BIBLIOGRAPHY

ON NUMERICAL SOFTWARE

by

Bo Einarsson

Permanent affilation: FÖRSVARETS FORSKNINGSANSTALT (FOA)
National Defence Research Institute
Department 2/Proving Grounds
Box 98, S-147 00 Tumba, Sweden

Memorandum No. UCB/ERL M77/19

25 March 1977

ELECTRONICS RESEARCH LABORATORY

College of Engineering
University of California, Berkeley
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Abstract:

This bibliography has been written at the request of the IFIP Working Group on Numerical Software (IFIP WG 2.5), and is intended to serve both members of the working group and others intent on improving numerical software.

It has been divided into twenty-one different areas. Within each area the references are given in alphabetical order by the first author. Some references occur in two or at most three areas. This is especially true for the individual articles in the books of Section 2. For some entries a summary is included; either the original abstract, or a shortened form of the original, or a summary written by the present author.

The aim of the bibliography is to be useful in the production and evaluation of good software for numerical mathematics. However, it does not include references to algorithms in the numerical analysis literature, nor does it include references to individual software products (routines). Section 7 on bibliographies includes many entries not strictly within the scope of the present work. I have tried to get Sections 4 (Numerical Program Libraries), 11 (Transportability), and 16 (Evaluations) as complete as possible, but the other sections are not so well covered, especially as regards matters outside of numerical software.

CONTENTS

History of this Bibliography

A first version of this bibliography, with the title "An Annotated Bibliography on Mathematical Software and Related Topics," was written in 1974 by Eva Edberg and Jan Johansson and was later published in the SIGNUM Newsletter, Vol. 11, No. 2 (August 1976), pp. 9-16, and No. 3 (October 1976), p. 6. That version was produced at Uppsala University, with financial support form the Swedish Institute of Applied Mathematics and the Stockholm Data Center.

At the request of the IFIP Working Group on Numerical Software (IFIP WG 2.5) I started early in 1975 to collect additional material, and with the support of the Swedish National Defense Research Institute, a preliminary version was distributed in May 1976 and a slightly revised version in October 1976.

This version, which is the first version in the form of a formal report, was produced at the Computer Science Division and Electronics Research Laboratory, University of California, Berkeley, California.

It has been discussed by IFIP WG 2.5 to put the bibliography in machine readable form at a later time. Consequently I have chosen not to have the material retyped in a uniform manner and apologize to the reader for any resulting inconvenience.

Acknowledgements

I would like to thank Eva Edberg and Jan Johansson for their excellent original work. I also thank Ed L. Battiste, Fred N. Fritsch, Thos E. Hull, Tapio Niemelä, John R. Rice, and Larry F. Shampine for significant contributions.

My work on the present version has been supported by grants from the Sweden-America Foundation and the National Science Foundation, while the production of the present report has been financed by the Office of Naval Research Contract N00014-76-C-0013. I wish to express my sincere thanks to these three organizations for their support.

I am also very grateful to Professors Elwyn R. Berlekamp, William Kahan, and Beresford N. Parlett for their kind hospitality during my stay at the Computer Science Division of the University of California at Berkeley during the winter quarter of 1977.

Finally, I would like to thank Maj-Britt Kåhre, Agneta Österlund, and Suzanne Briggs for excellent typing of the many entries.

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4. NUMERICAL PROGRAM LIBRARIES

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1119 Keystone Way, Carmel, Indiana 46032.
More than 3,000 proprietary software products produced by more than 800 vendors are described in the latest semiannual, two-volume ICP Software Directory. The first volume (338 pp.) is on systems software, and the second (614 pp.) covers applications software. There are over 2,000 product updates in this version, plus 600 new product listings. Price: $100/yr. by subscription, or $60 for two volumes on a one-time basis.

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4. NUMERICAL PROGRAM LIBRARIES

b) SOME COMMERCIAL NUMERICAL LIBRARIES (available at cost)

1. IMSL is a mathematical and statistical subroutine library in Fortran, available for IBM 360/370, Xerox, UNIVAC 1100, Honeywell-Bull 600/6000, DEC System-10, CDC 6600/7600/ CYBER 70/170, Burroughs 6700/7700

It is used at five hundred computer centers. New release each year as announced.Further information from International Mathematical & Statistical Libraries, Inc., 7500 Bellaire Boulevard, Sixth Floor, GNB Building, Houston, Texas 77036. Tel. (713) 772-1927.

