MODPAC V3A - Command Guide

Schönthal, Tomas

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TOMAS SCHÖNTHAL

Department of Automatic Control
Lund Institute of Technology
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This report describes how to use the interactive program package MODPAC. MODPAC includes facilities for analysis and transformation of dynamic systems on state space or transfer function form. This Command Guide is normally available as a text file on the computer where MODPAC is implemented. This file is continually updated.

A MODPAC User's Guide with more detailed information on the intended use of and the methods behind each command is planned as a separate report.

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MODPAC V3A - COMMAND GUIDE

CONTENTS:

1) GENERAL INFORMATION

MODPAC IS AN INTERACTIVE PROGRAM PACKAGE FOR TRANSFORMATION OF SYSTEM MODELS OFFERING THE FOLLOWING FACILITIES:

SYSTEM TRANSFORMATION (STATE SPACE MODELS, UNLESS OTHERWISE STATED)

CONT - DESAMPLES A SYSTEM
SAMP - SAMPLES A SYSTEM
SPSS - TABULATES THE TRANSFER FUNCTION FOR A GIVEN I/O VARIABLE PAIR OF A STATE SPACE MODEL
SSTRF1- TRANSFORMS A STATE SPACE MODEL INTO TRANSFER FUNCTION FORM
SYSTR - APPLIES A CHANGE OF COORDINATES IN STATE SPACE, Z = T*X
TBALAN- TRANSFORMS TO A BALANCED A-MATRIX
TCON - TRANSFORMS TO REACHABLE FORM (SINGLE INPUT SYSTEMS)
TDIAG - TRANSFORMS TO DIAGONAL FORM
THESS - TRANSFORMS TO HESSENBERG FORM
TOBS - TRANSFORMS TO OBSERVABLE FORM (SINGLE OUTPUT SYSTEMS)
TRFSS1- TRANSFORMS A TRANSFER FUNCTION MODEL INTO A STATE SPACE MODEL

OTHER SYSTEM MANIPULATIONS

KALD - KALMAN DECOMPOSER
LUEN1 - LUENBERGER OBSERVER, PART ONE
LUEN2 - LUENBERGER OBSERVER, PART TWO
PPLAC - POLE PLACEMENT USING STATE FEEDBACK (SINGLE INPUT)
RECON - STATE RECONSTRUCTOR USING A KALMAN FILTER

MATRIX AND POLYNOMIAL OPERATIONS

ALTER - ALTERS ELEMENTS IN A MATRIX FILE
ENTER - CREATES MATRIX FILES
EXPAN - MERGES A NUMBER OF MATRIX FILES INTO A NEW ONE
MATOP - EVALUATES ALGEBRAIC MATRIX EXPRESSIONS
POCONV- CONVERTS MISO TRANSFER FUNCTION MODELS FROM POLYNOMIAL
FILE FORM TO POLYNOMIAL IMAGE FORM AND VICE VERSA
POLY - POLYNOMIAL FILE EDITOR
REDUC - CREATES A MATRIX FILE FROM A PART OF AN OLD ONE
UNITM - CREATES A UNIT MATRIX FILE
ZEROM - CREATES A ZERO MATRIX FILE

PLOTTING

BODE - PLOTS BODE DIAGRAMS
NIC - PLOTS NICHOLS DIAGRAMS
NYQ - PLOTS NYQUIST DIAGRAMS
POLZ - COMPUTES AND PLOTS THE ZEROES OF A POLYNOMIAL

UTILITY FUNCTIONS

AGR - AGGREGATE FILE EDITOR
DELET - DELETES FILES
EDIT - GENERAL TEXT EDITOR
FHEAD - BINARY DATA FILE HEAD EDITOR
GETFIL- CONVERTS AN EXEC 8 FILE ELEMENT TO A MODPAC FILE
HCOPY - INITIATES OUTPUT TO THE L.D.C. CALCOMP PLOTTER
LIST - LISTS THE CONTENTS OF A BINARY DATA FILE OR A TEXT FILE
MOVE - COPIES FILES
SAVFIL- CONVERTS A MODPAC FILE TO AN EXEC 8 FILE ELEMENT
TURN - MANIPULATES PROGRAM SWITCHES

INTERACTION AIDS

SEE ELMQVIST-WIESLANDER:
"INTRAC - AN INTERACTIVE MONITOR, REFERENCE MANUAL"

MODPAC IS COMMAND DRIVEN, I.E. IT WRITES A PROMPTER (> OR $)
WHEN IT IS READY TO ACCEPT A COMMAND. THIS WILL TRIGGER
INPUT, COMPUTATIONS AND OUTPUT. IF ANYTHING GOES WRONG, MODPAC
WILL WRITE AN APPROPRIATE DIAGNOSTIC IN PLAIN ENGLISH.
ERRORS ARE USUALLY INCORRECT COMMAND SYNTAX, MISSING OR WRONGLY
PREPARED INPUT DATA OR NUMERICAL DIFFICULTIES.
THE PROMPTER WILL ALWYAS REAPPEAR AFTER AN ERROR, ENABLING
YOU TO REMEDY THE SITUATION AND CONTINUE AS IF NOTHING HAD HAPPENED.

THE COMMAND SYNTAX IS ROUGHLY:

ACTION [(SW)] [RESULT] < INPUT PARA

ACTION- COMMAND IDENTIFIER
SW   - FACILITY SELECTOR
RESULT- NAME OF RESULTING DATA SET
INPUT - NAME OF INPUT DATA SET
PARA - SOME PARAMETER, E.G. A TEST QUANTITY

AN ARGUMENT ENCLOSED BY SQUARE BRACKETS IS OPTIONAL, I.E. IT MAY
BE OMITTED FROM THE COMMAND STRING, CAUSING SOME DEFAULT ACTION TO BE
TAKEN. IN THE ABOVE EXAMPLE RESULT WILL BY DEFAULT OVERWRITE INPUT.

SOME COMMANDS ARE HIERARCHICAL, REQUIRING SUB-COMMANDS
FOR A MORE DETAILED SPECIFICATION.
WHEN MODPAC OPERATES IN SUB-COMMAND MODE, THE PROMPTER WILL APPEAR
FIVE STEPS TO THE RIGHT FOR EACH SUB-COMMAND LEVEL

MOST SUB-COMMAND SEQUENCES MAY BE FINISHED EITHER BY MEANS OF THE
STANDARD COMMANDS X AND KILL (EXECUTE AND ABORT, RESPECTIVELY).
THE DISPLAY FUNCTION LOOK IS ALSO AVAILABLE IN MOST CASES.

THE DATA SETS CONSISTS OF MASS STORAGE FILES. THREE DIFFERENT DATA
MODES ARE EMPLOYED:

A) TEXT FILES

B) BINARY DATA FILES

C) AGGREGATE FILES

A) TEXT FILES ARE EITHER MACROS OR SYSTEM DESCRIPTIONS

A-1) MACROS

SEE ELMQVIST-WIESLANDER:
"INTRAC - AN INTERACTIVE MONITOR, REFERENCE MANUAL"

A-2) SYSTEM DESCRIPTIONS

TWO CASES:

A-2-1) STATE SPACE MODELS

FOR THIS TYPE OF MODEL, AMAT, BUMAT, QO, RO ETC ARE REFERENCES TO MATRIX FILES, DYNAG, LOAG, ETC. ARE OPTIONAL NAMES OF AGGREGATE FILES, SEE C).

