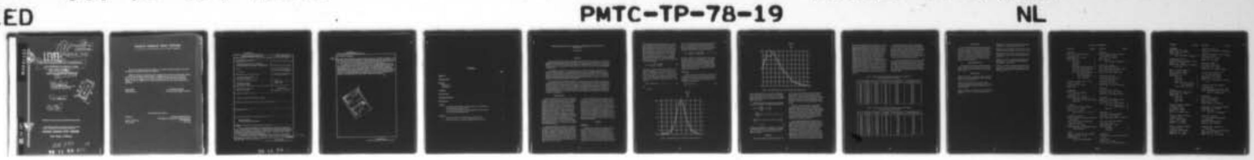
AD-A061 151 LOS ALAMOS SCIENTIFIC LAB N MEX F/G 12/1
ESTIMATING PERCENTILES OF NONNORMAL ANTHROPOMETRIC POPULATIONS. (U)
OCT 78 H F MARTZ N63126-77-M-0154

UNCLASSIFIED PMTC-TP-78-19 NL

1 OF 1
AD
A061151



END
DATE
FILMED
1-79
DDC

AD A061151

Technical Publication TP-78-19

TTU-BIOTECH-78-02M

LEVEL

ESTIMATING PERCENTILES OF NONNORMAL

ANTHROPOMETRIC POPULATIONS,

FINAL REPORT,

(NAS Contract N63126-77-M-0154)

By

H. F. MARTZ, JR
Los Alamos Scientific Laboratory
Los Alamos, New Mexico 87544

October 1978

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

(This article was published in *Human Factors Society Proceedings*, University of Michigan, Ann Arbor, Michigan, October 1978)

PACIFIC MISSILE TEST CENTER

Point Mugu, California

PACIFIC MISSILE TEST CENTER

AN ACTIVITY OF THE NAVAL AIR SYSTEMS COMMAND

This report was prepared by Mr. H. F. Martz, Jr., Los Alamos Scientific Laboratory, Los Alamos, New Mexico, under NAS Contract N63126-77-M-0154.

LCDR W. F. Moroney, Head, Human Factors Engineering Branch; Mr. G. M. Wrout, Head, Weapons Control and Software Systems Division; CDR G. L. Starbird, Associate Head, Systems Technology Department; Mr. A. C. Bittner, Jr., Task Engineering Manager; Mr. M. H. Cain, Project Engineering Manager; and Mr. N. H. Rohn, Director, Systems Evaluation Directorate, have reviewed this report for publication.

THAD PERRY
Technical Director

J. C. WEAVER, CAPT USN
Commander, Pacific Missile Test Center

Technical Publication TP-78-19

Published by . . . . Technical Information Division
Photography and Technical Information Department
Security classification . . . . UNCLASSIFIED
First printing . . . . 175 copies

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER TP-78-19; TTU-BIOTECH-78-02M	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) ESTIMATING PERCENTILES OF NONNORMAL ANTHROPOMETRIC POPULATIONS: FINAL REPORT		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) H. F. Martz, Jr.		8. CONTRACT OR GRANT NUMBER(s) NAS Contract N63126-77-M-0154 new
9. PERFORMING ORGANIZATION NAME AND ADDRESS Los Alamos Scientific Laboratory Los Alamos, NM 87544		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Pacific Missile Test Center Point Mugu, CA 93042		12. REPORT DATE October 1978
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) Naval Air Systems Command Washington, DC 20361		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Estimating percentiles
Nonnormal anthropometric populations

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The most commonly used method for estimating percentiles of anthropometric populations is based on the assumption that the population is normally distributed. This assumption is approximately true for many such variables, e.g., hip breadth. On the other hand, numerous nonnormally distributed anthropometric populations are known to exist, e.g., grip strength. The question of how to estimate percentiles of nonnormal populations is addressed here.

A nonparametric percentile estimation method, based on the use of a kernel-type probability density function estimator, is presented. A "nonparametric" method is defined as a method that does → next page

(Continued)

78 11 08 001

20. ABSTRACT *(Concluded)*

cont. not make or require any assumption about the statistical distribution of the underlying population. Thus, the method can be applied to any population of anthropometric data, regardless of the normality of the data. The method is simple to use; however, a single nonlinear equation must be numerically solved on a computer by any one of numerous well-documented nonlinear root finding methods.

