the outputs. The predictions from the model were invaluable to the crew.

Following the deployment, A&T removed the system and shipped it back to North Stonington. Shortly afterwards, PME-124, who owned the hardware, requested A&T ship the unit to TRW in Virginia.

KENT BEACON SUPPORT

During the KENT BEACON Operation, A&T provided a principal analyst to serve on the staff at Pearl Harbor. This analyst had been the principal investigator during A&T's involvement in the TASS program. At this time, the problems and capabilities of TASS were relatively new. The analyst was able to provide pertinent information concerning TASS employment. Also, the analyst evaluated all the available information and was able to provide ship deployment guidance. A summary report of KENT BEACON was authored by this analyst and issued by COMMANDER, THIRD FLEET.

TASSRAP MODELING SUPPORT

In 1976, LRAPP undertook the development of an at-sea system assisting towed array platforms with the complex decisions affecting towed array deployment. This system was designed to advise on optimum tow depth, tow speed, and expected detection ranges for towed array systems. As an initial step toward achieving this goal, A&T was tasked to develop an input module.

The module was designed in order to interact with all the modules to be executed. It requests all information necessary to complete all calculations along with presenting options open to the operator. Included among the options are the availability of English or metric units. In adition, wherever possible, default values are available for utilization if the operator is unable to obtain an in-situ value. Instructions for inputting the required data are presented to the operator as part of the input subroutine. Also, the operator is given the opportunity to correct or modify the input before proceeding into the optimization calculations.

There is also a provision in the module allowing the operator to repeat the identical calculations while modifying only a portion of the input data.

This module is written in FORTRAN IV language and was accompanied by a complete listing as well as flow diagrams of the subroutine.

A&T was also tasked to provide a usable data file containing salinity and temperature as a function of depth for the major operating areas throughout the world. Three functions are served by the data file. First, with this data, predictions can be made for future deployment areas before SVP data is obtained. Second, that portion of the water column unattainable by XBTs is completed from historical information necessary to calculate the sound velocity.

Basically, this task consisted of redesigning and updating the environmental data file contained in the TASSRAP model. These files were constructed from data in the NAVOCEANO Compressed Ocean Station Retrieval System. Each ocean basin has been divided into convenient geographical areas with these areas further subdivided. Each sub-area is characterized by similar environmental conditions represented by an array of depth, temperature, and salinity values at standard depths from the surface to the bottom. These files exist on a seasonal basis for the areas of interest.

A routine was developed using the in-situ XBT measurement and merge it with the historical data file. Based on the merged BT, a sound velocity profile was developed representative of the area and season. This SVP is used in the tow depth selection model and in the propagation loss calculations.

In addition, another data file was created delineating bottom loss provinces. This file was integrated into the program so that the computer accesses the proper bottom loss provinces for the latitude and longitude input from the operator. As a result, the operator is relieved from constantly referring to a chart of bottom loss provinces.

Required programming for the access of this file was written in FORTRAN IV and accompanied by a computer listing as well as necessary flow charts.

LRAPP acquired an ICAPS computer on which to do the programming effort. This system was used as LRAPP owned a similar system which was on loan to CTF-69 in Naples, Italy. When this system arrived at A&T, hardware specialists refurbished the equipment. Also, the XDOS operating system was installed on the system.

A&T also developed a target data file for the TASSRAP system which contained the applicable target information within the spectrum of the towed array systems. Data used in the file was the latest available data as reported by NISC. In addition to frequency information, the data file contains operating depth and speed for various operating modes. Included among these modes are: transit, area search, barrier, surveillance, snorkel, and convoy penetration. Also, as part of the target file, reliability factors are stored for each parameter. Reliability factors represent the probability that this parameter will be available. for example, parameters which are aspect dependent receive low reliability factors.

Various documentation of the subroutines and data files was provided which facilitates interpretation of these subroutines and files. This documentation included flow charts, program listings, sample outputs, and other descriptive material. This information is sufficient so that field changes could be accomplished with a minimal effort.

Also, contained in the documentation are applicable mathematics and analysis on which the subroutines were based. As a result, program analysts will be able to make major changes if required. In addition, all data files have been dated to allow the operator to discern if he has more current information and make any changes. Also, all references utilized in preparation of the program are listed.

An operator's manual was developed describing the employment of the TASSRAP system. This manual was written for the at-sea operator and contains step-by-step

procedures of not only how to use the basic system, but also a complete description of the various options and how these may be used to the operator's advantage. These descriptions are complemented by samples of the available outputs and questions asked by the computer. In addition, error messages which may appear during the operation of the program are noted along with the necessary corrective actions. Also, general computer operations (e.g., instructions for turning the machine on/off, when to turn it off, and so forth) were included.

