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ELLPACK Control Card Procedures: XEQ ELLPACK, XEQ GETELL

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ELLPACK CONTROL CARD PROCEDURES :

XEQ ELLPACK

XEQ GETELL

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Abstract

This document describes how to run ELLPACK jobs and to obtain copies of ELLPACK source programs on Purdue's CDC computer system. In most cases, only one control card is required to perform each of these tasks. In addition, several options allowing the testing of new ELLPACK modules or the temporary modification of old ones are available.

ELLPACK, a research tool for partial differential equations software, is described in [1,2].

XEQ ELLPACK

The batch control card used to run ELLPACK programs is

XEQ(ELLPACK,ID=CIB,optional parameters)

where "optional parameters" is a list of items selected from any of the sets below. (The XEQ processor is a control card macro processor. It expands the control card macro in the file named ELLPACK saved under user id CIB. See [3]). In what follows we assume that the reader is familiar with the description of the sequence of events in the execution of ELLPACK programs given in the ELLPACK User's Guides [1,2].

Parameter Set A : Running ELLPACK Programs

I=file	=>	the user's ELLPACK input program is on the given local file (default=INPUT)
L=file	=>	place listing of ELLPACK control program (the FORTRAN main program generated by the Preprocessor) on the specified local file (default=OUTPUT)
EFL=n	=>	use n (octal) words of core in compiling the ELLPACK control program (default=55000)
PLOT	=>	cause any plotting done by ELLPACK to be routed to the Versatec electrostatic printer. This must be specified if plotting output is desired.

Parameter Set B : Modifying the Preprocessor

PM=file	=>	the specified local file contains Modify directives to be applied to Preprocessor routines before execution (see [5])
PFL=n	=>	use n (octal) words of core in compiling the modified Preprocessor routines (default=55000)
PL=file	=>	place compilation listing of modified Preprocessor routine on the specified local file
E=n	=>	set the MNF compiler message level to n during all compilations done in this run (see [4])
XR=n	=>	set the MNF compiler cross reference table level to n during all compilations in this run (see [4])
PB=file	=>	load the binary decks (object modules) in the specified file along with the

```
                  Preprocessor
                  (the file should contain compiled versions
                  of modified Preprocessor routines)
PMAP         => generate a load map for the Preprocessor
                  execution
NOLOAD       => must be specified if a change is being made
                  to the Preprocessor main program
```

Parameter Set C : Modifying the Modules

```
N=file       => the specified local file contains FORTRAN
                  subprograms to be compiled and executed
                  along with the modules
                  (If routines in 'file' are also in the
                  ELLPACK library, the routines in 'file'
                  are used)
EM=file      => the specified local file contains Modify
                  directives to be applied to ELLPACK
                  modules routines before execution
EFL=n        => (see set A)
EL=file      => place the compilation listing of all added
                  or modified ELLPACK module routines on the
                  specified local file
E=n          => (see set B)
XR=n         => (see set B)
EB=file      => load the binary decks (object modules) in
                  the specified file along with the ELLPACK
                  modules (The file should contain compiled
                  versions of modified module routines).
MAP          => generate load map for module execution
```

Parameter Set D : Others

```
NODAY        => supress listing of dayfile (control cards)
NOLIST       => supress all output except listing of
                  control program and output of modules
```

If more than one of the files specified on the XEQ card is INPUT, then these records should appear in the input stream in the order PM, PB, I, EM, N, EB. The following files are rewound and used as scratch files: HEADER, ASSIGN, MODSEQ, PNCH, LGO, DATA, FORT, ELLPGM, ELLGO, PLOT, COMPILE, SAVE. In addition, the following permanent file names should be considered as reserved words: ELLPK77, SOURCE7, PRELIB7, BINARY7.

Examples

1. XEQ(ELLPACK,ID=CIB)

   This card simply executes the ELLPACK program on the INPUT file.

2. XEQ(ELLPACK,ID=CIB,I=EXAMPL,MAP,PLOT,EFL=65000)

   This card executes the ELLPACK program in the local file EXAMPL. The ELLPACK control program generated by the Preprocessor is compiled with a field length of 65000 (octal) words (this is required, for instance, when user-specified routines are very long). A load map is generated before execution and plotting output is routed to the electrostatic printer.