STATE SPACE SYNTAX

```
BEGIN cont

CONTINUOUS STATE SPACE REPRESENTATION

DYNAMICS, [AGGREGATE: dynag,]

DX/DT = amat*X + bumat*U [+ bwmat*W] [+ bvmat*v]

Y = cmat*X [+ dumat*U] [+ dwmat*W] [+ demat*E]

Z = smat*X  [+ humat*U] [+ hwmat*W]

[INITIAL STATE VECTOR : x0vec]

LOSS FUNCTION, [AGGREGATE: loag,]
Q0: q0mat, Q1: q1mat, Q12: q12mat, Q2: q2mat

COVARIANCE FUNCTION, [AGGREGATE: covag,]
R0: r0mat, R1: r1mat, R12: r12mat, R2: r2mat

EXTENDED LOSS FUNTION, [AGGREGATE: eloag,]
EQ0: eq0mat, EQ1: eq1mat, EQ12: eq12mat, EQ2: eq2mat,
EQ3: eq3mat, EQ4: eq4mat

END



BEGIN disc

DISCRETE STATE SPACE REPRESENTATION

* deviations from  the continuous case:

SAMPLE INTERVAL value S

* DX/DT = ... is replaced by:

XNEW = amat*X ...

* value is a number expressing the sample interval in seconds

END
```

Note

The DYNAMICS declaration should precede DX/DT = ... (XNEW = ...)
The SAMPLE INTERVAL declaration should precede the DYNAMICS declaration

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A-2-2) MISO TRANSFER FUNCTION MODELS

NOTE: POLYNOMIAL NAME IS A REFERENCE TO A POLYNOMIAL FILE.
POLYNOMIAL IMAGE IS THE POLYNOMIAL WRITTEN IN MATHEMATICAL
NOTATION WITHIN THE TEXT OF THE SYTEM FILE.
E.G. FOR A CONTINUOUS TIME SECOND ORDER POLYNOMIAL:

K2 S^2 K1 S[^1] + K0

AND FOR A DISCRETE TIME SECOND ORDER POLYNOMIAL:

1 + K1 Q^-1 + K2 Q^-2

SEE FURTHER B-5)

MISO TRANSFER FUNCTION SYNTAX

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```
BEGIN [section-name]

DISCRETE/CONTINUOUS MISO TRANSFER FUNCTION

* comments:

* the followins items are isnored in the continuous case:

* [SAMPLE INTERVAL]
" [A-polynomial nr]
" [C-polynomial nr]
" [DPOLYNOMIAL]
* [LOSS FUNCTION]
" [AIC]

* [.-polynomial name] is a reference to a polynomial file
" and will override [.-polynomial image]
" [.-polynomial nr] and [.-polynomial name]
" may not appear tosether

* AGGREG asrnam is a reference to an assresate file,
" incorporatins [.-polynomial name]

[SAMPLE INTERVAL value S]

APOLYNOMIAL [A-polynomial nr] [A-polynomial name]
[A-polynomial imase]

BPOLYNOMIAL [B-polynomial nr] [B-polynomial name]
[B-polynomial imase]

[CPOLYNOMIAL [C-polynomial nr] [C-polynomial name]]
[C-polynomial imase]
[LAMBDA [c-polynsnomial nr] value]

[DPOLYNOMIAL [D-polynomial nr] [D-polynomial name]]
[D-polynomial imase]

INITIAL OUTPUT VALUES [INITIAL polynomial name]
[INITIAL-polynomial imase]

[LOSS FUNCTION value]
[AIC value]

[AGGREG asrname]