Two examples are used to illustrate the method. In the first example, selected samples of size 50 of hip breadth data are randomly drawn from a population of size 2420 observations from the 1967 anthropometric survey of U.S. Air Force flying personnel. The proposed method is compared to the standard gaussian method. Since this population was selected as normally distributed, the standard method outperforms the proposed nonparametric method. In the case of grip-strength data, the proposed method yields more accurate estimates, in a mean squared error sense, of the upper percentiles of this population. For anthropometric distributions known to be nonnormal or where normality cannot be assumed, the proposed nonparametric method appears a method for consideration.

CONTENTS

ESTIMATING PERCENTILES OF NONNORMAL ANTHROPOMETRIC POPULATIONS: FINAL REPORT

H. F. Martz, Jr.

ABSTRACT

The most commonly used method for estimating percentiles of anthropometric populations is based on the assumption that the population is normally distributed. This assumption is approximately true for many such variables, e.g., hip breadth. On the other hand, numerous nonnormally distributed anthropometric populations are known to exist, e.g., grip strength. The question of how to estimate percentiles of nonnormal populations is addressed here.

A nonparametric percentile estimation method, based on the use of a kernel-type probability density function estimator, is presented. A "nonparametric" method is defined as a method that does not make or require any assumption about the statistical distribution of the underlying population. Thus, the method can be applied to any population of anthropometric data, regardless of the normality of the data. The method is simple to use; however, a single nonlinear equation must be numerically solved on a computer by any one of numerous well-documented nonlinear root finding methods.

Two examples are used to illustrate the method. In the first example, selected samples of size 50 of hip breadth data are randomly drawn from a population of size 2420 observations from the 1967 anthropometric survey of U.S. Air Force flying personnel. The proposed method is compared to the standard gaussian method. Since this population was selected as normally distributed, the standard method outperforms the proposed nonparametric method. In the case of grip-strength data, the proposed method yields more accurate estimates, in a mean squared error sense, of the upper percentiles of this population. For anthropometric distributions known to be nonnormal or where normality cannot be assumed, the proposed nonparametric method appears a method for consideration.

INTRODUCTION

It is common practice to characterize anthropometric design limits in terms of suitable percentiles of a population of interest. A percentile gives the percentage of persons within the population who have a body dimension of a certain size or smaller. There are two commonly used methods for estimating percentiles. The first method is a simple well-known counting procedure. The data are arranged in ascending order of size, and then are grouped into convenient class intervals. Finally, the number of measurements below each upper class limit are counted, divided by the total number of measurements, and multiplied by 100 to determine the percentile rank. This method may be used either for the entire population or for a sample from the population. In the case of sample data, the computed percentile is an estimate of the (true) underlying population percentile. As a consequence, it is subject to certain statistical errors.

The second commonly used method is to assume that the anthropometric measurement of interest is normally distributed. The mean and variance of this distribution are then used in conjunction with stated "factors" to estimate the desired percentiles. The method requires that either the entire population of measurements is available or that the sample size is sufficiently large. The required "factors" are provided by Roebuck (1957), and a complete description may be found in the book by Roebuck, Kroemer, and Thomson (1975, pp. 132-144).

Most human factors investigators are aware of the existence of certain anthropometric populations which are nonnormally distributed. An example of such a population will be presented later. The question of how to estimate percentiles of such populations is an important one. The purpose of this paper is to present a method which can be used to obtain either population percentiles or percentile estimates for <u>any</u> anthropometric population. The method is a nonparametric one, which means that it does not assume specific knowledge of the statistical distribution, e.g., the normal distribution, of the measurement of interest. Thus, the method is particularly appropriate for use in populations which are either not known to be normal or known to be nonnormal.