3. XEQ(ELLPACK,ID=CIB,PM=INPUT,NOLOAD,PFL=6000,PL=0)
   7/8/9 (end of record)
   *DECK,PPMAIN
   ... modifications ...
   *DECK,PPOUTP
   ... modifications ...
   7/8/9 (end of record)
   * ELLPACK INPUT PROGRAM
   .
   OUTPUT. PLOT-ERROR
   END.
   6/7/8/9 (end of file)

   This control card sequence applies modifications to the Preprocessor decks PPMAIN and PPOUTP, compiles them with a field length of 60000 (octal) words (the compilation listing is supressed) and then runs the ELLPACK program on INPUT file. NOLOAD is specified since the Preprocessor routine PPMAIN is modified.

4. XEQ(ELLPACK,ID=CIB,I=PROB,N=STAR,NOLIST,MAP)

   This card causes the ELLPACK program on the local file PROB to be processed by the Preprocessor and then the FORTRAN routines in the local file STAR are compiled along with the generated ELLPACK control program. This would be useful, for instance, if a new version of the five point star module (with the same calling sequence as the current one) were being tested. No compilation listing would be produced, although a load map would be.

XEQ GETELL

This section describes how to easily obtain copies of ELLPACK source programs on the Purdue CDC system. Only one batch control card is needed to do this; it is

```
XEQ(GETELL,ID=CIB,parameters)
```

where one or more of the parameters from the list below may appear. (The XEQ processor executes the control card macro located in the file GETELL in user id CIB.)

Parameters

```
PREPROS => get Preprocessor
DOMAIN  => get domain processor
PURDUE  => get Purdue modules
PURDUE8 => get Purdue modules (ELLPACK 78)
YALE    => get Yale modules
TEXAS   => get Texas modules (including ITPACK)
LINPACK => get LINPACK modules
BANK    => get Randy Bank's modules
SEWELL  => get Granville Sewell's modules
OUTPUT7 => get ELLPACK 77 output modules
OUTPUT8 => get ELLPACK 78 output modules
I=file  => get modules put on compile file by the
           Modify directives on the given file.
           See [5] for a description of Modify
           and Appendix 3 of this document for
           a description of Modify deck names.
```

The following two parameters allow listings of the obtained routines to be easily generated. Note that listing or compiling large collections of modules, e. g. PURDUE or TEXAS, may require large amounts of tracks, I/O units and pages of output.

```
LIST    => produce a source listing of the obtained
           routines
COMPILE => produce a compilation listing of the
           obtained routines.
           the parameter CFL=xxxxx gives the field
           length for the compilation. default is 55000.
```

After the XEQ procedure has been executed the local file CODE contains the requested source programs.

Examples

1. XEQ(GETELL,ID=CIB,OUTPUT,LIST)

This card produces a source listing of all output modules in ELLPACK 77.

2. XEQ(GETELL,ID=CIB,DOMAIN,COMPILE,CFL=65000)

This card produces a compilation listing of the ELLPACK domain processor. A field length of 65000 (octal) words is used for the compilation.

3.
```
XEQ(GETELL,ID=CIB,I=INPUT)
PFILES,PUT,STRCOPY,X=CODE.
7/8/9     (end of record)
*EDIT,STAR5
6/7/8/9     (end of file)
```

This sequence of control cards saves a copy of the ELLPACK module routine STAR5 in the users PFILE file STRCOPY.

References

[1] J. R. Rice, ELLPACK 77 User's Guide, Purdue University Computer Science Department Report CSD-TR 289, Sept. 13, 1978.

[2] J. R. Rice, ELLPACK 78 User's Guide -- Preliminary Version, Purdue University Computer Science Department Report CSD-TR 306, May 9, 1979.

[3] R. C. Scwabel, XEQ Reference Manual, Purdue University Computer Center Document L3 XEQ, June 1977.

[4] M. J. Frisch and L. A. Liddiard (eds.), MNF (MiNnesota Fortran) Reference Manual for CDC 6000/7000/Cyber Series Computers, University Computer Center, University of Minnesota, 1976.

[5] Modify Reference Manual, Purdue University Computer Center Document V0-MODIFY, December 1975.