2. NAG is a British subroutine library, available in both Fortran and Algol 60. An Algol 68 version is being developed. Versionsexist for IBM 360/370, CDC 6600/7600, CYBER 70/170, Burroughs 5700/6700/7700, UNIVAC 1100, PRIME, DEC System 10 and various ICL computers. It is used extensively in British Universities and is now being made available internationally. Further information from the NAG Central Office, 7 Banbury Road, Oxford OX2 6NN, England.Tel (0865) 511245.
New release each year as announced. Work is in progress on a version for GEC computers.

Ref. Bulletin of the Institute of Mathematics and its Applications, Nov 1972, SIGNUM Newsletter, Vol. 8, No. 2 (April 1973), pp. 16-21, and in "Software for Numerical Mathematics", Ed. by D.J. Evans, Academic Press, London 1974.

3. The PORT Mathematical Subroutine Library is a rather recent software product from Bell Laboratories, Murray Hill, New Jersey 07974. It has been written with particular emphasis on portability, which is achieved by careful language specification and specifying computer classes by means of predefined machine constants. The library has been described by Phyllis Fox, see references in section 2, COWELL, Wayne R (Editor) with entry FOX and section 4a. The library has been tested extensively on IBM and Honeywell.

Information on availability is given in the SIGNUM Newsletter, Vol. 11, No. 2 (August 1976), p. 8.

P. A. Fox, A. D. Hall and N. L. Schryer, "The PORT Mathematical Subroutine Library", Computing Science Technical Report No. 47, Bell Laboratories, Murray Hill, New Jersey, September 1976.

4. SL-Math is a numerical program library available as a Program Product from IBM. The source code, written in Fortran, contains routines for sparse matrices. Ref. IBM System/360 and System/370, IBM 1130 and IBM 1800, Subroutine Library-Mathematics, User's Guide SH 12-5300-0, and Subroutine Library Mathematics, General Information GH 12-5103-0, (1971).

A version in PL/1 is called PL-Math, but does not contain the sparse routines.

5. BOEING has developed a large numerical program library for use on CDC computers. A description is in A.C.R. Newbery, "The Boeing Library and Handbook of Mathematical Routines", in "Mathematical Software", Ed. by John R. Rice, Academic Press, New York 1971, pp. 153-169.

Further information from Control Data. This library is now considered almost obsolete.

4. NUMERICAL PROGRAM LIBRARIES

c) SOME NON-COMMERCIAL NUMERICAL LIBRARIES

1. SSP. This old and well-known Fortran library from IBM is available on most computers. It is considered to be out-of-date but still used. There also exists a PL/1 version (The only known non-commercial PL/1 library?) Ref. System/360 Scientific Subroutine Package, Version III, Programmer's Manual GH 20-0205-3 with Technical Newsletter N 20-1944.

2. MATH-PACK. Univac has a Fortran library similar to SSP. Most other computer manufacturers also have similar libraries.

3. CNRS. A collection "Procedures Algol en Analyse Numérique" has been issued by Centre National de la Recherche Scientifique, Service des Publications, Ventes 15, Quai Anatole-France, Paris 7.

4. HARWELL. The United Kingdom Atomic Energy Authority Research Group at Harwell has a large Fortran library, that is being used also at many other centers. Further information is available from Mr S. Marlow, Building 8.9, AERE, Harwell, Oxfordshire OX11 ORA. See also the report AERE-R 7477, A catalogue of Subroutines.

   The original version is for IBM 360/370. The library is specially strong in optimization and sparse matrices.

5. NPL. The National Physical Laboratory has a large library of routines which aims to cover most numerical processes widely required in the scientific disciplines. The Algorithms are coded in Algol 60 and Standard Fortran although some may be available in one language only. The highest degree of machine and compiler independence has been aimed at. There is one document for each algorithm for each available language. Routines may be supplied individually.

The library is based upon expertise accumulated by numerical analysts at NPL through years of research and problem solving. These analysts may be consulted upon most numerical problems and usually provide advice and assistance in the early stages of use of an algorithm. Material is continually added to the library as a result of research effort at NPL.