METHOD

Background

Over the past two decades there have been some important developments in the area of statistical theory known as "nonparametric probability density function estimation." Wegman (1972a) presents a thorough summary survey of the historical developments in this area. In short, the basic idea is to provide an estimator which can be used to estimate the complete underlying probability density function, based on a sample from the population, without the necessity to first estimate certain "parameters" of the population such as the mean, variance, etc. However, such characteristics may be estimated once the estimated probability density function has been obtained. Of particular interest here are the percentiles of such an estimated probability density function. The particular probability density function estimator considered here is attributed to Rosenblatt (1956) and Parzen (1962). Suppose that we have a random sample $x_1, x_2, \ldots x_n$ of size n from some population having unknown and unspecified probability density function f(x). Following Rosenblatt (1956) and Parzen (1962), the estimator of f(x), $f_n(x)$, may in general be represented

$$f_n(x) = \frac{1}{nh} \sum_{i=1}^{n} K\left(\frac{x-x_i}{h}\right) \quad (1)$$

where K(·) is a suitably chosen function, referred to as the "kernel," "smoothing," or "window" function, and h ≡ h(n) is a suitably chosen function of n in which it is required that $h \to 0$ and $nh \to \infty$ as $n \to \infty$. The kernel function K must also satisfy certain conditions which are given in Parzen (1962). Based on the work of Parzen (1962), Wegman (1972a, b), and Bennet (1970), the particular K and h given by

$$K(x) = 0.5 \exp(-|x|), \quad -\infty < x < \infty \quad (2)$$

and

$$h = sn^{-0.2}$$

where s is the sample standard deviation of the measurement $x_1, \ldots, x_n$, are selected for use here. Although other functions could be considered, this choice is known to produce good results [Bennett (1970)]. Thus, the probability density function estimator to be used here is given by

$$f_n(x) = \frac{0.5}{nh} \sum_{i=1}^{h} \exp\left(-\left|\frac{x-x_i}{h}\right|\right) \quad -\infty < x < \infty \quad (3)$$

To better understand this estimator, figures 1 and 2 give a plot of (3) based on a random sample of size 100 observations from a symmetric (approximately gaussian) distribution and an asymmetric right-skewed distribution, respectively. Both f(x) and $f_n(x)$ are shown for comparison, and arbitrary scales were chosen for x. It is observed in both cases that the estimates provide reasonably close approximations to the true densities.

Development

Of interest here are the percentiles of $f_n(x)$ given in (3), since these are the desired estimates of the population percentiles of f(x). Let x_a represent the 100 (a)th percentile of $f_n(x)$ given in (3). That is, for a specified value of a, x_a satisfies the equation given by

$$\int_{-\infty}^{x_a} f_n(x)\,dx = a. \quad (4)$$

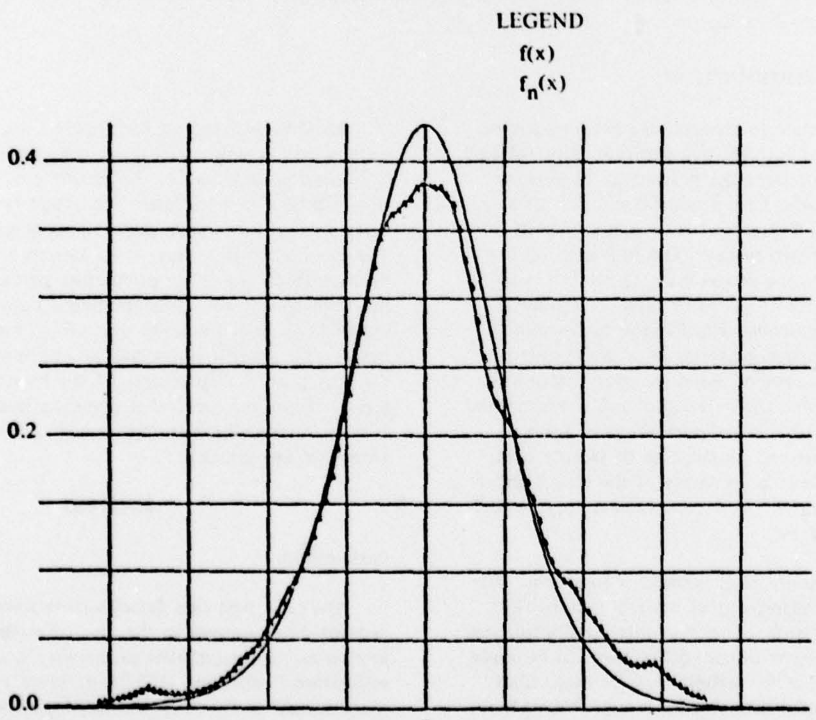


Figure 1. The Estimate $f_n(x)$ of an Underlying Gaussian Density f(x).