Appendix 1 : The ELLPACK Macro

Note : The character ↑ is an ampersand

```
'IF,STR,NODAY,1
DISABLE,PLIST.
'IF,STR,NOLIST,3
'SET,EL=0
'SET,PL=0
'SET,L=0
REWIND,HEADER,ASSIGN,MODSEQ,PNCH,LGO.
REWIND,DATA,FORT,ELLPGM,ELLGO,PLOT.
IF(FILE(ELLPK77,DR))
ELSE.
FILES,ELLPK77,T=R.
ATTACH,PRELIB7,ELLPK77.
ATTACH,BINARY7,ELLPK77.
ENDIF.
IF(FILE(SOURCE7,EX))
ELSE.
'SET,GETSRC=NO
'IF,DEF,PM,1
'SET,GETSRC=YES
'IF,DEF,EM,1
'SET,GETSRC=YES
'IFEQ,↑GETSRC,YES,1
FILUP(OPEN,SOURCE7,ELLPK77)
ENDIF.
'IF,DEF,PM,3
MODIFY(P=SOURCE7,N=0,C=COMPILE,I=↑PM,U,L=↑PL=OUTPUT)
RFL,↑PFL=55000.
MNF,N,R=↑XR=0,I=COMPILE,L=↑PL=OUTPUT,E=↑E=3.
'IF,STR,PMAP,1
MAP,PART.
CLEAR,C.
'IF,STR,NOLOAD
'ELSE,1
GET(PRELIB7,LGO,NR) REL/BB.-ELLPCK
'IF,DEF,PB,1
COPYBF,↑PB,LGO.
LOAD,LGO,PRELIB7,MNFLIB,RUNLIB.
EXECUTE,ELLPCK,HEADER,ASSIGN,MODSEQ,↑I=INPUT,OUTPUT,PNCH,
                                    DATA,FORT.
'IF,STR,PMAP,1
MAP,OFF.
REWIND,HEADER,DATA,ASSIGN,MODSEQ,FORT.
COPYBF,HEADER,ELLPGM,1,CON,DER,DEF.
COPYBF,DATA,ELLPGM,1,CON,DER,DEF.
COPYBF,ASSIGN,ELLPGM,1,CON,DER,DEF.
COPYBF,MODSEQ,ELLPGM,1,CON,DER,DEF.
COPYBF,FORT,ELLPGM,1,CON,DER,DEF.
```

```
REWIND,ELLPGM.
RFL,↑EFL=55000.
MNF,N,R=↑XR=0,I=ELLPGM,B=ELLGO,L=↑L=OUTPUT,E=↑E=3.
'SET,MORE=NO
'IF,DEF,EM,1
'SET,MORE=YES
'IF,DEF,N,1
'SET,MORE=YES
'IFEQ,↑MORE,YES,1
REWIND,ELLPGM.
'IF,DEF,EM,2
MODIFY(P=SOURCE7,N=0,C=COMPILE,I=↑EM,L=↑EL=OUTPUT,U)
COPYBF,COMPILE,ELLPGM,1,CON,DER,DEF.
'IF,DEF,N,1
COPYBR,↑N,ELLPGM,1,CON,DER,DEF.
'IFEQ,↑MORE,YES,3
REWIND,ELLPGM.
RFL,↑EFL=55000.
MNF,N,R=↑XR=0,I=ELLPGM,B=ELLGO,L=↑EL=OUTPUT,E=↑E=3.
'IF,STR,MAP,1
MAP,PART.
'IF,DEF,EB,1
COPYBF,↑EB,ELLGO.
CLEAR,C.
ENABLE,PLIST.
LOAD,ELLGO,BINARY7,MNFLIB,RUNLIB.
EXECUTE,,↑I=INPUT,OUTPUT,PLOT,SAVE,SCRTCH.
'IF,STR,PLOT,1
EPPLOT.
TRMSG,NA.  ELLPACK-EXECUTION-COMPLETE
GOTO,END.
PROCEED.
TRMSG,NA.  ELLPACK-EXECUTION-FAILED@
-END.
PROCEED.
```

