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DECUS NO.	12-55
TITLE	FFAESIM
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SOURCE LANGUAGE	LAP6-DIAL

1. FFEAESIM

EAE-simulator for use with FFTD (DEC-12-FQEA)

2. ABSTRACT

This program enables PDP-12 users to run the Fast Fourier Transform program FFTD without the EAE-option. The time for transformation will be approx. 6.5 times longer than with the EAE-option, or 1024 values in 30 seconds.
It consists of a modified version of Digital-8-17-U, Extended Arithmetic Element Instruktion Set Simulator, and a patch for changing the EAE-instructions in the FFTD program.

3. STORAGE

Occupies following locations:

165 - 177
200 - 357
1600 - 1653

4. USAGE

Add the binary to the FFTD binary using DIAL-MS and the following commands:

```
ZERO
AB FFTD,U
AB FFEAESIM,U
SB NAME,U(,L)
```

Note 1. Do not change the order between FFTD and FFEAESIM.
Note 2. Specifying L mode retains the selfstarting feature.

5. RESTRICTIONS

None.

6. DESCRIPTION

The program simulates the following instructions:
MQL ; DVI ; MUY ; SHL ; ASR ; LSR ; MQA using software routines, a pseudo MQ-register and a pseudo stepcounter.

6. cont. As FFTD uses the LINC-instruction MUL, the actual MQ-register is read into the pseudo-MQ at the beginning of each routine. Likewise, the MQ is slaved to the pseudo-MQ at the end of each routine.

Furthermore, the datafield is changed to field Ø when necessary as the software routines uses indirect adressing.

For information regarding the software routines refer to Digital-8-17-U.

Brief summary of program operation:

a) The patch changes the EAE-instructions in FFTD to: JMS I 171 - 177, providing the entry to the different software routines.

b) These start with a (effectively) save AC instruction wich is followed by a JMS I GET instruction, transferring to

c) the MQDFGT routine wich reads MQ into pseudo-MQ and changes datafield to Ø.

d) Then the actual EAE instructions are performed. These terminates with a JMS I PUT instruction, transferring to

e) the DFMQPT routine wich transfers the pseudo-MQ to the MQ and restores the datafield.