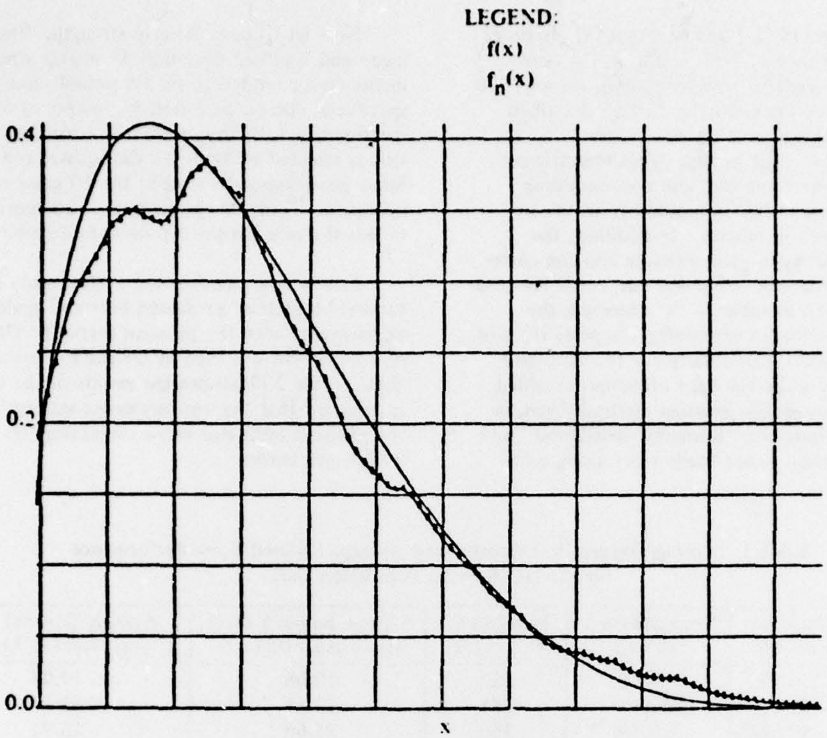


Figure 2. The Estimate $f_n(x)$ of an Underlying Right-Skewed Density f(x).

Thus, x_α is the required percentile estimate of the population percentile value for which 100 (α) % of the anthropometric measurements do not exceed this value. For example, if $\alpha = 0.95$, then $x_{0.95}$ is the required estimate of the 95th population percentile.

Substituting (3) into (4), integrating, and simplifying gives x_α as the solution to the nonlinear equation given by

$$G(x_\alpha) \equiv h \ln \left[\sum_{i=1}^{n} \exp(x_i/h) \right]$$

$$- h \ln \left\{ \sum_{i=1}^{n} \exp(|x_i + x_\alpha|/2h - |x_i - x_\alpha|/2h - x_i/h) \right.$$

$$\left. + \sum_{i=1}^{n} \exp(|x_i - x_\alpha|/2h - |x_i + x_\alpha|/2h + x_i/h - 2n_\alpha \right\}$$

$$- x_\alpha = 0. \quad (5)$$

Although this equation looks formidable, it may be easily and efficiently solved for x_α on a computer by means of any one of numerous well-documented nonlinear root finding subroutines.

EXAMPLES

The percentile estimation method presented here was used to estimate selected percentiles for certain anthropometric variables in the survey of USAF flying personnel conducted by Clauser, Alexander, and Kennedy (1967). In this survey, 185 variables were finally selected and recorded for 2420 male pilots. Two of these anthropometric variables will be considered here, namely, hip breadth and grip strength.