Review copies of this manual were provided to LRAPP for comments and recommendations to be included in the final version.

PURCHASE DUPLICATE TASSRAP EQUIPMENT

The TASSRAP system on which the preliminary software development took place was not suitable for at-sea deployment. It became apparent that an at-sea test would occur, and A&T was tasked to produce a duplicate hardware system.

Under this task, A&T purchased and integrated into a final system:

- Data General NOVA 820 CPU
- Tektronix 4610 Hardcopy Unit
- Tektronix 4012 Display Terminal
- XEBEC XDF-50 Disk Controller
- Caelus 303/2 Disk Drive
- XEBEC XFD-100 Floppy Disk Drive

TASSRAP II OB AT-SEA TEST

In the fall of 1977, LRAPP sponsored an extensive at-sea exercise. It was decided to couple a preliminary evaluation of the TASSRAP OB system with this exercise. One task undertaken by A&T in preparation for this exercise was converting the software to

execute as a stand-alone system from a floppy disk drive. This was a major undertaking as the entire system had been designed to execute from a 2.5 megabyte disk drive, and the floppy disk drive held two disks with a maximum storage of 250 kilobytes each. Also, the software constantly read from the disk and used overlay techniques which require a disk. It was necessary to split the program into discrete components and provide messages to the operator as to the proper floppy to load. (It was this effort that saved the sea test as the hard disk malfunctioned, and all the TASSRAP runs were made using the floppy disk drive.)

A&T packaged the newly-purchased at-sea system and shipped it to the deployment site.

An analyst from A&T flew to the deployment site and installed the system aboard the test vessel. This analyst also deployed with the vessel during CHURCH STROKE II, Cruise IV to serve as the TASSRAP evaluation test director. During the test, numerous people operated the system in order to gather as much data as possible in its usability.

Following Cruise IV, the analyst removed the system and shipped it back to A&T in North Stonington.

IMPROVE TASSRAP SOFTWARE AND EVALUATE TASSRAP II OB SYSTEM CAPABILITIES

A&T undertook the task of modifying portions of the TASSRAP OB software following the recommendations arising from the evaluation during CHURCH STROKE II. During this test, it was apparent that information could be presented to the operator in a more suitable fashion. Overall, these changes were designed to make the system usable by fleet personnel.

Also, the hardware was groomed following its return to A&T. This was done to insure the system had not been damaged in shipping.

Concurrently with the work at A&T, other modifications were being made to the TASSRAP software. As a result of these modifications, A&T undertook the task to design model validation tests. These tests were designed to show consistency within the software. During this testing period, A&T transported the system to TRACOR in Rockville, Maryland, for a demonstration at an LRAPP meeting.

A&T also modified the TASSRAP II OB User's Guide to reflect the differences between the at-sea hardware and original hardware configuration.

TAPPS SOFTWARE AND DATA FILE MODIFICATION

During the software modification effort following CHURCH STROKE II, the theory on bottom loss changed.

A&T was given a separate task to incorporate these new theoretical developments into the TAPPS software. This task included modifying the bottom loss data base and modifying the bottom loss algorithms. Following these modifications, extensive testing was performed to determine that the proper effect had been achieved.

A&T surveyed data from at-sea towed array exercises to determine the applicability of the data for TAPPS evaluation. The purpose was to do an ashore evaluation as a prelude to at-sea evaluation.

TAPPS AT-SEA EVALUATION

In anticipation of further at-sea TAPPS evaluations, A&T purchased spare components for the TAPPS CPU. These spare components included a CPU-1, CPU-2, Basic I/O, and 16 kilobyte memory boards. Also, A&T purchased a power supply unit to maintain a constant electrical voltage and frequency for the disk drive.

NORDA owns two TAPPS computers. One of these computers was not suitable for the rigors of an at-sea deployment and relegated to the ashore software development and support role. This system was not compatible with the at-sea unit due to the fact that each system had different disk controllers. A&T purchased a XEBEC XDF-50 disk controller for the ashore unit to provide compatibility between the two units.

Before shipping the hardware to the test vessel, A&T groomed the entire system. The hardware engineers performed a rigorous checkout, inspection, and cleaning of the hardware. Marginal components were replaced.

A&T also converted the modified TAPPS software to operate as a stand-alone system from floppy disks. This conversion provided a backup system as insurance against hard disk failure.

In addition to the hardware and software preparations, A&T developed the test plan. This plan detailed the tests to be performed and the data to be collected.