f) Finally, a JMP I EXIT instruction returns operation to the FFTD program.

```
0000                    *20
0001                    /EAE-SIMULATOR FOR FFTL (DEC-12-F0EA)
0002                    /ADAPTED FROM DIGITAL-8-17-U
0003                    /INSTRUCTIONSET:
0004                    /MQL;   DVI;   MUY;   SHL;   ASR;
0005                    /LSR;   MQA;   NO MICROPROGRAMMING!
0006                    /USES FOLLOWING LOCATIONS:
0007                    /165-177
0010                    /200-357
0011                    /1600-1653
0012                    /MQ-REGISTER IS SLAVED TO PSEUDO-MQ
0013                    /FOR USE WITH LINC INSTRUCTION MUL
0014                    /H G HELGESON FOA 202
0015                    /5.7.1971
0016                            PMODE
0017                            *165
0020    0165    0000    SUDOMQ, 0               /PSEUDO-MQ
0021    0166    0000    SUDOSC, 0               /STEPCOUNTER
0022    0167    1614    GET,    DFMQGT
0023    0170    1640    PUT,    DFMQPT
0024    0171    1610            PSDMQL
0025    0172    0271            PSDDVI
0026    0173    0327            PSDMUY
0027    0174    0201            PSDSHL
0030    0175    0233            PSDASR
0031    0176    0224            PSDLSR
0032    0177    1600            PSDMQA
0033                            *200
0034    0200    0037            37
0035    0201    0000    PSDSHL, 0               /SHL
0036    0202    3224            DCA PSDLSR      /SAVE AC
0037    0203    4567            JMS I GET
0040    0204    1601            TAD I PSDSHL    /SHIFT COUNT
0041    0205    2201            ISZ PSDSHL      /EXIT POINT
0042    0206    0200            AND PSDSHL-1    /5 BIT COUNTER
0043    0207    7040            CMA
0044    0210    3166            DCA SUDOSC
0045    0211    1165            TAD SUDOMQ      /SHIFT COMBINED
0046    0212    7104            CLL RAL         /AC AND MQ
0047    0213    3165            DCA SUDOMQ      /1 BIT LEFT
0050    0214    1224            TAD PSDLSR
0051    0215    7004            RAL
0052    0216    3224            DCA PSDLSR
0053    0217    2166            ISZ SUDOSC
0054    0220    5211            JMP .-7         /MORE SHIFTING
0055    0221    4570            JMS I PUT
0056    0222    1224            TAD PSDLSR
0057    0223    5601            JMP I PSDSHL    /EXIT
0060    0224    0000    PSDLSR, 0               /LSR
0061    0225    3201            DCA PSDSHL      /SAVE AC
0062    0226    4567            JMS I GET
0063    0227    1224            TAD PSDLSR
0064    0230    3233            DCA PSDASR      /USE ASR
0065    0231    7100            CLL             /ROUTINE
0066    0232    5241            JMP PSDASR+6
```

```
0067    0233  0000  PSDASR, 0               /ASR
0070    0234  7100          CLL             /SET LINK=SIGN
0071    0235  7510          SPA
0072    0236  7020          CML
0073    0237  3201          DCA PSDSHL      /SAVE AC
0074    0240  4567          JMS I GET
0075    0241  1633          TAD I PSDASR    /SHIFT COUNT
0076    0242  2233          ISZ PSDASR      /EXIT POINT
0077    0243  0200          AND PSDSHL-1    /5 BIT COUNTER
0100    0244  7040          CMA
0101    0245  3166          DCA SUDOSC
0102    0246  1201          TAD PSDSHL      /RESTORE AC
0103    0247  5253          JMP .+4
0104    0250  1201          TAD PSDSHL
0105    0251  7510          SPA
0106    0252  7020          CML
0107    0253  7010          RAR
0110    0254  3201          DCA PSDSHL
0111    0255  1165          TAD SUDOMQ
0112    0256  7010          RAR
0113    0257  3165          DCA SUDOMQ
0114    0260  7100          CLL
0115    0261  2166          ISZ SUDOSC
0116    0262  5250          JMP .-12        /MORE SHIFTING
0117    0263  4570          JMS I PUT
0120    0264  1201          TAD PSDSHL
0121    0265  7510          SPA
0122    0266  7020          CML             /LINK=AC0
0123    0267  5633          JMP I PSDASR
0124    0270  7763          7763
0125    0271  0000  PSDDVI, 0               /DVI
0126    0272  3201          DCA PSDSHL      /SAVE HI DIVID
0127    0273  4567          JMS I GET
0130    0274  1671          TAD I PSDDVI    /DIVISOR
0131    0275  2271          ISZ PSDDVI      /EXIT POINT
0132    0276  7141          CLL CMA IAC
0133    0277  3233          DCA PSDASR      /2:S COMP DIVIS
0134    0300  1201          TAD PSDSHL      /HI ORDER DIVID
0135    0301  1233          TAD PSDASR
0136    0302  7630          SZL CLA
0137    0303  5671          JMP I PSDDVI    /DIV OVERFLOW
0140    0304  1270          TAD PSDDVI-1
0141    0305  3224          DCA PSDLSR      /COUNTER
0142    0306  5317          JMP .+11
0143    0307  1201          TAD PSDSHL
0144    0310  7004          RAL
0145    0311  3201          DCA PSDSHL
0146    0312  1201          TAD PSDSHL
0147    0313  1233          TAD PSDASR
0150    0314  7430          SZL
0151    0315  3201          DCA PSDSHL
0152    0316  7200          CLA
0153    0317  1165          TAD SUDOMQ
0154    0320  7004          RAL
0155    0321  3165          DCA SUDOMQ
0156    0322  2224          ISZ PSDLSR
0157    0323  5307          JMP .-14
0160    0324  4570          JMS I PUT
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```
0161    0325  1201          TAD PSDSHL      /COUNT EXHAUSTED