First, let us consider hip breadth. The population mean and standard deviation of all hip breadth measurements are respectively computed to be 352 millimeter (mm) and 19 mm. Based on a random sample of 500 hip breadth measurements, the hypothesis of normality of this population is accepted by the chi-square, Kolmogorov-Smirnov, and Cramer-Von Mises goodnes-of-fit tests at the 20 percent level of significance. Thus, this population will be considered to be "normally distributed."

Let us examine the performance of the percentile estimation method presented here and compare the performance with the gaussian percentile estimation method. Of course, the gaussian method is expected to yield superior results in this case which may be thought of as a worst case analysis for the alternative percentile estimation method presented here. The procedure was as follows: Ten successive random samples each of size 50 were drawn without replacement from the population of hip breadth measurements. The 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 97.5, 99, and 99.5th percentile estimates were computed for each sample by both the gaussian method [see Roebuck, Kroemer, and Thomason (1975)] and equation (5). In order to compare the performance of both methods, the corresponding population percentiles were computed for all 2420 observations by means of the counting method described earlier. These population percentiles were taken to be the standard reference values. The average nonparametric percentile estimates, gaussian estimates, and corresponding population percentiles were then computed from the ten samples and are presented in table 1. In addition, the average squared error between each estimate and the corresponding population percentile value was computed for both methods and is also given in table 1. As observed, the gaussian method is superior for estimating the percentiles of the hip breadth population, particularly for the 70th and larger percentiles. This is the result of utilizing the added information of normality in the gaussian method when, in fact, the population is indeed a "normally distributed" one. Recall that this assumption is not made when using equation (5).

Now let us consider grip strength. The population mean and standard deviation of all grip strength measurements are computed to be 5.6 pounds and 7.6 pounds, respectively. Based on a random sample of 500 grip strength measurements, the hypothesis of normality of this population is rejected by both the chi-square, and Cramer-Von Mises goodness-of-fit tests at the 10 percent level of significance. Thus, this population is not normally distributed as was the case for the hip breadth distribution.

Let us now examine the performance of the percentile estimation method presented here and again compare the performance with the gaussian method. The same manner of comparison was used as for the hip breadth population data. Table 2 illustrates the results of the comparison. It is observed that the nonparametric estimator outperforms the gaussian estimator when estimating the 97.5, 99, and 99.5th percentiles.

Table 1. Average Percentile Estimates and Average Squared Error Performance for the Hip Breadth Population Data

Percentile	Gaussian Estimate	Nonparametric Estimate	Population Percentile	Average Squared Error (Gaussian Estimate)	Average Squared Error (Nonparametric Estimate)
50.0	354.79	354.78	352	19.08	19.03
55.0	357.15	357.17	354	22.11	22.17
60.0	359.54	359.59	356	25.66	25.94
65.0	362.01	362.19	359	23.38	24.32
70.0	364.62	364.94	362	22.53	24.70
75.0	367.43	368.01	365	23.22	26.37
80.0	370.58	371.72	367	32.17	42.77
85.0	374.22	376.19	371	32.31	51.90
90.0	378.84	381.94	376	33.66	67.13
95.0	385.65	390.15	385	32.31	66.63
97.5	391.55	397.36	392	38.33	75.86
99.0	398.42	406.15	402	59.12	79.65
99.5	403.11	412.09	408	76.38	88.61

Table 2. Average Percentile Estimates and Average Squared Error Performance for the Grip Strength Population Data

Percentile	Gaussian Estimate	Nonparametric Estimate	Population Percentile	Average Squared Error (Gaussian Estimate)	Average Squared Error (Nonparametric Estimate)
50.0	56.35	56.35	56	0.82	0.82
55.0	57.28	57.28	57	0.90	0.90
60.0	58.22	58.22	58	1.02	1.02
65.0	59.19	59.19	59	1.19	1.19
70.0	60.22	60.22	60	1.42	1.42
75.0	61.32	61.42	61	1.76	1.90
80.0	62.56	62.93	63	2.20	2.14
85.0	63.99	64.70	64	2.47	3.23
90.0	65.80	66.99	66	3.19	4.99
95.0	68.48	70.60	70	6.64	7.69
97.5	70.80	73.61	73	10.35	9.21
99.0	73.50	76.90	76	13.36	10.90
99.5	75.34	79.22	78	15.38	13.31

CONCLUSIONS

In conclusion, based on the limited comparison just described, it is conjectured that the nonparametric percentile estimator will outperform the gaussian estimator for nonnormal populations. Although extensively investigated, the degree of performance improvement appears to be proportional to the degree of nonnormality. Future effort needs to be directed toward an extensive Monte Carlo simulation for further examination of the proposed nonparametric percentile estimator.