Immediately prior to CHURCH STROKE III, A&T transported the TAPPS from North Stonington, Connecticut, to Norfolk, Virginia, and installed the system aboard the USS MOINESTER.

During the CHURCH STROKE III Exercise, A&T provided an analyst onboard the MOINESTER to act as the TAPPS test director.

Following the exercise, A&T personnel removed the TAPPS from the MOINESTER and shipped the unit to San Diego. A&T personnel flew to San Diego and installed the system aboard the USS ALBERT DAVID for testing during SHAREM 32. A&T also provided an analyst to act as the TAPPS test director during the exercise. This person also instructed the crew of the USS ALBERT DAVID on operating the TAPPS.

During SHAREM, the commanding officer of the ALBERT DAVID was so impressed by TAPPS that he requested NORDA to leave the system aboard his ship.

Following SHAREM 32, A&T analyzed the data generated from several TAPPS sea tests including CHURCH STROKE III and SHAREM 32. The purpose of the analysis was to determine what actually occurred during the exercise and compare the performance of the TAPPS with the at-sea results. This analysis produced the TAPPS EVALUATION report issued by Analysis & Technology.

CHURCH STROKE III EXERCISE SUPPORT

In preparation for CHURCH STROKE III, A&T assisted LRAPP in preparation of a data collection plan. This plan was designed to facilitate the post-exercise data analysis.

During the CHURCH STROKE III exercise, A&T provided a principal analyst to ride aboard the USS MOINESTER to monitor the exercise and ensure the proper data was collected.

After the exercise was completed, A&T reconstructed several events. The results of the reconstruction were used in A&T Report No. P-776-001-80, TAPPS Evaluation.

TOWED ARRAY PERFORMANCE PREDICTION SYSTEM UPGRADE

The Towed Array Surveillance System Range Prediction (TASSRAP) model was installed in 1973. In early 1980, A&T surveyed present and potential users to ascertain the utility of system and determine enhancements for the system. Assistance was provided in updating the various computer files used by the model. Also, A&T provided numerous subroutines used by TAPPS for installation in the FNWC TASSRAP model.

A&T also participated in the development of a new message format for the TASSRAP messages.

TOWED ARRAY PERFORMANCE PREDICTION SYSTEM SUPPORT

In June 1980, A&T representatives flew to San Diego, California, and removed the TAPPS from the USS ALBERT DAVID. The system was then shipped from San Diego to Analysis & Technology in North Stonington, Connecticut. A&T engineers extensively examined the system and replaced numerous marginal components.

Software modifications were made to the system based upon comments made by the crew of the ALBERT DAVID.

TAPPS SUPPORT

In December of 1980, Analysis & Technology shipped the TAPPS computer to San Diego for installation aboard the USS DAVID R. RAY. Early in January 1981, the A&T installation team flew to San Diego and installed the TAPPS aboard the DAVID R. RAY in Sonar Control. Following installation of the computer, the senior member of the team deployed with the DAVID R. RAY during a ten-day READIEX. The A&T representative provided detailed instruction on TAPPS operation.

Prior to the DAVID R. RAY deployment, problems arose with the TAPPS hardware. A&T resolved this problem by hiring Data General as a subcontractor to replace a power supply in the central processing unit.

TASS SUPPORT FOR THE MEDITERRANEAN SEA

A&T was tasked by NORDA to provide two acoustic analysts to brief personnel aboard a TASS ship and demonstrate the required tactics necessary for successful submarine surveillance in the Mediterranean Sea. The A&T personnel had a complete understanding of environmental acoustics in the Mediterranean and briefed the crew on the high noise field, modes of acoustics transmission, and towed array tactics.

A&T also provided at-sea support during deployment of the TASS ship. This support was to provide technical assistance in noise field data collection and data analysis. While at sea, each component of the TASS system, from each array hydrophone through the WAP-II, were checked out and evaluated against previous TASS measurements. Resulting degradations were noted.

APPENDIX A

This appendix lists the documents written by Analysis & Technology, Inc., under Contract N00014-C-76-0043.

- KENT BEACON Summary Report, SECRET, NO FOREIGN DISSEM, issued by COMMANDER, THIRD FLEET
- TASSRAP Input Module, UNCLASSIFIED
- TASSRAP II Target File, SECRET, NO FOREIGN DISSEM
- Quick Look at Predicted Detection Ranges Utilizing the LAMBDA-II Array, SECRET, NO FOREIGN DISSEM
- TASSRAP II OB User's Guide, UNCLASSIFIED
- TASSRAP II OB System Test, UNCLASSIFIED
- TAPPS OB User's Manual, UNCLASSIFIED
- TAPPS Evaluation, SECRET
- The TASSRAP Standard Message, CONFIDENTIAL
- AN/SQR-18A System Overview, CONFIDENTIAL
- Trip Aboard USS DAVID R. RAY, UNCLASSIFIED
- 1975-1982 Summary Report, UNCLASSIFIED

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Encl: (1) List of DECLASSIFIED LRAPP Documents

1. In accordance with reference (a), a declassification review has been conducted on a number of classified LRAPP documents.