Appendix 2 : The GETELL Macro

Note : The character ↑ is an ampersand

```
REWIND,COMPILE.
IF(FILE(ELLPK77,DR))
ELSE.
FILES,ELLPK77,T=R.
ENDIF.
IF(FILE(SOURCE7,EX))
ELSE.
FILUP(OPEN,SOURCE7,ELLPK77)
ENDIF.
'IF,STR,PREPROS,3
PFILES,GET,PPNAME,ID=CIB.
MODIFY,NR,P=SOURCE7,I=PPNAME,C=CODE,LS.
RETURN,PPNAME.
'IF,STR,PURDUE,3
PFILES,GET,PUNAME,ID=CIB.
MODIFY,NR,P=SOURCE7,I=PUNAME,C=CODE,LS.
RETURN,PUNAME.
'IF,STR,PURDUE8,3
PFILES,GET,P8NAME,ID=CIB.
MODIFY,NR,P=SOURCE7,I=P8NAME,C=CODE,LS.
RETURN,P8NAME.
'IF,STR,TEXAS,3
PFILES,GET,TXNAME,ID=CIB.
MODIFY,NR,P=SOURCE7,I=TXNAME,C=CODE,LS.
RETURN,TXNAME.
'IF,STR,DOMAIN,3
PFILES,GET,DMNAME,ID=CIB.
MODIFY,NR,P=SOURCE7,I=DMNAME,C=CODE,LS.
RETURN,DMNAME.
'IF,STR,YALE,3
PFILES,GET,YANAME,ID=CIB.
MODIFY,NR,P=SOURCE7,I=YANAME,C=CODE,LS.
RETURN,YANAME.
'IF,STR,BANK,3
PFILES,GET,BANAME,ID=CIB.
MODIFY,NR,P=SOURCE7,I=BANAME,C=CODE,LS.
RETURN,BANAME.
'IF,STR,LINPACK,3
PFILES,GET,LINAME,ID=CIB.
MODIFY,NR,P=SOURCE7,I=LINAME,C=CODE,LS.
RETURN,LINAME.
'IF,STR,SEWELL,3
PFILES,GET,SENAME,ID=CIB.
MODIFY,NR,P=SOURCE7,I=SENAME,C=CODE,LS.
RETURN,SENAME.
'IF,STR,OUTPUT7,3
PFILES,GET,O7NAME,ID=CIB.
```

```
MODIFY,NR,P=SOURCE7,I=07NAME,C=CODE,LS.
RETURN,07NAME.
'IF,STR,OUTPUT8,3
PFILES,GET,08NAME,ID=CIB.
MODIFY,NR,P=SOURCE7,I=08NAME,C=CODE,LS.
RETURN,08NAME.
'IF,DEF,I,1
MODIFY,NR,P=SOURCE7,I=↑I,C=CODE,LS.
REWIND,CODE.
'IF,STR,COMPILE,2
RFL,↑CFL=55000.
MNF,N,I=CODE,P,E=0.
'IF,STR,LIST,1
COPYSBF,CODE,OUTPUT,1,RI.
ENDIF.
```

Appendix 3 : Modify Deck Names

The ELLPACK Modify source library is made up of "decks", each deck containing one FORTRAN routine (with a few exceptions). Each Modify deck name is the same as the name of the FORTRAN subprogram that it contains. Thus, for example, the Modify deck STAR5 contains the FORTRAN subroutine STAR5. There are two exceptions:

1. The Preprocessor

The Preprocessor deck names each have the prefix PP followed by the first four characters of the FORTRAN subprogram contained in the deck. The Preprocessor main program is contained in the deck PPMAIN and the Preprocessor's block data subprogram is in the deck PPDATA. The Preprocessor decks are: PPAXRI, PPBCRI, PPBOUN, PPBREA, PPCLOS, PPDISC, PPDOMA, PPDPLI, PPEQUA PPFORT, PPGRID, PPHEAD, PPHOLE, PPINDE, PPINTP, PPINTV, PPKEYB, PPKEYM, PPKEY2, PPMAIN, PPMATC, PPMIXB, PPMODN, PPOPTI, PPOUTP, PPPARA, PPREAD, PPRECB, PPSEGN, PPSEQU, PPSOLU.

2. The Domain Processor

All deck names in the domain processor have the prefix DM. Several FORTRAN subprograms are contained in each deck. The deck names are: DMBWAL, DMCHAN, DMFILL, DMMAIN, DMNEIG.

On the following pages is a list of all subprograms in the March 1979 version of ELLPACK organized by modules.