A guide to the library will be supplied free of charge upon application to: Dr. J.R.A. Cooper, Division of Numerical Analysis and Computing, National Physical Laboratory. Teddington, Middlesex TW11 OLW.

6. NATS. National Activity to Test Software is a United States project managed by the Applied Mathematics Division of the Argonne National Laboratory in cooperation with universities in North America and Europe. So far the eigensystem package EISPACK and the special functions package FUNPACK are available for all main U.S. computers.

   Further information from Burton S. Garbow, Applied Mathematics Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439.

   EISPACK is available for IBM 360/370, CDC 6600/7600, UNIVAC 1100, DEC System-10, Honeywell 600/6000 and Burroughs 6700.

   FUNPACK is avaiable for IBM 360/370, CDC 6600/7600 and UNIVAC 1100.

Ref. Garbow, B.S.: EISPACK - A Package of Matrix Eigensystem Routines, Computer Physics Communications, Vol. 7, No. 4, (April 1974), pp. 179-184.

Smith, B.T., et al: Matrix Eigensystem Routines-EISPACK Guide, Lecture Notes in Computer Science, Volume 6, Second Edition, Springer-Verlag, Berlin-Heidelberg - New York, 1976.

7. JPL. The Jet Propulsion Laboratory in Pasadena, California has a private library, described in Report 1846-23; Rev. A, February 1, 1975. This report is an excellent example of how a private library ought to be documented and presented to its local users.

8. NUMAL.
On request of the Academic Computing Centre of Amsterdam (SARA) the Mathematical Centre adapted and extended its library of numerical procedures for use with the CD CYBER 70 System, the resulting library called "NUMAL" (" NUM" ERICAL PROCEDURES IN "AL"GOL 60).

The aim of NUMAL is to provide a high level numerical library for Algol 60 Programmers. The library contains a set of validated numerical procedures together with supporting documentation. Except for a small number of double precision arithmetic routines all the source texts are written in Algol 60 and they are to a high degree independent of the computer/compiler used.

The library is now in use by several scientific computer centers in the Netherlands. Full reference documentation (ca. 800 pages) is distributed to subscribers. Once a year additions and improvements are released.

Ref. Mathematical Centre report NW8/76: NUMAL,a library of numerical procedures in ALGOL 60. Index and KWIC-index (3rd edition).

Further information from Stichting Mathematisch Centrum, 2e Boerhaavestraat 49, Amsterdam-1005, The Netherlands.

9. CERN. The "Centre Européenne pour la Recherche Nucléaire" in Geneva has one of the largest subroutine libraries in Europe. It is intended for the CDC 6600/7600 series, but mappings exist to other systems, including UNIVAC 1100. Some routines are very machine dependent. The library is classified according to SHARE and contains three categories

   a) numerical routines
   b) data manipulation routines
   c) nuclear physics applications

   Further information from Program Librarian, CERN, Div. DD, CH-1211 Geneva 23, Switzerland.

10. CPC (Computer Physics Communications Program Library). Computer programs in Physics are being collected at the Queen's University of Belfast and are announced in the Computer Physics Communications, see Volume 1 (1970), pp. 473-476 and Volume 10 (1975), p. 203. The current indexes of the contents of the program library as well as the programs are available from the C.P.C. Program Library, School of Physics and Applied Mathematics, Queen's University, Belfast BT7 1NN, Northern Ireland.

11. ANL. The Argonne Code Center is responsible for operating a computer software and data exchange and information center under U.S. Energy Research and Development Administration. Registered Installations receive a copy of the Program Abstracts, ANL 7411. A nominal fee is required for non-ERDA installations. Information is available from:

Argonne Code Center
Argonne National Laboratory
9700 South Cass Avenue
ARGONNE, Illinois 60439.

12. CACM. Collected algorithms from ACM is a collection of the algorithms published in the Communications of the ACM and ACM Transactions on Mathematical Software. The 1976 Index is published in Communications of the ACM, Vol. 19 (1976), p. 696. Further information from ACM.

5. CLASSIFICATION

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FORD, Brian: Classification of Numerical Algorithm Libraries. Manuscript 9 January 1975, Oxford University (2 pp.)