END
```

B) THERE ARE FIVE TYPES OF BINARY DATA FILES IN USE AT PRESENT:

B-1) TIME SERIES FILES

SEE WIESLANDER: "IDPAC USER'S GUIDE, REV. 1"

B-2) FREQUENCY RESPONSE FILES

SEE WIESLANDER: "IDPAC USER'S GUIDE, REV. 1"

B-3) LOCUS FILES

A LOCUS FILE IS A MATRIX CONSISTING OF M ROWS AND 2*N+1 COLUMNS.
COLUMN 1 CONTAINS THE VALUES OF A SO CALLED LOCUS PARAMETER,
E.G. THE LOOP GAIN FOR A ROOT LOCUS ANALYSIS.
COLUMNS 2*I, I = 1,N CONTAINS THE REAL PARTS OF N COMPLEX VALUES,
COLUMNS 2*I+1 THE CORRESPONDING IMAGINARY PARTS.
THE COMPLEX NUMBERS REPRESENT EIGENVALUES OR POLYNOMIAL
ZEROES.
E.G. THE POLZ COMMAND OUTPUTS A LOCUS FILE CONSISTING OF
1 ROW AND 2*NDEG+1 COLUMNS, WHERE NDEG IS THE EFFECTIVE
DEGREE OF THE INPUT POLYNOMIAL

B-4) MATRIX FILES

A MATRIX FILE FOR AN M*N MATRIX CONSISTS OF M RECORDS,
N REAL NUMBERS IN EACH.
THUS THE I:TH RECORD HOLDS THE MATRICE'S I:TH ROW.

B-5) POLYNOMIAL FILES

A POLYNOMIAL FILE OF DEGREE NDEG CONSISTS OF
(NDEG-1) K*L COEFFICIENT MATRICES, THE LEADING COEFFICIENT MATRIX
BEING STORED AT THE BEGINNING OF THE FILE.

NOTE: FOR K = L = 1 THERE EXISTS AN ALTERNATIVE REPRESENTATION,
NAMELY THE SO-CALLED POLYNOMIAL IMAGE.
A POLYNOMIAL IMAGE CONSISTS OF ONE OR MORE ROWS OF A TEXT FILE,
WHICH HOLD A FREE FORMAT SERIES EXPANSION OF THE POLYNOMIAL IN
THE OPERATOR 'Q^-' (DISCRETE TIME, REFER TO IDPAC) OR
'S' (CONTINUOUS TIME).

C) AGGREGATE FILES

A SET OF BINARY DATA FILES WITH SOME PROPERTY IN COMMON,
E.G. THE SYSTEM MATRICES FOR A STATE SPACE MODEL,
MAY BE MERGED INTO A SO CALLED AGGREGATE FILE, WHICH MERELY HAS AN
ADMINISTRATIVE FUNCTION. IT SPEEDS UP FILE ACCESS AND
GIVES THE USER AN EXTRA DEGREE OF FREEDOM TO NAME FILES.

REFERENCES TO A FILE WITHIN AN AGGREGATE FILE CAN BE MADE IN
THREE DIFFERENT WAYS:

C-1) VIA THE AGR COMMAND

C-2) FROM A COMMAND LINE

ASSUMING THAT AG IS THE NAME OF AN AGGREGATE FILE AND THAT
BD REPRESENTS A BINARY DATA FILE, THEN:

LIST BD " LISTS THE SINGLE DATA FILE BD AND

LIST AG:BD " LISTS AG'S COMPONENT FILE BD

IN THE LATTER CASE THE COLON NOTATION SHOULD BE NOTED.
IT IS STANDARD FOR ALL THE FILE MANIPULATING COMMANDS.

C-3) FROM A SYSTEM DESCRIPTION

IF A SYSTEM FILE CONTAINS AN AGGREGATE DECLARATION, THEN IT
IS VERY IMPORTANT THAT THE REFERENCED AGGREGATE FILE IS SO
STRUCTURED, THAT ITS COMPONENT FILES APPEAR IN THE SAME ORDER
AS THEY ARE SPECIFIED IN THE SYSTEM DESCRIPTION.
THE NUMBER OF DATA FILES REFERENCED FROM THE SYSTEM DESCRIPTION
AND THE NUMBER OF COMPONENT FILES WITHIN THE AGGREGATE FILE
MUST AGREE.

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2) DETAILED DESCRIPTIONS OF THE VARIOUS MOPAC COMMANDS IN ALPHABETIC ORDER

AGR

CREATES AND UPDATES AN AGGREGATE FILE

THE MAIN COMMAND SPECIFIES OPERATION, I.E. UPDATE OR CREATION
COMPONENT FILES ARE MANIPULATED IN MUCH THE SAME WAY
AS A LINE ORIENTED TEXT EDITOR OPERATES ON TEXT LINES, I.E.
THE MAY BE INSERTED, ELIMINATED, ETC.

COMMAND:
AGR AGROUT

OR

AGR [AGROUT <] AGRIN

AGROUT - NAME OF RESULTING AGGREGATE FILE
BY DEFAULT AGROUT = AGRIN
AGRIN - NAME OF ORIGINAL AGGREGATE FILE

NOTE: IF THE ASSIGNMENT OPERATOR < IS OMITTED,
THEN AGROUT WILL BE CREATED FROM SCRATCH,
I.E. THE PREVIOUS ISSUE OF AGROUT, IF ANY, WILL BE DISCARDED

SUB-COMMANDS:

THE SUB-COMMANDS IMPLICITLY USE A POINTER TO THE
CURRENT COMPONENT FILE

LOOK [NAME]
DISPLAY THE TABLE OF CONTENTS OF AGROUT
IF NAME IS PRESENT, THEN ONLY THE ENTRIES NAMED NAME,
IF ANY, WILL BE DISPLAYED, THE POINTER IS NOT AFFECTED
FOR EACH ENTRY ONE MAY SEE IF IT IS FLAGGED FOR
INSERTION, DELETION AND/OR ISOLATION

KILL
LEAVE SUB-COMMAND MODE, CURRENT AGR-COMMAND
INCLUDING SUB-COMMANDS WILL HAVE NO EFFECT

X
LEAVE SUB-COMMAND MODE, CURRENT AGR-COMMAND
INCLUDING SUB-COMMANDS WILL TAKE EFFECT

LOC NAME
MAKE THE POINTER POINT AT THE COMPONENT FILE NAME
THE SCAN TAKES PLACE BETWEEN THE CURRENT POINTER
LOCATION PLUS ONE AND THE LAST ENTRY, AT WHICH PLACE
THE POINTER REMAINS IN CASE OF NO SUCCESS

INS NAME
INSERT THE INDIVIDUAL FILE NAME AFTER THE CURRENT
POINTER LOCATION, THEN AUTO-INCREMENT THE POINTER

REP [NAME]
REPLACE THE COMPONENT FILE AT THE CURRENT POINTER
LOCATION BY THE INDIVIDUAL FILE NAME,
THE POINTER IS NOT AFFECTED
BY DEFAULT NAME EQUALS THE NAME OF
THE COMPONENT FILE AT THE CURRENT POINTER LOCATION

DEL

DELETE THE COMPONENT FILE AT THE CURRENT POINTER LOCATION, THEN AUTO-DECREMENT THE POINTER

ISO

SHORT FOR ISOLATE, I.E. COPY THE COMPONENT FILE AT THE CURRENT POINTER LOCATION TO AN INDIVIDUAL FILE WITH THE SAME NAME, THE POINTER IS NOT AFFECTED

TOP

MAKE THE POINTER POINT ABOVE THE FIRST COMPONENT FILE

BOT

MAKE THE POINTER POINT AT THE LAST COMPONENT FILE

REM

REMOVE THE REP, DEL AND ISO FLAGS FROM THE CURRENT POINTER LOCATION, THE POINTER IS NOT AFFECTED

ADV [NR]

ADVANCE THE POINTER NR STEPS, BY DEFAULT NR = 1, IN CASE OF NO SUCCESS, THE POINTER WILL REMAIN AT THE LAST ENTRY IF NR.GT.0 AND AT LOCATION 0 IF NR.LT.0

NOTE: THE SUB-COMMANDS DO NOT FORCE ANY I/O TO TAKE PLACE (EXCEPT FOR FILE EXISTENCE TESTS) UNTIL X IS TYPED
THE APPROPRIATE ENTRIES IN AGROUT'S TABLE OF CONTENTS, HOWEVER ARE FLAGGED FOR THE CORRESPONDING OPERATIONS
FOR THIS REASON THE CHRONOLOGICAL ORDER BETWEEN SEVERAL OPERATIONS IS UNESSENTIAL,
E.G. THE SEQUENCES:

>ISO	AND	>DEL	, RESPECTIVELY, ARE EQUIVALENT
>DEL		>ADV	
		>ISO	

IN BOTH CASES THE COMPONENT FILE AT THE CURRENT POINTER LOCATION WILL FIRST BE COPIED INTO AN INDIVIDUAL FILE WITH THE SAME NAME AND THEN BE ELIMINATED FROM AGROUT

15.

ALTER

ENABLES THE OPERATOR TO ALTER MATRIX ELEMENTS

COMMAND:
ALTER [AGGREG:] MATRIX [(IR IC) VALUE]
AGGREG - AGGREGEATE FILE NAME
MATRIX - MATRIX NAME
IR - FIRST INDEX
IC - SECOND INDEX
VALUE - NEW VALUE

SUBCOMMANDS:
KILL - RESUMES MAIN COMMAND MODE, MATRIX IS NOT UPDATED
X - RESUMES MAIN COMMAND MODE, MATRIX IS UPDATED

IF THE MATRIX NAME IS THE ONLY ARGUMENT THE INDICES
AND THE NEW VALUE ARE ENTERED AS A SUBCOMMAND:
IR IC VALUE
THUS TO ALTER SEVERAL ELEMENTS IN A MATRIX THE MATRIX
NAME NEED BE ENTERED ONLY ONCE.

BODE

PLOTS AMPLITUDE AND PHASE VERSUS ANGULAR FREQUENCY
IN A LOGARITHMIC DIAGRAM ON DISPLAY

COMMAND:
BODE [('ONE'/'TWO')] FRF1[(F11 F12..)] [FRF[(F21..)]..

'ONE'/'TWO' - SWITCH INDICATING THAT AMPLITUDE AND PHASE
WILL BE PLOTTED IN SEPARATE DIAGRAMS ('ONE')
OR TOGETHER IN ONE DIAGRAM ('TWO')
DEFAULT VALUE IS 'TWO'

FRF.. - FREQUENCY RESPONSE FILE NAME(S)
F11.. - FREQUENCY RESPONSE NUMBER(S)(DEFAULT ALL)

SUBCOMMANDS:

PAGE - REQUEST NEXT PLOT PAGE (RELEVANT ONLY IF
AMPLITUDE AND PHASE ARE PLOTTED SEPARATELY)

KILL - SKIPS THE PHASE PLOT (RELEVANT ONLY IF AMPLITUDE
AND PHASE ARE TO BE PLOTTED SEPARATELY)

NOTE: FREQUENCIES ARE IN THE FIRST COLUMN OF THE FREQUENCY
RESPONSE FILE WHILE THE AMPLITUDE IS IN THE SECOND AND THE
PHASE IN THE THIRD . MAX 500 FREQUENCIES ARE PLOTTED.
ZERO OR NEGATIVE VALUES OF THE AMPLITUDE ARE REPLACED
BY THE SMALLEST POSITIVE VALUE.
ONLY 5 DECADES MAY BE PLOTTED. THUS IF THE SPECTRUM
SPANS OVER MORE THAN 5 DECADES ALL VALUES SMALLER
THAN YMAX*E-5, WHERE YMAX IS THE LARGEST VALUE OF THE
SPECTRUM, ARE REPLACED BY YMAX*E-5.
THE PHASE IS PLOTTED ALONG A LINEAR AXIS IN DEGREES.
MAX 50 FREQUENCY RESPONSES MAY BE PLOTTED.

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CONT

COMPUTES THE SYSTEM MATRICES FOR A CONTINUOUS
VERSION OF A DISCRETE LINEAR DYNAMIC SYSTEM

COMMAND:
CONT [SYSOUT][(NAMOUT)] < SYSIN[(NAMIN)] [EPS]
SYSOUT - NAME OF SYSTEM FILE FOR OUTPUT SYSTEM
BY DEFAULT SYSOUT = SYSIN