2. The LRAPP documents listed in enclosure (1) have been downgraded to UNCLASSIFIED and have been approved for public release. These documents should be remarked as follows:

   Classification changed to UNCLASSIFIED by authority of the Chief of Naval Operations (N772) letter N772A/6U875630, 20 January 2006.

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Declassified LRAPP Documents

Report Number	Personal Author	Title	Publication Source (Originator)	Pub. Date	Current Availability	Class.
NORDA35VOL.1BK 2OF3	Lauer, R.B.	THE ACOUSTIC MODEL EVALUATION COMMITTEE (AMEC) REPORTS, VOL. 2- APPENDICES A-D- EVALUATION OF THE FACT PL9D TRANSMISSION LOSS MODEL	Naval Ocean R&D Activity	810901	ND ADC034019	U
NORDA36VOL.3BK 2OF3	Lauer, R.B., et al.	THE ACOUSTIC MODEL EVALUATION COMMITTEE (AMEC) REPORTS, VOL. 3- APPENDICES A-D- EVALUATION OF THE RAYMODE X PROPAGATION LOSS MODEL (U)	Naval Ocean R&D Activity	810901	ND ADC034022	U
Unavailable	Hooper, M. W., et al.	MEASUREMENTS AND ANALYSIS OF ACOUSTIC BOTTOM INTERACTION IN THE NORTHWESTERN MEXICAN BASIN	University of Texas, Applied Research Laboratories	811005	ADA107551	U
Unavailable	Kirby, W. D.	FINAL REPORT FOR CONTRACT NUMBER N00014-78-C-0862	Science Applications Inc.	820201	ADA111000	U
Unavailable	Brunson, B. A., et al.	PHYSICAL SEDIMENT MODEL FOR THE PREDICTION OF SEAFLOOR GEOACOUSTIC PROPERTIES	Planning Systems Inc.	820701	ADA119445	U
Unavailable	Cavanagh, R. C., et al.	NORDA PARABOLIC EQUATION WORKSHOP, 31 MARCH - 3 APRIL 1981	Naval Ocean R&D Activity	820901	ADA121932	U
NORDA34VOL.1A	Martin, R. L., et al.	THE ACOUSTIC MODEL EVALUATION COMMITTEE (AMEC) REPORTS, VOL. 1A- SUMMARY OF RANGE INDEPENDENT ENVIRONMENT ACOUSTIC PROPAGATION DATA SETS	Naval Ocean R&D Activity	820901	ADC034017; ND	U
Unavailable	Bartberger, C. L., et al.	THE ACOUSTIC MODEL EVALUATION COMMITTEE (AMEC) REPORTS, VOLUME 2. THE EVALUATION OF	Naval Ocean R&D Activity	820901	ADC034019	U
Unavailable	Deavenport, R., et al.	THE ACOUSTIC MODEL EVALUATION COMMITTEE (AMEC) REPORTS, VOLUME 3. EVALUATION OF THE RAYMODE X PROPAGATION LOSS MODEL. BOOK 2. APPENDICES A-D	Naval Ocean R&D Activity	820901	ADC034022	U
Unavailable	Unavailable	1975-1982 SUMMARY REPORT	Analysis and Technology, Inc.	821217	ADA192591	U
Unavailable	DeChico, D.	ACOUSTIC EVALUATION OF SANDERS ASSOCIATES ACODAC SENSORS	Naval Air Development Center	830301	ADB073873	U
NRL-FR-8695; NRL-8695	Palmer, L. B., et al.	TRANSVERSE HORIZONTAL COHERENCE AND LOW-FREQUENCY ARRAY GAIN LIMITS IN THE DEEP OCEAN	Naval Research Laboratory	830809	ND	U
Unavailable	Unavailable	ENGINEERING SUPPORT FOR ACOUSTIC AND ANALYSIS SYSTEM	Systems Integrated	840101	ADB091112	U
Unavailable	Unavailable	SEAS (SURVEILLANCE ENVIRONMENTAL ACOUSTIC SUPPORT PROGRAM) SUPPORT	Systems Integrated	840229	ADB091119	U