ACKNOWLEDGMENTS

The author wishes to thank Mr. Alvah Bittner of the Pacific Missile Test Center, Point Mugu, California for his support of the research and for his assistance in preparing this manuscript.

REFERENCES

Bennett, G. K. (1970). "A Computer Analysis of Parzen's Density Estimator," unpublished report prepared at Texas Tech University, Lubbock, Texas.

Clauser, C. E., M. Alexander, K. W. Kennedy (1967). "USAF Anthropometry of Flying Personnel - 1967," Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.

Parzen, E. (1962). "On Estimation of a Probability Density Function and its Mode," Annals of Math. Stat., 33, pp. 1065-76.

Roebuck, J. A. (1957). "Anthropometry in Aircraft Engineering Design," J. Aviation Med., 28, pp. 41-56.

Roebuck, J. A., K. H. E. Kroemer, W. G. Thomson. Engineering Anthropometry Methods. New York: Wiley, 1975.

Rosenblatt, M. (1956). "Remarks on Some Nonparametric Estimates of a Density Function," Annals of Math. Stat., 26, pp. 832-7.

Wegman, E. J. (1972a). "Nonparametric Probability Density Estimation: I. A Summary of Available Methods," Technometrics, 14, pp. 533-46.

Wegman, E. J. (1972b). "Nonparametric Probability Density Estimation: II. A Comparison of Density Estimation Methods," Journal of Statistical Computation and Simulation, 1, pp. 225-45.

INITIAL DISTRIBUTION

EXTERNAL	Copies
Commander Naval Air Systems Command Headquarters Washington, DC 20361	
ATTN: AIR-954	2
AIR-50174	2
AIR-03P1	1
AIR-03P3	1
AIR-03PA4 (Mr.Momiyama)	1
AIR-340F (CDR Chatelier)	5
AIR-415C (Mr.Booher)	1
AIR-5313 (LCDR Johnson)	1
(Mr. Merriman)	1
(Mr. Hemingway)	1
(Mr. Arnoff)	1
Defense Documentation Center Cameron Station Alexandria, VA 22314	
ATTN: TIOG	12
Commander Naval Material Command Headquarters Washington, DC 20360	
ATTN: MAT-03R4 (Dr.Moore)	1
MAT-03424 (Dr.Rubenstein)	2
MAT-0344	1
Commander Naval Ocean Systems Command San Diego, CA 92152	
ATTN: Mr. W. Lewis	1
Code 823 (Dr. J. Silva)	1
Commanding Officer Naval Aerospace Medical Research Laboratory Naval Aerospace and Regional Medical Center Pensacola, FL 32512	
ATTN: Aerospace Psychology Dept. (CDR Goodson)	1
Chief Bureau of Medicine and Surgery Washington, DC 20372	
ATTN: Code 51	1
Code 513 (CDR Gibson)	1

EXTERNAL	Copies
Commander Naval Personnel Research and Development Center San Diego, CA 92152	
ATTN: Code 10	5
Code 311(Dr.F.Muckler)	2
Officer in Charge New London Laboratory Naval Underwater Systems Center New London, CT 06320	
ATTN: Code TD 112(Mr.Lamb)	1
Commanding Officer Naval Ship Research and Development Center Annapolis Division Annapolis, MD 21402	
ATTN: Code 2733 (Mr. McLane)	1
Commander Naval Air Test Center Patuxent River, MD 20670	
ATTN: Code 3T353(Mr.Walchli)	1
Commander Naval Air Development Center Warminster, PA 18974	
ATTN: Code 604 (CDR Theisen)	1
Code 6041 (CDR Lane)	5
(CDR Curren)	10
Code 813	1
Commander Naval Sea Systems Command Washington, DC 20360	
ATTN: Code 06H1-3(Mr. Jenkins)	1
Chief of Naval Operations Navy Department Washington, DC 20360	
ATTN: OP-987F	1
OP-987M4	1
OP-987H	1
Commander Operational Test and Evaluation Force Naval Base Norfolk, VA 23511	
ATTN: Code 22 (Mr.Enderwick)	1