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IBM Systems Reference Library, Catalog of Programs for IBM System/360, GC 20-1619.
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KLAUS, Roland L: Short Communications. A Numbering scheme for a computer programming library. SOFTWARE - Practice & Experience, Vol 6, No. 3, July-September 1976, pp 435-437.

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Shirley A. Lill, User documentation for a general numerical library: the NAG approach, pp. 423-432 of D.J. Evans (Ed.), Software for Numerical Mathematics, Proceedings of the Loughborough University Conference of the Institute of Mathematics and its Applications held in April 1973, Academic Press, London 1974.

LOZIER, W. E., MAXIMON, L. C. and SADOWSKI, W. L.: Documentation of Mathematical Function Routines.
This paper concerns what kind of documentation that a program should have for the purpose of certification and validation by an independent tester, for example a reviewer for an algorithm journal.

NAG Reference Manual for Internal Project Use. NAG Central Office, 7 Banbury Road, Oxford OX2 6NN, England.

NEWMAN, N and LANG, T: Documentation for Computer Users. SOFTWARE - Practice & Experience, Vol 6, No. 3, July-September 1976, pp 321-326.

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K. A. REDISH - McMaster University
Tree Structures for a Program Library Index

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
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ROBERTS, K. V.: The Publication of Scientific FORTRAN Programs, Computer Physics Communications, Vol 1, pp. 1 - 9. [1969]
This article outlines some general principles which appear to be necessary if an international literature of published scientific programs is to be successfully established. Programming conventions are suggested for FORTRAN, together with several automatic documentation tools which have already been tried out and found useful.

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SCOWEN, R. S. and LAWRENCE, A. R.: Some experiments in improving program documentation. In "International Computing Symposium 1973," A. Günther, et al. (eds.), North-Holland/American Elsevier, Amsterdam (1974), pp. 55-58.

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This bibliography contains more than 1000 entries. Price: $ 4 ($ 5 if invoice required).

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Fritz Bierbaum,

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Some 900 basic information sources have been given a critical evaluation. The sources are listed in ten categories. The author has written a critical review for each entry.
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15. CRITERIA FOR EVALUATING NUMERICAL SOFTWARE

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16. EVALUATIONS

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21. JOURNALS RELATED TO NUMERICAL SOFTWARE

The following journals publish algorithms and/or computer codes within the numerical software area:

ACM Transactions on Mathematical Software (Association for Computing Machinery, 1133 Avenue of the Americas, New York, New York 10036)

Angewandte Informatik (Friedr. Vieweg + Sohn GmbH, Burgplatz 1, D-3300 Braunschweig, German Federal Republic)

BIT (DATA A/S, Kronprinsensgade 14, DK-1114 Copenhagen K, Denmark)

Communications of the ACM (Association for Computing Machinery, 1133 Avenue of the Americas, New York, New York 10036)

Computer Journal (British Computer Society, 29 Portland Place, London W1N 4AP, England)

Computer Physics Communications (North-Holland Publishing Company, P.O.Box 103, Amsterdam W, The Netherlands)

Computing (Springer-Verlag, P.O.Box 367, A-1011 Vienna, Austria)

Journal of Computational and Applied Mathematics (Koninklijke Vlaamse Ingenieursvereniging, Jan van Rijswicijcklaan 58, B-2000 Antwerp, Belgium)

Numerische Mathematik (Springer-Verlag, Heidelberger Platz 3, D-1 Berlin 33, German Federal Republic)

The following are important review journals:

Computing Reviews (Association for Computing Machinery, 1133 Avenue of the Americas, New York, New York 10036)
This journal also has the annual "Bibliography and Subject Index of Current Computing Literature".

CPST, Computer programs in science and technology. Science Associates/ International, Inc., 23 East 26th Street, New York, NY 10010 (Annual subscription $95.00).

Computer and Information Systems, Cambridge Scientific Abstracts, Inc., Suite 437, 6611 Kenilworth Avenue, Riverdale, Maryland 20840.

Quaterly Bibliography of Computers and Data Processing, Applied Computer Research, P.O. Box 9280, Phoenix, Arizona 85068.

Weekly Government Abstracts. Computers, Control & Information Theory, National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.