NAMOUT - NAME OF SECTION WITHIN SYSOUT
SYSIN - NAME OF SYSTEM FILE FOR INPUT SYSTEM
NAMIN - NAME OF SECTION WITHIN SYSIN
EPS - TEST QUANTITY
BY DEFAULT EPS = THE RESERVED VARIABLE REPS.

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DELET

DELETS FILES FROM DISK

COMMAND:
DELET FNAM1[(DLODE1)] [FNAM2[(DMODE2)] ...]
FNAM - FILE NAME
DMODE - DATA MODE INDICATOR = 'D'/'T'/'A'
D - FNAM IS ASSUMED TO CONTAIN BINARY DATA
T - FNAM IS ASSUMED TO CONTAIN TEXT
A - FNAM IS ASSUMED TO BE AN AGGREGATE FILE
(BY DEFAULT DMODE = 'D')

19.

EDIT

SYMBOLIC TEXT EDITOR

COMMAND:
EDIT FNAME
FNAME - NAME OF SYMBOLIC TEXT FILE

EDIT WORKS IN TWO MODES: INPUT AND EDIT MODE,
MODE SWITCHING IS ACCOMPLISHED BY MEANS OF AN EMPTY LINE

INPUT - EACH LINE FROM THE KEYBOARD WILL BE ADDED TO FNAME
EDIT - EACH LINE FROM THE KEYBOARD WILL BE INTERPRETED AS A
SUBCOMMAND TO EDIT

SUBCOMMANDS:
T - GOTO TOP OF FNAME
B - GOTO BOTTOM OF FNAME
N [M] - GO M (DEFAULT 1) LINES BELOW
P [M] - PRINT THE M (DEFAULT 1) LINES ON THE TERMINAL
L STR - LOCATE THE STRING 'STR'
F STR - FIND A LINE BEGINNIG WITH THE STRING 'STR'
C /STR1/STR2/
CHANGE THE STRING 'STR1' TO 'STR2'
A STR - APPEND THE STRING 'STR' TO THE CURRENT LINE
R STR - REPLACE THE CURRENT LINE BY THE STRING 'STR'
I STR - INSERT THE LINE 'STR' AFTER THE CURRENT LINE
D [M] - DELETE M (DEFAULT 1) LINES INCLUDING THE CURRENT
O [M] - DELETE M (DEFAULT 1) LINES INCLUDING THE CURRENT,
THEN SWITCH TO INPUT MODE
DIS 'ON'/'OFF'
ENABLE/DISABLE OUTPUT ON THE DISPLAY
E - EXIT FROM THE EDITOR

NOTE: INITIALLY DIS IS 'OFF' AND THE MODE IS 'EDIT'
IF FNAME IS NOT FOUND, THE MODE WILL BE 'INPUT'

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```
ENTER
      CREATES A MATRIX FILE

      COMMAND:
      ENTER [(DEV)] [AG:]MAT NR [NC] [TSAMP]

      DEV      - INPUT DEVICE = 'MAC'/'NRM' FOR MACRO AND KEYBOARD
                 INPUT RESPECTIVELY (DEFAULT='NRM')
      AG       - NAME OF AGGREGATE FILE
      MAT      - NAME OF MATRIX FILE
      NR       - NUMBER OF ROWS
      NC       - NUMBER OF COLUMNS (DEFAULT NR)
      TSAMP    - SAMPLE INTERVAL (DEFAULT 0. S)

      SUBCOMMANDS:
      KILL     - RESUME MAIN COMMAND MODE, MAT IS NOT UPDATED/GENERATED
      X        - RESUME MAIN COMMAND MODE, MAT IS UPDATED/GENERATED

2383>
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EXPAN

CREATES A NEW MATRIX FROM ANY NUMBER OF OLD MATRICES. IT MAY BE SPECIFIED WHERE IN THE NEW MATRIX THE UPPER LEFT CORNER OF THE OLD MATRICES SHALL BE PLACED.

COMMAND:

EXPAN [[AG1:]M1] < [AG2:]M2[(IX2 IY2)] [[AG3:]M3[(,,)],,]

AG - AGGREGATE FILE NAME

M - MATRIX FILE NAME

IXI,IYI - THE COORDINATES IN THE NEW MATRIX FOR THE UPPER LEFT CORNER OF MATRIX MI (BY DEFAULT IX=IY=1)

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FHEAD

DISPLAYS FILE HEAD AND ENABLES THE USER TO CHANGE ITS PARAMETERS

COMMAND:
FHEAD [AGGREG:] FILE
AGGREG - AGGREGATE FILE NAME
FILE - FILE NAME

SUBCOMMANDS:
INDEX VALUE
SET THE INDEX:TH PARAMETER TO VALUE

NOTE: THE 7:TH PARAMETER IS READ-ONLY AND ATTEMPTS TO ALTER PARAMETERS 1, 2, 3 OR 10 WILL YIELD A WARNING ON THE TERMINAL, SINCE THEY AFFECT FILE DIMENSIONS

LOOK - LOOK AT THE FILE HEAD PARAMETERS ON THE DISPLAY
KILL - EXIT FROM FHEAD WITHOUT UPDATING THE FILE HEAD
X - EXIT FROM FHEAD AND UPDATE THE FILE HEAD

23.

GETFIL AND SAVFIL
DECODES & EXECUTES THE COMMANDS:

<OPER> <PROGFILE> <FILE SPEC.> [<FILE SPEC.>]*
<OPER>::= GETFIL / SAVFIL
<FILE SPEC.>::= <FILE> [-<EXT>]
<EXT>::= D / A

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HCOPY

COMMAND SYNTAX:

HCOPY [<SWITCH>/<FACTOR>]
<SWITCH>:= ON/OFF

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KALD

DECOMPOSES A GIVEN SYSTEM INTO SUBSYSTEMS ACCORDING TO CONTROLLABILITY AND OBSERVABILITY. THE RESULT OF THE DECOMPOSITION MAY BE VIEWED SCHEMATICALLY ON THE DISPLAY, AND ON THE LINE PRINTER IF THE RESERVED VARIABLE PRINT.=1
THE USER MAY SAVE PARTS OF INTEREST BY MEANS OF SUBCOMMANDS

COMMAND:
KALD SNAME[(NAME)] [AEPS REPS]
SNAME - NAME OF SYSTEM DESCRIPTION FILE FOR ORIGINAL SYSTEM
NAME - NAME OF SECTION WITHIN SNAME
AEPS - ABSOLUTE TEST QUANTITY, BY DEFAULT
AEPS = THE RESERVED VARIABLE AEPS.
REPS - RELATIVE TEST QUANTITY, BY DEFAULT
REPS = THE RESERVED VARIABLE REPS.

SUBCOMMANDS:
SAVE RNAME[(NAME)] < RESLT [ATTR1 [ATTR2]]

RNAME - NAME OF OUTPUT SYSTEM/MATRIX
NAME - NAME OF SECTION WITHIN RNAME (VALID ONLY IF RNAME REPRESENTS A SYSTEM)

RESLT - MNEMONIC FOR DATA SET TO BE SAVED
RESLT='SYS''AMAT''BMAT''CMAT''TMAT'
SYS - SAVE SYSTEM
AMAT - SAVE A-MATRIX
BMAT - SAVE B-MATRIX
CMAT - SAVE C-MATRIX
TMAT - SAVE TRANSFORMATION-MATRIX

ATTR1 - DATA ATTRIBUTE, INVALID IN CONNECTION WITH 'TMAT'
ATTR1='TOT''C''NC''O''NO'/1/2/3/4
TOT - SAVE THE TOTAL DATA SET
C - SAVE THE CONTROLLABLE MODES
NC - SAVE THE NON-CONTROLLABLE MODES
O - SAVE THE OBSERVABLE MODES
NO - SAVE THE NON-OBSERVABLE MODES
1/2/3/4 - SAVE THE COUPLINGS BETWEEN THE VARIOUS SUBSYSTEM (VALID TOGETHER WITH AMAT ONLY)

ATTR2 - DATA ATTRIBUTE, INVALID WITH RESLT='TMAT' AND ATTR1='TOT', BUT COMPULSORY IF ATTR1 = 1/2/3/4
ATTR2='C''NC''O''NO'/1/2/3/4
NOTE: THE ATTRIBUTES 'C''NC' MAY ONLY BE COMBINED WITH 'O''NO'

LOOK[(DEV)]
- SHOW THE DECOMPOSITION SCHEMATICALLY ON THE DISPLAY

DEV - DEVICE = 'DIS''LP''TP' (BY DEFAULT DEV = 'DIS')

X
- END THE SUBCOMMAND-SEQUENCE

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LIST

LISTS ON DISPLAY, LINE PRINTER OR TELETYPE THE CONTENTS OF (A PART OF) A DATA FILE, A MACRO FILE OR A SYSTEM FILE FOR A DATA FILE THE COLUMNS AND THE FIRST RECORD AND NUMBER OF RECORDS MAY BE SPECIFIED, FOR A SYSTEM FILE SECTIONS OF INTERESTS MAY BE SPECIFIED

COMMAND:
LIST [(DEV)] [(DMODE)] [AGGREG:] FNAME [(A1 A2 ...)] [IF NUM]

DEV - DEVICE = 'DIS'/'LP'/'TP'
- DIS - DISPLAY
- LP - LINE PRINTER
- TP - TELEPRINTER
- (BY DEFAULT DEV = 'DIS')

DMODE - DATA MODE INDICATOR = 'D'/'T'
- D - FNAME IS ASSUMED TO CONTAIN BINARY DATA
- T - FNAME IS ASSUMED TO CONTAIN TEXT
- (BY DEFAULT DMODE = 'D')

AGGREG - AGGREGATE FILE, INVALID IN CONNECTION WITH DMODE = 'T'

FNAME - NAME OF FILE TO BE LISTED

A.. - ATTRIBUTES ASOCIATED WITH FNAME, IF DMODE='D', THEN A.. DENOTES COLUMN NUMBERS, OTHERWISE NAMES OF SECTIONS WITHIN FNAME

IF - NUMBER OF 1ST RECORD TO BE LISTED
- (VALID ONLY IN CONNECTION WITH DMODE='D')

NUM - NUMBER OF RECORDS TO BE OUTPUT
- (VALID ONLY IN CONNECTION WITH DMODE='D')

27

LUEN1

THE LUENBERGER OBSERVER COMMANDS ARE STRUCTURED IN THREE STEPS, LUEN1, A POLE ASSIGNMENT COMMAND AND LUEN2.

IN LUEN1 A SYSTEM TRANSFORMATION IS PERFORMED IN ORDER TO:
1.CHECK IF ALL MEASUREMENTS ARE INDEPENDENT , I.E. TEST THE RANK(C)
2.REARRANGE THE ROWS OF C TO GET THE FORM C=(0 I)
THE TRANSFORMATION MATRIX T IS CALCULATED

IN NEXT STAGE A MATRIX K IS CALCULATED IN ORDER TO ACHIEVE DESIRED POLES OF THE SYSTEM A11-K*A21

IN LUEN2 T AND K ARE GIVEN AND THE OBSERVER MATRICES ARE CALCULATED

COMMAND:
LUEN1 T SYST1 < SYST2[(NAME2)] [EPS]

T — NAME OF TRANSFORMATION MATRIX
SYST1 — SYSTEM DESCRIPTION FILE NAME FOR THE NEW (REDUCED) SYSTEM
SYST2 — SYSTEM DESCRIPTION FILE NAME FOR THE ORIGINAL SYSTEM
NAME2 — SECTION NAME OF THE ORIGINAL SYSTEM, SYST2
EPS — TEST QUANTITY
BY DEFAULT EPS = THE RESERVED VARIABLE REPS.

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LUEN2

THE LUENBERGER OBSERVER COMMANDS ARE STRUCTURED IN THREE STEPS, LUEN1, A POLE ASSIGNMENT COMMAND AND LUEN2

IN LUEN1 A SYSTEM TRANSFORMATION IS PERFORMED IN ORDER TO :