*-- DOMAIN
MODULES

```
DOMAIN
    DCOORD
    BWALK
    CHANGE
        NCOORD
        BWALK
            BCOORD
            DBACK
                BCDORD
            REGULA
                BCOORD
            SECANT
                BCOORD
        LOCATE
    FILL
        EXPAND
    LOCATE
    NEIGH
        BCOORD
        ISETGT
```

*-- DISCRETIZATION
MODULES

1. DYNAMIND-CG

```
DCGDRV
    DCG
        DCGCG
            DCGMUL
        GMA
        KPICK
            EIGEN
            GMAERR
            TCHECK
        POSTCG
        PRECG
            DCGMUL
        TEVAL
            DCGDAG
            DCGSCL
            PERCIG
            TRIEIG
    DCGDSC
        BCOND
```

2. DYNAMIND-CG4

```
DCGDPU
    DCG
        DCGCG
            DCGMUL
        GMA
        KPICK
            EIGEN
            GMAERR
            TCHECK
        POSTCG
        PRECG
            DCGMUL
        TEVAL
            DCGDAG
            DCGSCL
            PERCIG
            TRIEIG
    DCGDSC
        BCOND
    PCUBED
    PDE
    PDERHS
```

3. FFT 9-POINT

```
FFT9
    DISCRT
    EQSOL
        CRED
        EVENRD
        FETCHX
        FOUR
            KFOLD
            NEG
            TFOLD
            ZERO
        ODDRD
        STOREX
    RGHTSD
        BCOND
        PDERHS
    SETF
```

4. MARCHING ALGORITHM

```
GMADRV
    GMA
        GMASRT
        PARTN
        ROOTSC
            QL
        ROOTSG
            BANDR
            QL
        STEP1
            MARCH1
            MARCH3
            TRI1
        STEP2
            TRI1
            TRI2
        STEP3
            TRI1
            TRI2
        STEP4
            MARCH1
            MARCH2
            TRI1
    GMABC
    GMADSC
        BCOND
        TCHECK
    GMAS
        GMASRT
        PARTN
        PINVIT
        PROJ
        STEP1
            MARCH1
            MARCH3
            TRI1
        STEP2
            TRI1
            TRI2
        STEP3
            TRI1
            TRI2
        STEP4
            MARCH1
            MARCH2
            TRI1
        TINVIT
    KPICK
        EIGEN
        GMAERR
        TCHECK
```

5. HODIE-ACDEF

```
HOACDE
```

6. HODIE-ACF

```
HOACF
    HOLR9A
        ALPHAS
            ABASIS
            PDE
        BETAS
            BBASIS
            PDE
            SNGSOL
        DIRBC9
            BCOND
            BNDPC5
        H9DFEQ
            PDERHS
```

7. HODIE-HELMHOLTZ

```
HOHELM
    HODSUP
        DCOEFS
            PDE
        DIRBC9
            BCOND
            BNDPC5
        PDERHS
```

8. HODIE 27-POINT 3D

```
HOLR27
    PCUBED
    BCOND
    PDERHS
```

9. P3-C1 COLLOCATION

```
P3C1CO
    BASE
    BOUNDR
        BCOND
    DBASE
    DDBASE
    PDE
    PDERHS
    P3C1CH
        BCUBCO
            BASE
            DBASE
            DDBASE
            PDERHS
        BDHOMG
        TRUE
```

10. P3-C1 GALERKIN

```
P3C1GH
    HGALEQ
        BASE
        BDHONG
        BICUBH
            PDE
            PDERHS
        DBASE
        TRUE
```

11. 5-POINT STAR

```
STAR5
    BNDED5
        BCOND
    BNDPC5
    ELIMD5
        BNDPC5
    INTEG5
        PDE
        PDERHS
    SELF5
        PDE
        BCOND
```

12. 9-POINT STAR

```
STAR9
```

13. 7-POINT 3D

```
SYM7PT
    PNT3D
        BCOND
        PDE
```

14. TEST DISCRETIZATION

```
TESTDI
```

15. 2DEPEP

```
THDEP
    THMAIN
        FE
            F
                PDE
            GB
                BCOND
                PDE
        GENREG
        INTR
            FB
                BCOND
        MEJOR
        SPLT
            FB
                BCOND
            XYS
                BCOORD
                PDE
```

*-- INDEXING MODULES

1. NATURAL

```
NATORD
```

2. NESTED DISECTION

```
NESTDI
```

3. RED-BLACK

```
RBNDX
```

4. YALE RCM

```
RCMDRV
```

5. TEST INDEXING

```
TESTIN
```

6. YALE MIN DEG

```
YSMPD
    ODRV
        ORDER
```

*-- SOLUTION MODULES

1. BAND SOLVE

```
BNDSOL
```

2. YALE ENVELOPE

```
ENVDRV
```

3. JACOBI CG

```
JCG
    ECHOUT
    ITICK
    ITJCG
        CHGCON
            EIGVAL
                DETERM
        ITERM
        PARCON
            SDOT
        SPMPY
            SOMPY
        SUM3
        TSTSTP
            SDOT
    ITOCK
    SCAL
        SPDTF
            SODTF
    SCOPY
    SNRM2
    UNSCAL
        SPDTF
            SODTF
    VFILL
```