EXTERNAL	Copies
Commander Naval Weapons Center China Lake, CA 93555 ATTN: Code 533	1
Code 3175(Mr.R.Erickson)	1
Commanding Officer Naval Training Equipment Center Orlando, FL 32813 ATTN: Code N-00T(Dr.A.F.Smode)	1
Code N215	1
Chief of Naval Research 800 N. Quincy Street Arlington, VA 22217 ATTN: Code 212	1
Code 221	1
Code 434	1
Code 437	1
Code 455(Dr.M.Tolcott)	2
(G.S.Malecki)	5
Code 458(Dr.E.M.Farr)	2
Director Naval Research Laboratory Washington, DC 20375 ATTN: Code 20	1
Code 2029	1
Code 2627	1
Code 5707	1
Office of Naval Research Branch Office 495 Summer Street Boston, MA 02100 ATTN: Dr. James Lester	1
Office of Naval Research Branch Office 536 S. Clark Street Chicago, IL 60605 ATTN: Dr. M. Bertin	1
Office of Naval Research Branch Office 1030 East Green Street Pasadena, CA 91106 ATTN: Mr. R. Lawson	1

EXTERNAL	Copies
Commanding Officer Director, Cybernetics Technology Office Advanced Research Projects Agency 1400 Wilson Blvd. Arlington, VA 22209 ATTN: Dr. R. Young	1
OAD(E&LS) ODDR&E Pentagon, Room 3D129 Washington, DC 20301 ATTN: COL H.L. Taylor, USAF	1
U.S. Air Force Office of Scientific Research Bolling Air Force Base Washington, DC 20332 ATTN: Life Sciences Directorate, NL	1
Aerospace Medical Research Laboratory Wright-Patterson AFB, OH 45433 ATTN: AMRL/HES(LCOL J.A.Birt)	1
(Dr.D.A. Topmiller)	1
Commander Naval Safety Center Naval Air Station Norfolk, VA 23511 ATTN: LCDR R. H. Shannon	1
Commandant of the Marine Corps Washington, DC 20380 ATTN: Code RD-1 (Dr. A. L. Slafkosky)	1
Technical Director U.S. Army Human Engineering Laboratory Aberdeen Proving Ground Aberdeen, MD 21005	1
Massachusetts Institute of Technology Dept. of Mechanical Engineering Cambridge, MA 02139 ATTN: Dr. T. B. Sheridan	1

EXTERNAL	Copies
Texas Tech University	
Lubbock, TX 79409	
ATTN: Center of Biotechnology and Human Performance	
Dr. M. Ayoub	1
Dr. D. Chatfield	1
Dr. C. Halcomb	1
Dr. J. D. Ramsey	10
Decision Science, Inc.	
4901 Morena Boulevard	
San Diego, CA 92117	
ATTN: Dr. L. J. Fogel	1

INTERNAL	Copies
Commander PACMISTESTCEN	
Code 0000	
CAPT J.C. Weaver	1
Technical Director	
Code 0002	
Thad Perry	1
Project Management Group	
Code 0100	
CAPT N.A. Deam	1
Systems Evaluation Directorate	
Code 1001	
CAPT D.D. DeWitt	1
Weapons Control and Software Div.	
Code 1226	
LCDR W.F. Moroney	25
A. C. Bittner, Jr.	10
Fleet Weapons Engineering Directorate	
Code 2001	
CAPT C.L. Axel	1
G.R. Wachold	1
Range Directorate	
Code 3001	
CAPT H.M.J. Lewis, Jr.	1
Engineering Applications Directorate	
Code 4001	
R. S. Walker	1
Technical Information Division	
Code 4230-1	
M.F. Hayes	10
Code 4231	1
Library Systems Office	
Code 6814-2	
Reports Section	2
Patent Counsel	
Code PC	
Dr. J.M. St. Amand	1