1.CHECK IF ALL MEASUREMENTS ARE INDEPENDENT, I.E. TEST THE
  RANK(C)
2.REARRANGE THE ROWS OF C TO GET THE FORM C=(0 I)
THE TRANSFORMATION MATRIX T IS CALCULATED

IN NEXT STAGE A MATRIX K IS CALCULATED IN ORDER TO ACHIEVE
DESIRED POLES OF THE SYSTEM A11-K*A21

IN LUEN2 T AND K ARE GIVEN AND THE OBSERVER MATRICES ARE
CALCULATED

COMMAND:
LUEN2 SYST1 < SYST2[(NAME2)] T K [EPS]

SYST1 - SYSTEM DESCRIPTION FILE NAME FOR THE LUENBERGER OBSERVER
        (OF REDUCED ORDER)
SYST2 - SYSTEM DESCRIPTION FILE NAME FOR THE ORIGINAL SYSTEM
        (OF FULL ORDER)
NAME2 - SECTION NAME OF THE ORIGINAL SYSTEM, SYST2
T   - NAME OF TRANSFORMATION MATRIX (FULL ORDER), GIVEN FROM LUEN1
K   - NAME OF GAIN MATRIX (REDUCED ORDER), GIVEN FROM POLE PLACEMENT
EPS   - TEST QUANTITY FOR MATRIX INVERSION
        BY DEFAULT EPS = THE RESERVED VARIABLE REPS.

29

MATOP

EVALUATES MATRIX EXPRESSIONS

COMMAND:
MATOP [(EXT)] [[AGGREG:]MATRIX] < ALGEBRAIC MATRIX EXPRESSION
EXT - THOSE OF THE GLOBAL VARIABLES DET.EXT, MINMAX.EXT AND TRACE.EXT THAT ARE PREVIOUSLY DEFINED AS REAL VARIABLES WILL RETURN THE DETERMINANT, THE MIN-MAX NORM AND THE TRACE OF THE RESULTING MATRIX, RESPECTIVELY, PROVIDED THAT EXT IS PRESENT IN THE COMMAND LINE
AGGREG - AGGREGATE FILE NAME
MATRIX - NAME OF RESULTING MATRIX FILE (BY DEFAULT MATRIX = THE 1ST MATRIX NAME IN THE ALGEBRAIC EXPRESSION)

LEGAL OPERATIONS ARE:
ADDITION, SUBTRACTION, MULTIPLICATION,
TRANSPOSITION, PSEUDOINVERSION AND
EXPONENTIATION
THE EXPONENT MUST BE A SINGLE INTEGER, AND
A NEGATIVE VALUE WILL ADDITIONALLY YIELD
INVERSION. THE EXPRESSION MAY CONTAIN NESTED
PARENTHESES
- : SUBTRACTION
+ : ADDITION
* : MULTIPLICATION BETWEEN MATRICES OR
A SCALAR AND A MATRIX
TR : TRANSPOSITION
PSINV : PSEUDOINVERSION
^ EXP : EXPONENTIATION FOLLOWED BY INVERSION
IF EXP .LT. 0

NOTE: INVERSION AND PSEUDO-INVERSION ARE GOVERNED BY THE GLOBAL TEST QUANTITIES REPS. AND PSEPS. , RESPECTIVELY

MOVE

TRANSFERS A DATA FILE, A PARAMETER FILE, A MACRO FILE OR SPECIFIED COLUMNS IN A DATA FILE FROM ONE KIND OF MASS STORAGE TO ANOTHER. CAN ALSO BE USED TO REARRANGE THE COLUMNS OF A DATA FILE

COMMAND:
MOVE OUTP [(DMODE)] [[AGOUT:] FILOUT [(C11,,)]] [OPT] <
INP [AGIN:] FILIN [(C21,,)]

OUTP — OUTPUT DEVICE = 'DK'/'DT'/'PP'
(DISK, DEC-TAPE AND PAPER TAPE PUNCH, RESPECTIVELY)
DMODE — DATA MODE = 'D'/'T' (DEFAULT: DMODE='D')
D — THE FILE IS ASSUMED TO CONTAIN BINARY DATA
T — THE FILE IS ASSUMED TO CONTAIN FREE TEXT
(E.G. A MACRO)
AGOUT — OUTPUT AGGREGATE FILE, INVALID IF DMODE = 'T'
FILOUT — OUTPUT FILE NAME [WITH COLUMN NUMBERS]
OPT — DELETE OPTION = 'DE'/'ND' (DEFAULT: OPT='DE')
DE: DELETE THE COLUMNS C11,,
ND: DO NOT DELETE C11,,, BUT MOVE THEM RIGHTWARDS
INP — INPUT DEVICE = 'DK'/'DT'/'PR'
(DISK, DEC-TAPE AND PAPER TAPE, RESPECTIVELY)
AGIN — INPUT AGGREGATE FILE, INVALID IF DMODE = 'T'
FILIN — INPUT FILE NAME [WITH COLUMN NUMBERS]

NOTE: DT MEANS DT2, OPT IS RELEVANT ONLY IF OUTP='DK'

MAXIMUM NUMBER OF INPUT COLUMNS IS 21 AND MAXIMUM NUMBER OF OUTPUT COLUMNS IS RESTRICTED TO 6 FOR PAPERTAPE

AGGREGATE FILE REFERENCES ARE ILLEGAL WITH OPT = 'ND' OR WITH OUTPUT COLUMN NUMBERS EXPLICITLY SPECIFIED
INPUT AND OUTPUT MAY NOT REFERENCE THE SAME AGGREGATE FILE

NIC

PLOTS NICHOLS CURVES ON DISPLAY

COMMAND:
NIC [WMIN WMAX] FRF[(F11 ,,)] [FRF ,,,]

WMIN,WMAX - FREQUENCY LIMITS ,DEFAULT: ALL FREQUENCIES PLOTTED
FRF,, - FREQUENCY RESPONSE FILENAME(S)
F11,, - FREQUENCY RESPONSE NUMBER(S) , DEFAULT: ALL

NOTE: MAX 5 CURVES MAY BE DISPLAYED

NYQ

PLOTS NYQUIST CURVES ON DISPLAY

COMMAND:
NYQ [WMIN WMAX] FRF[(F11 ,,)] [FRF ,,,]

WMIN,WMAX - FREQUENCY LIMITS ,DEFAULT: ALL FREQUENCIES PLOTTED
FRF,, - FREQUENCY RESPONSE FILENAME(S)
F11,, - FREQUENCY RESPONSE NUMBER(S) , DEFAULT: ALL

NOTE: MAX 5 CURVES MAY BE DISPLAYED

POCONV

CONVERTS MISO TRANSFER FUNCTION MODELS FROM POLYNOMIAL IMAGE FORM TO POLYNOMIAL FILE FORM AND VICE VERSA

COMMAND:

POCONV [SYSOUT][(NAMOUT)] < SYSIN[(NAMIN)]

CONVERTS A WHOLE SYSTEM DESCRIPTION

SYSOUT - NAME OF OUTPUT SYSTEM FILE, BY DEFAULT SYSOUT = SYSIN
NAMOUT - NAME OF SECTION WITHIN SYSOUT
SYSIN - NAME OF INPUT SYSTEM FILE
NAMIN - NAME OF SECTION WITHIN SYSIN

OR:

POCONV POFILE < SYSIN[(NAMIN)] POTYPE [NR]

CONVERTS POLYNOMIAL IMAGE(S) OF A GIVEN TYPE TO A POLYNOMIAL FILE

POFILE - RESULTING POLYNOMIAL FILE
SYSIN - SEE ABOVE
NAMIN - SEE ABOVE
POTYPE - TYPE OF INPUT POLYNOMIAL IMAGE
= 'A''B''C''D''I', 'I' BEING SHORT FOR 'INITIAL'
NR - POLYNOMIAL NUMBER, IF OMITTED, THEN ALL THE POLYNOMIAL IMAGES OF TYPE POTYPE WILL BE CONVERTED

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POLY

CREATES AND UPDATES A SCALAR OR MATRIX POYNOMIAL FILE

COMMAND:
POLY [[AGOUT:]POLOUT] [<] [[AGIN:]POLIN] [NR NC] [TSAMP]

AGOUT - NAME OF OUTPUT AGGREGATE FILE
POLOUT - NAME OF OUTPUT POLYNOMIAL FILE
AGIN - NAME OF INPUT AGGREGATE FILE
POLIN - NAME OF INPUT POLYNOMIAL FILE
NR - NUMBER OF ROWS IN A COEFFICIENT MATRIX (DEFAULT: 1)
NC - NUMBER OF COLUMNS IN A COEFFICIENT MATRIX (DEFAULT: 1)
TSAMP - SAMPLE INTERVAL
BY DEFAULT TSAMP = THE RESERVED VARIABLE DELTA.

NOTE: IF THE ASSIGNMENT SYMBOL < IS OMITTED, THEN A NEW
POLYNOMIAL WILL BE CREATED FROM SCRATCH
THE ARGUMENTS NR, NC AND TSAMP ARE VALID ONLY
WHEN A NEW POLYNOMIAL IS CREATED

SUB-COMMANDS TO POLY:

NOTE: SOME OF THE SUB-COMMANDS OPERATE IMPLICITLY ON
THE COEFFICIENT DEGREE NUMBER, WHICH INITIALLY POINTS
AT THE LOWEST ORDER COEFFICIENT, AND THEREAFTER
POINTS AT THE COEFFICIENT THAT WAS LAST PROCESSED
THE VALUE OF THE POINTER MAY BE EXPLICITLY ASSIGNED
IN THE CORRESPONDING COMMAND STRINGS

THE POINTER SHOULD BE EXPRESSED AS THE ABSOLUTE VALUE OF THE
EXPONENT FOR THE CORRESPONDING COEFFICIENT MATRIX
IN THE POLYNOMIAL

LOOK [DEG]
DISPLAY THE COEFFICIENT OF DEGREE DEG
DEG IS NOT AFFECTED

KILL
LEAVE SUB-COMMAND MODE, CURRENT POLY-COMMAND
INCLUDING SUB-COMMANDS WILL HAVE NO EFFECT

X
LEAVE SUB-COMMAND MODE, CURRENT POLY-COMMAND
INCLUDING SUB-COMMANDS WILL TAKE EFFECT

INS [DEG]
INSERT A COEFFICIENT MATRIX OF DEGREE DEG + 1
DEG IS AUTO-INCREMENTED
THE CONTENTS OF THE COEFFICIENT MATRIX IS
SPECIFIED BY MEANS OF SUB-COMMANDS, SEE BELOW

FOR A SCALAR POLYNOMIAL A SHORT FORM EXISTS:

INS [DEG] < VALUE
IN THIS CASE SUB-COMMANDS ARE NOT EXPECTED,
SINCE THE COEFFICIENT THEN IS ASSIGNED VALUE

ALT VALUE [DEG] [NR NC]
ALTER THE (NR,NC):TH VALUE OF
OF THE COEFFICIENT MATRIX OF DEGREE DEG
TO VALUE, BY DEFAULT (NR,NC) = (1,1)
DEG IS NOT AFFECTED

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```
ADDZ VRE [VIM]
          ADD THE ZEROES VRE +- I*VIM TO A SCALAR POLYNOMIAL,
          OR, IN OTHER WORDS, INTRODUCE THE FACTOR:
          ( Z - ( VRE + I*VIM ) ) * ( Z - ( VRE - I*VIM ) )
          OR, IN THE ABSENCE OF VIM, MERELY: ( Z - VRE ) ,
          WHERE Z DENOTES THE INDEPENT VARIABLE

MULC V
          MULTIPLY THE ENTIRE POLYNOMIAL BY THE CONSTANT V

DIVC V
          DIVIDE THE ENTIRE POLYNOMIAL BY THE CONSTANT V

DEL [DEG]
          DELETES THE COEFFICIENT MATRIX OF DEGREE DEG
          DEG IS AUTO-DECREMENTED

SUB-COMMANDS TO INS:

NR NC VALUE
          DEFINES THE VALUE OF THE (NR,NC):TH
          ELEMENT IN THE COEFFICIENT MATRIX OF DEGREE DEG

KILL
          DISCARDS INS AND LEAVES DEG UNAFFECTED

X
          INS TAKES EFFECT AND IF NO VALUES WERE INSERTED,
          THEN A ZERO COEFFICIENT MATRIX RESULTS

NOTE: WHEN CREATING A POLYNOMIAL FROM SCRATCH,
THEN DEG SHOULD BE EXPLICITLY SPECIFIED AS -1
IN THE FIRST INS COMMAND
```