4. JACOBI SI

```
JSI
    ECHOUT
    ITICK
    ITJSI
        CHGSI
            CHFDV
            SDOT
            SNRM2
        ITERM
        PARSI
        SAXPY
        SCOPY
        SPMPY
            SOMPY
        SUM2
        SUM3
        TSTSTP
            SDOT
    ITOCK
    SCAL
        SPDTF
            SODTF
    SCOPY
    SNRM2
    UNSCAL
        SPDTF
            SODTF
    VFILL
```

5. LINPACK (BAND)

```
LPKBD
    SGBFA
        ISAMAX
        SAXPY
        SSCAL
    SGBSL
        SDOT
        SAXPY
```

```
LPKSBA
    SPBFG
        SDOT
    SPBSM
        SAXPY
        SDOT
```

7. REDUCED SYSTEM CG

```
RSCG
    ECHOUT
    ITICK
    ITOCK
    ITRSCG
        CHGCON
            EIGVAL
                DETERM
        ITERM
        PARCON
            SDOT
        SPUTU
            SOUTU
        SUM3
        TSTSTP
            SDOT
    SAXPY
    SCAL
        SPDTF
            SODTF
    SCOPY
    SNRM2
    SPUTU
        SOUTU
    SUM3
    UNSCAL
        SPDTF
            SODTF
    VFILL
```

8. REDUCED SYSTEM SI

```
RSSI
    ECHOUT
    ITICK
    ITOCK
    ITRSSI
        CHGSI
            CHEBY
            SDOT
            SNRM2
        ITERM
        PARSI
        SAXPY
        SCOPY
        SPUTU
            SOUTU
        SUM3
        TSTCHG
        TSTSTP
            SDOT
    SAXPY
    SCAL
        SPDTF
            SODTF
    SCOPY
    SNRM2
    SPUTU
        SOUTU
    UNSCAL
        SPDTF
            SODTF
    VFILL
```

9. SPARSE GE - PIVOTING

```
SPVGEP
    DPSTU
        RSPTUV
```

```
SOR
    ECHOUT
    ITICK
    ITOCK
    ITSOR
        ITERM
        SAXPY
        SCOPY
        SDOT
        SPFGS
            SOFGS
        TAU
    SCAL
        SPDTF
            SODTF
    SNRM2
    UNSCAL
        SPDTF
            SODTF
    VFILL
```

11. SYMMETRIC SOR CG

```
SSORCG
    BETA
        SDOT
        SPUTU
            SOUTU
    ECHOUT
    ITICK
    ITOCK
    ITSRCG
        CHGCON
            EIGVAL
                DETERM
        ITERM
        OMEG
            BETA
                SDOT
                SPUTU
                    SOUTU
            SDOT
            SPMPY
                SOMPY
        OMGCHG
        PARCON
            SDOT
        SAXPY
        SCOPY
        SPBGS
            SOBGS
        SPFGS
            SOFGS
        SUM2
        SUM3
        TSTSTP
            SDOT
    OMEG
        BETA
            SDOT
            SPUTU
                SOUTU
        SDOT
        SPMPY
            SOMPY
    SAXPY
    SCAL
        SPDTF
            SODTF
    SCOPY
    SNRM2
    SPFGS
        SOFGS
    UNSCAL
        SPDTF
            SODTF
    VFILL
```

12. SYMMETRIC SOR SI

```
SSORSI
    BETA
        SDOT
        SPUTU
            SOUTU
    ECHOUT
    ITICK
    ITOCK
    ITSRSI
        CHGSI
            CHEBY
            SDOT
            SNRM2
        ITERM
        OMEG
            BETA
                SDOT
                SPUTU
                    SOUTU
            SDOT
            SPMPY
                SOMPY
        OMGCHG
        PARSI
        SAXPY
        SCOPY
        SDOT
        SPBGS
            SOBGS
        SPFGS
            SOFGS
        SUM2
        SUM3
        TSTCHG
        TSTSTP
            SDOT
    OMEG
        BETA
            SDOT
            SPUTU
                SOUTU
        SDOT
        SPMPY
            SOMPY
    SCAL
        SPDTF
            SODTF
    SCOPY
    SNRM2
    UNSCAL
        SPDTF
            SODTF
    VFILL
```