0162    0326  5671          JMP I PSDDVI
0163    0327  0000  PSDMUY, 0               /MUY
0164    0330  7300          CLA CLL
0165    0331  4567          JMS I GET
0166    0332  3201          DCA PSDSHL      /CLEAR PRODUCT
0167    0333  1270          TAD PSDDVI-1
0170    0334  3224          DCA PSDLSR      /COUNTER
0171    0335  1727          TAD I PSDMUY
0172    0336  3233          DCA PSDASR      /OPERAND
0173    0337  2327          ISZ PSDMUY      /EXIT POINT
0174    0340  5350          JMP .+10
0175    0341  1201          TAD PSDSHL
0176    0342  7420          SNL
0177    0343  5346          JMP .+3
0200    0344  7100          CLL
0201    0345  1233          TAD PSDASR
0202    0346  7010          RAR
0203    0347  3201          DCA PSDSHL
0204    0350  1165          TAD SUDOMQ
0205    0351  7010          RAR
0206    0352  3165          DCA SUDOMQ      /LO ORDER PROD.
0207    0353  2224          ISZ PSDLSR
0210    0354  5341          JMP .-13
0211    0355  4570          JMS I PUT
0212    0356  1201          TAD PSDSHL      /HI ORDER PROD.
0213    0357  5727          JMP I PSDMUY
0214                        *1600
0215    1600  0000  PSDMQA, 0               /MQA
0216    1601  3210          DCA PSDMQL
0217    1602  4222          JMS MQGET
0220    1603  1210          TAD PSDMQL      /INCLUSIVE OR
0221    1604  7040          CMA
0222    1605  0165          AND SUDOMQ      /MQ AND
0223    1606  1210          TAD PSDMQL      /AC
0224    1607  5600          JMP I PSDMQA
0225    1610  0000  PSDMQL, 0               /MQL
0226    1611  3165          DCA SUDOMQ
0227    1612  4243          JMS MQPUT
0230    1613  5610          JMP I PSDMQL
0231    1614  0000  DFMQGT, 0               /GET DATA FIELD
0232    1615  1237          TAD C6201
0233    1616  6214          RDF
0234    1617  3241          DCA DFPUT       /STORE CDF N
0235    1620  6201          CDF 0           /CHANGE TO 0
0236    1621  5225          JMP .+4
0237    1622  0000  MQGET,  0               /GET MQ REG.
0240    1623  1222          TAD MQGET
0241    1624  3214          DCA DFMQGT
0242    1625  6141          LINC
0243                        LMODE
0244    1626  0005          QAC
0245    1627  0241          ROL 1
0246    1630  0475          QLZ I
0247    1631  7634          JMP .+3
0250    1632  1620          BSE I
0251    1633  0001          0001
0252    1634  0002          PDP
0253                        PMODE
```

```
0254    1635  3165          DCA SUDOMQ        /STORE IN SUDOMQ
0255    1636  5614          JMP I DFMQGT
0256    1637  6201  C6201,  6201              /CDF
0257    1640  0000  DFMQPT,  0                 /RESTORE DF
0260    1641  7402  DFPUT,   HLT               /HOLDS CDF N
0261    1642  5246          JMP .+4
0262    1643  0000  MQPUT,   0                 /SUDOMQ TO MQ
0263    1644  1243          TAD MQPUT
0264    1645  3240          DCA DFMQPT
0265    1646  1165          TAD SUDOMQ
0266    1647  6141          LINC
0267                        LMODE
0270    1650  0314          ROR 14
0271    1651  0002          PDP
0272                        PMODE
0273    1652  7200          CLA
0274    1653  5640          JMP I DFMQPT
0275                /PATCH FOR FFTD FOR USE WITH EAESIM
0276                /2.7.1971
0277                        PMODE
0300                        *561
0301    0561  4576          JMS I 176         /LSR
0302                        *1004
0303    1004  4571          JMS I 171         /MQL
0304                        *1017
0305    1017  4573          JMS I 173         /MUY
0306                        *1021
0307    1021  4574          JMS I 174         /SHL
0310                        *1025
0311    1025  4574          JMS I 174         /SHL
0312                        *1063
0313    1063  4571          JMS I 171         /MQL
0314                        *1074
0315    1074  4576          JMS I 176         /LSR
0316                        *1076
0317    1076  4574          JMS I 174         /SHL
0320                        *1111
0321    1111  4576          JMS I 176         /LSR
0322                        *1113
0323    1113  4574          JMS I 174         /SHL
0324                        *1122
0325    1122  4576          JMS I 176         /LSR
0326                        *1124
0327    1124  4574          JMS I 174         /SHL
0330                        *1143
0331    1143  4575          JMS I 175         /ASR
0332                        *1147
0333    1147  4575          JMS I 175         /ASR
0334                        *1152
0335    1152  4577          JMS I 177         /MQA
0336                        *6330
0337    6330  4577          JMS I 177         /MQA
0340                        *6343
0341    6343  4577          JMS I 177         /MQA
0342                        *7067
0343    7067  4571          JMS I 171         /MQL
0344                        *7072
0345    7072  4572          JMS I 172         /DVI
```

```
0346                                    *7077
0347        7077   4577                 JMS I 177          /MQA

NO ERRORS

C6201   1637                            SUDOSC 0166
DFMQGT  1614
DFMCPT  1640
DFPUT   1641
GET     0167
MQGET   1622
MQPUT   1643
PSDASR  0233
PSDDVI  0271
PSDLSR  0224
PSDMQA  1600
PSDMQL  1610
PSDMUY  0327
PSDSHL  0201
PUT     0170
SUDOMQ  0165
```