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POLZ

COMPUTES THE ZEROES OF A POLYNOMIAL
WITH REAL, SCALAR COEFFICIENTS

COMMAND:
POLZ [(PLOT)] [[AGOUT:]ZERFIL <] SYSIN[(NAMIN)] POTYPE [NR] [EPS]

OR:
POLZ [(PLOT)] [[AGOUT:]ZERFIL <] [AGIN:]POLY [EPS]

PLOT - PLOT SWITCH = 'P'/'NP'
P - A PLOT OF THE ZEROES IS DESIRED
NP - NO PLOT IS DESIRED
(BY DEFAULT PLOT = 'P')
AGOUT - NAME OF OUTPUT AGGREGATE FILE
ZERFIL - LOCUS FILE RECEIVING THE ZEROES
SYSIN - NAME OF SYSTEM FILE
NAMIN - NAME OF SECTION WITHIN SYSIN OF THE
TYPE MISO TRANSFER FUNCTION
POTYPE - POLYNOMIAL TYPE = 'A'/'B'/'C'/'D'/'I'
NR - POLYNOMIAL NUMBER
BY DEFAULT NR = 1
EPS - RELATIVE TEST QUANTITY USED TO DISTINGUISH
NON-ZERO COEFFICIENTS, BY DEFAULT
EPS = THE RESERVED VARIABLE REPS.