13. SYMMETRIC BAND

```
SYMBND
```

14. TEST SOLUTION

```
TESTSO
```

13. YALE SPARSE

```
YSMPS
    CDRV
        NRDC
        NSFC
            NROC
        NNFC
        NNSC
    NDRV
        NNF
        NNS
        NSF
    SDRV
        SNF
        SNS
        SSF
    TDRV
        TRK
```

•— OUTPUT MODULES

1. CONTOUR PLOT

```
CONTUR
    AXIS
    CCONTR
        DRAW
            NUMBER
            PLOT
        FILLO
        IGET
        MARK1
    NUMBER
    PLOT
    SYMBOL
```

2. CONTOUR PLOT

```
CONT78
```

3. MAXIMUM

```
FNCMAX
```

4. MAXIMUM

```
FMAX78
```

5. TABLE OF VALUES

```
TABLER
```

6. TABLE OF VALUES

```
TABL78
```

7. PLOT THE DOMAIN

```
DOMPLT
    AXIS
    BCODRD
    DATE
    LINE
    SCALE
    SYMBOL
```

8. THE ERROR

```
ERROR
    SOLUT
        BCOND
        CGAPRH
            BASE
            DBASE
            DDBASE
        COLAPR
            BASE
            DBASE
            DDBASE
        QUADRD
            NEARST
        QUADRT
            NEARST
        TESTEV
        UVALS
            BCOND
            UUNKS
        UVAL7
            BCOND
    TRUE
```

9. THE ERROR

```
ERR078
```

10. PLOT THE REGION AND THE GRID LINES

```
REGPLT
    AXIS
    LINE
    PLOT
    SCALE
```

11. THE RESIDUAL

```
RESID
    BCOND
    CDXU
    CDYU
    PDE
    PDERHS
    SOLUT
        BCOND
        CGAPRH
            BASE
            DBASE
            DDBASE
        COLAPR
            BASE
            DBASE
            DDBASE
        QUADRD
            NEARST
        QUADRT
            NEARST
        TESTEV
        UVALS
            BCOND
            UUNKS
        UVAL7
            BCOND
```

12. THE RESIDUAL

```
RES178
```

13. THE COMPUTED SOLUTION

```
SOLUT
    BCOND
    CGAPRH
        BASE
        DBASE
        DDBASE
    COLAPR
        BASE
        DBASE
        DDBASE
    QUADRD
        NEARST
    QUADRT
        NEARST
    TESTEV
    UVALS
        BCOND
        UUNKS
    UVAL7
        BCOND
```

14. THE COMPUTED SOLUTION

```
SOLU78
```

15. THE TRUE SOLUTION

```
TRUEFN
    TRUE
```

16. THE TRUE SOLUTION

```
TRUE78
```

•— INTERFACE MODULES

1. FOR BAND SOLVE

```
BNDSTR
    BANDUI
```

2. FOR ITPACK

```
INTITP
    APXUNK
    BLDMAT
        SPELM
            SOELM
        SPFIN
            SOFIN
        SPINI
            SOINI
        SPSIJ
            SOSIJ
    DFAULT
```

3. FOR LINPACK BAND

```
LBDSTR
    BANDUI
```

4. FOR LINPACK SPD BAND

```
LSBDST
    BANDUI
```

5. FOR SPARSE GE

```
SPDSTR
    SPNEPP
```

```
*-- COMMON
    BLOCK
    NAMES

BLANK COMMON
AMATZZ
BCTYZZ
BGRIZZ
BUDPY
BUBLZZ
BUMPYZ
BPIYZZ
BRANZZ
BVECZZ
B1
B2
COEFZZ
CONTRL
CPDE
DUSOLU
DUMY
EBIFORM
FFT
GRIDXZ
GRIDYZ
GRIDZZ
GTYPZZ
IBCOZZ
IGRIZZ
LUBLGS
IUUMZZ
ITCOM1
ITCOM2
ITCOM3
ITCOM4
ITPTP
ITPTOC
MACHCP
MESH
NDXEZZ
NDXUZZ
NDXCOP
PTICZZ
PROB1
PROB
PROB2
PSCTRO
PLOTS
SYMCOM
VGRIZZ
VRIBZZ
XGRDZZ
YGRDZZ
```