AGIN - NAME OF INPUT AGGREGATE FILE
POLY - NAME OF POLYNOMIAL FILE

37.

PPLAC

POLE PLACEMENT USING STATE FEEDBACK IN A DYNAMICAL
SINGLE INPUT SYSTEM

COMMAND:
PPLAC L [[SYST1][(NAME1)]] < SYST2[(NAME2)] EVAL [EPS]

L — NAME OF FEED-BACK MATRIX SIZE 1*NX
SYST1 — SYSTEM DESCRIPTION FILE NAME FOR THE CLOSED LOOP SYSTEM
BY DEFAULT SYST1 = SYST2 IF NAME1 IS PRESENT
NAME1 — SECTION NAME OF THE NEW SYSTEM, SYST1
SYST2 — SYSTEM DESCRIPTION FILE NAME FOR THE ORIGINAL SYSTEM
(A,B,C,D)
NAME2 — SECTION NAME OF THE ORIGINAL SYSTEM, SYST2
EVAL — NAME OF LOCUS FILE CONTAINING DESIRED POLES
EPS — TEST QUANTITY
BY DEFAULT EPS = THE RESERVED VARIBLE REPS.

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RECON

RECONSTRUCTION OF THE STATE OF A DYNAMICAL SINGLE OUTPUT SYSTEM USING A KALMAN FILTER

COMMAND:
RECON K [SYST1] < SYST2[(NAME2)] EVAL [EPS]

K - NAME OF GAIN MATRIX SIZE NX*1
SYST1 - SYSTEM DESCRIPTION FILE NAME OF THE KALMAN FILTER
SYST2 - SYSTEM DESCRIPTION FILE NAME FOR THE ORIGINAL SYSTEM
NAME2 - SECTION NAME OF THE ORIGINAL SYSTEM, SYST2
EVAL - NAME OF LOCUS FILE CONTAINING DESIRED POLES
EPS - TEST QUANTITY
BY DEFAULT EPS=THE RESERVED VARIBLE REPS.

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REDUC

GENERATES A NEW MATRIX FROM A PART OF AN OLD ONE

COMMAND:

```
REDUC [[AG1:]M1] < [AG2:]M2 (IX1 IY1 IX2 IY2)
AG       - AGGREGATE FILE NAME
M        - MATRIX NAME
IX1,IX2  - INDICES FOR THE UPPER LEFT CORNER OF
           THE PART TO BE SAVED
IX2,IY2  - INDICES FOR THE LOWER RIGHT CORNER OF
           THE PART TO BE SAVED
```

SAMP

COMPUTES THE SYSTEM MATRICES FOR A SAMPLED VERSION OF A CONTINUOUS LINEAR DYNAMIC SYSTEM

COMMAND:
SAMP [SYSOUT][(NAMOUT)] < SYSIN[(NAMIN)]
SYSOUT - NAME OF SYSTEM FILE FOR OUTPUT SYSTEM
BY DEFAULT SYSOUT = SYSIN
NAMOUT - NAME OF SECTION WITHIN SYSOUT
SYSIN - NAME OF SYSTEM FILE FOR INPUT SYSTEM
NAMIN - NAME OF SECTION WITHIN SYSIN

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SAVFIL - SEE GETFIL

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SPSS

COMPUTES THE POWER SPECTRUM OR THE AMPLITUDE AND PHASE
FOR THE TRANSFER FUNCTION OF A SPECIFIED INPUT-OUTPUT
VARIABLE PAIR FOR A DISCRETE OR CONTINUOUS STATE-SPACE MODEL

COMMAND:
SPSS [('POW'/'AMP')] FRF[(F)]<-SYST[(NAME)] NY NU [FREQ]

'POW'/'AMP'	- SWITCH CHOOSING A POWER SPECTRUM OR AN AMPLITUDE AND PHASE COMPUTATION DEFAULT IS 'AMP'
FRF	- FREQUENCY RESPONSE FILE
F	- FREQUENCY RESPONSE NUMBER (DEFAULT VALUE 1)
SYST	- SYSTEM FILE NAME
NAME	- SECTION NAME OF SYSTEM FILE
NY	- OUTPUT (MEASUREMENT) SIGNAL NUMBER
NU	- INPUT (CONTROL) SIGNAL NUMBER
FREQ	- FILE WITH FREQUENCY VALUES IN THE FIRST COLUMN

43

```
SSTRF1
      TRANSFORMS A MISO STATE SPACE MODEL INTO A
      TRANSFER FUNCTION MODEL

      COMMAND:
      SSTRF1 [SYSOUT][(NAMOUT)] < SYSIN[(NAMIN)]
      SYSOUT  - NAME OF SYSTEM FILE FOR OUTPUT SYSTEM
                BY DEFAULT SYSOUT = SYSIN
      NAMOUT  - NAME OF SECTION WITHIN SYSOUT
      SYSIN   - NAME OF SYSTEM FILE FOR INPUT SYSTEM
      NAMIN   - NAME OF SECTION WITHIN SYSIN

      NOTE: SYSOUT IS REPRESENTED BY POLYNOMIAL FILES
      THE RESERVED VARIABLE REPS. IS USED AS A TEST QUANTITY
      TO VERIFY THAT SYSIN IS OBSERVABLE
```

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SYSTR

TRANSFORMS A DYNAMICAL SYSTEM IN STATE SPACE REPRESENTATION
WHEN COORDINATES ARE TRANSFORMED AS Z=T*X

ORIGINAL SYSTEM

$$\dot{X} = A*X + B*U$$
$$Y = C*X + D*U$$

THE TRANSFORMED SYSTEM

$$\dot{Z} = T*A*T^{-1}*Z + T*B*U$$
$$Y = C*T^{-1}*Z + D*U$$

WHERE Z=T*X

COMMAND:
SYSTR [SYST1][(NAME1)] < SYST2[(NAME2)] T [EPS]

SYST1 - SYSTEM DESCRIPTION FILE NAME FOR THE TRANSFORMED
SYSTEM
BY DEFAULT SYST1 = SYST2
NAME1 - SECTION NAME OF THE TRANSFORMED SYSTEM, SYST1
SYST2 - SYSTEM DESCRIPTION FILE NAME FOR THE ORIGINAL
SYSTEM
NAME2 - SECTION NAME OF THE ORIGINAL SYSTEM, SYST2
T - NAME OF TRANSFORMATION MATRIX
EPS - TEST QUANTITY FOR MATRIX INVERSION
BY DEFAULT EPS=THE RESERVED VARIBLE REPS.

TBALAN

TRANSFORMATION OF A DYNAMICAL SYSTEM IN STATE SPACE REPRESENTATION TO GET A BALANCED A-MATRIX

THE ORIGINAL SYSTEM

$$\dot{X} = A*X + B*U$$
$$Y = C*X + D*U$$

THE TRANSFORMED SYSTEM

$$\dot{Z} = T*A*T^{-1}*Z + T*B*U$$
$$Y = C*T^{-1}*Z + D*U$$

WHERE $Z=T*X$

COMMAND:
TBALAN T [[SYST1][(NAME1)]] < SYST2[(NAME2)] [EPS]

T - NAME OF TRANSFORMATION MATRIX
SYST1 - SYSTEM DESCRIPTION FILE NAME FOR THE TRANSFORMED SYSTEM
NAME1 - SECTION NAME OF THE NEW SYSTEM, SYST1
SYST2 - SYSTEM DESCRIPTION FILE NAME FOR THE ORIGINAL SYSTEM
NAME2 - SECTION NAME OF THE ORIGINAL SYSTEM, SYST2
EPS - TEST QUANTITY
BY DEFAULT EPS=THE RESERVED VARIBLE REPS.

-52F1>

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TCON

TRANSFORMATION TO REACHABLE CANONICAL FORM OF A DYNAMICAL SINGLE INPUT SYSTEM IN STATE SPACE REPRESENTATION

ORIGINAL SYSTEM

$$\dot{X} = A*X + B*U$$
$$Y = C*X + D*U$$

THE TRANSFORMED SYSTEM

$$\dot{Z} = T*A*T^{-1}*Z + T*B*U$$
$$Y = C*T^{-1}*Z + D*U$$

WHERE Z=T*X

COMMAND:

TCON T [[SYST1][(NAME1)]] < SYST2[(NAME2)] [EPS]

T - NAME OF TRANSFORMATION MATRIX
SYST1 - SYSTEM DESCRIPTION FILE NAME FOR THE TRANSFORMED SYSTEM
BY DEFAULT SYST1 = SYST2 IF NAME1 IS PRESENT
NAME1 - SECTION NAME OF THE TRANSFORMED SYSTEM, SYST1
SYST2 - SYSTEM DESCRIPTION FILE NAME FOR THE ORIGINAL SYSTEM
NAME2 - SECTION NAME OF THE ORIGINAL SYSTEM, SYST2
EPS - TEST QUANTITY
BY DEFAULT EPS = THE RESERVED VARIBLE REPS.

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TDIAG

TRANSFORMATION TO DIAGONAL FORM OF A DYNAMICAL SYSTEM IN STATE SPACE REPRESENTATION

THE ORIGINAL SYSTEM

$$\dot{X} = A*X + B*U$$
$$Y = C*X + D*U$$

THE TRANSFORMED SYSTEM

$$\dot{Z} = T*A*T^{-1}*Z + T*B*U$$
$$Y = C*T^{-1}*Z + D*U$$

WHERE $Z=T*X$

COMMAND:
TDIAG EIGVEC [[SYST1][(NAME1)]] < SYST2[(NAME2)] [EPS]

EIGVEC- NAME OF EIGENVECTOR MATRIX
(=NAME OF INVERTED TRANSFORMATION MATRIX)
SYST1 - SYSTEM DESCRIPTION FILE NAME FOR THE TRANSFORMED SYSTEM
BY DEFAULT SYST1 = SYST2 IF NAME1 IS PRESENT
NAME1 - SECTION NAME OF THE TRANSFORMED SYSTEM, SYST1
SYST2 - SYSTEM DESCRIPTION FILE NAME FOR THE ORIGINAL SYSTEM
NAME2 - SECTION NAME OF THE ORIGINAL SYSTEM, SYST2
EPS - TEST QUANTITY
BY DEFAULT EPS=THE RESERVED VARIABLE REPS.

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THESS

TRANSFORMATION TO HESSENBERG FORM OF A DYNAMICAL SYSTEM IN STATE SPACE REPRESENTATION

THE ORIGINAL SYSTEM

$$\dot{X} = A*X + B*U$$
$$Y = C*X + D*U$$

THE TRANSFORMED SYSTEM

$$\dot{Z} = T*A*T^{-1}*Z + T*B*U$$
$$Y = C*T^{-1}*Z + D*U$$

WHERE $Z=T*X$

COMMAND:
THESS T [[SYST1][(NAME1)]] < SYST2[(NAME2)] [EPS]

T — NAME OF TRANSFORMATION MATRIX
SYST1 — SYSTEM DESCRIPTION FILE NAME FOR THE TRANSFORMED SYSTEM
BY DEFAULT SYST1 = SYST2 IF NAME1 IS PRESENT
NAME1 — SECTION NAME OF THE TRANSFORMED SYSTEM, SYST1
SYST2 — SYSTEM DESCRIPTION FILE NAME FOR THE ORIGINAL SYSTEM
NAME2 — SECTION NAME OF THE ORIGINAL SYSTEM, SYST2
EPS — TEST QUANTITY
BY DEFAULT EPS=THE RESERVED VARIBLE REPS.

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TOBS

TRANSFORMATION TO OBSERVABLE CANONICAL FORM OF A DYNAMICAL SINGLE OUTPUT SYSTEM IN STATE SPACE REPRESENTATION

ORIGINAL SYSTEM

$$\dot{X} = A*X + B*U$$
$$Y = C*X + D*U$$

THE TRANSFORMED SYSTEM

$$\dot{Z} = T*A*T^{-1}*Z + T*B*U$$
$$Y = C*T^{-1}*Z + D*U$$

WHERE Z=T*X

COMMAND:
TOBS T [[SYST1][(NAME1)]] < SYST2[(NAME2)] [EPS]

T — NAME OF TRANSFORMATION MATRIX
SYST1 — SYSTEM DESCRIPTION FILE NAME FOR THE TRANSFORMED SYSTEM
BY DEFAULT SYST1 = SYST2 IF NAME1 IS PRESENT
NAME1 — SECTION NAME OF THE TRANSFORMED SYSTEM, SYST1
SYST2 — SYSTEM DESCRIPTION FILE NAME FOR THE ORIGINAL SYSTEM
NAME2 — SECTION NAME OF THE ORIGINAL SYSTEM, SYST2
EPS — TEST QUANTITY
BY DEFAULT EPS = THE RESERVED VARIBLE REPS.

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TRFSS1

TRANSFORMS A MISO TRANSFER FUNCTION MODEL INTO A
OBSERVABLE CANONICAL STATE SPACE MODEL

COMMAND:
TRFSS1 [SYSOUT][(NAMOUT)] < SYSIN[(NAMIN)]
SYSOUT - NAME OF SYSTEM FILE FOR OUTPUT SYSTEM
BY DEFAULT SYSOUT = SYSIN
NAMOUT - NAME OF SECTION WITHIN SYSOUT
SYSIN - NAME OF SYSTEM FILE FOR INPUT SYSTEM
NAMIN - NAME OF SECTION WITHIN SYSIN

NOTE: SYSIN IS REPRESENTED BY POLYNOMIAL FILES
THE RESERVED VARIABLE REPS. IS USED TO TEST THE MAGNITUDE
OF THE LEADING COEFFICIENT OF THE B-POLYNOMIALS

```
TURN
        MANIPULATES PROGRAM SWITCHES

        COMMAND:
        TURN SWITCH STATE
      SWITCH  - SWITCH NAME = 'DIS'/'TIME'
                  DIS    - ENABLES/DISABLES ALL OUTPUT ON THE DISPLAY
                           (DEFAULT: DIS IS ENABLED)
                  TIME   - IF DISABLED, DATA WILL BE PLOTTED VERSUS
                           SAMPLE NUMBER, ELSE VERSUS TIME UNITS
        STATE   - SWITCH STATE = 'ON'/'OFF', IF SWITCH='TIME',
                  'H'/'M'/'S' IS USED INSTEAD OF 'ON'
                  ON     - THE SWITCH IS ENABLED
                  H      - PLOTTING WILL BE VERSUS TIME IN HOURS
                  M      - PLOTTING WILL BE VERSUS TIME IN MINUTES
                  S      - PLOTTING WILL BE VERSUS TIME IN SECONDS
                  OFF    - THE SWITCH IS DISABLED
```

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UNITM AND ZEROM
GENERATES A ZERO OR UNIT MATRIX

COMMANDS:
UNITM [* FACTOR] [AG:]MAT NR [TSAMP]

ZEROM [AG:]MAT NR [NC] [TSAMP]

FACTOR - SCALE FACTOR (BY DEFAULT FACOR = 1.)
AG - NAME OF AGGREGATE FILE
MAT - NAME OF MATRIX FILE
NR - NUMBER OF ROWS
NC - NUMBER OF COLUMNS (DEFAULT NR)
TSAMP - SAMPLE INTERVAL (BY DEFAULT TSAMP = 0. S)

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ZEROM - SEE UNITM