EMIMGFFT.DOC

(last update Nov 27, 1989)

CONTENTS

A. INTRODUCTION

EMIMGFFT computes the Fast Fourier Transform (FFT) of a boxed, floated IMAGE. It will compute FFTs from 128x128 up to 1024x1024 depending on the size of IMAGE. The FFT size is restricted to powers of 2. For images whose largest dimension is < 513 pixels, the FFT is computed entirely in "core" memory and works fastest when there are no other users on the computer accessing large amounts of memory. For larger calculations, the FFT is computed in two steps, using "core" memory to store the first dimension of the FFT and SCRATCH disk space for additional memory.

B. PROGRAM INPUT

1. Enter the name of the file containing the IMAGE data you wish to Fourier transform.

   If the IMAGE data are read from a BYTE-packed data file containing more than 1 IMAGE, specify a range (IMG_NUM1, IMG_NUM2) and increment (IMG_NUM_STEP) if you wish to compute multiple FFTs in one session. Each FFT is stored in a separate file, with all files having the same name but with different version numbers. Consequently, YOU MUST keep track of which FFT file corresponds with teh IMAGES from the packed data file.

2. You have the option to change IMG_BKG, the background value, but this is rarely done except with certain model image data. Type "Y" to cahnge IMG_BKG, otherwise "N" or <CR> (or anything else) will bypass the option. Changing IMG_BKG affects the floating of the image and, consequently, the value of FZERO. This may produce spurious "spikes" in the Fourier transform due to edge effects.

3. Enter the desired FFT size (IDIM1,IDIM2). The only allowed values for IDIM1 and IDIM2 are 128, 256, 512 and 1024. IDIM1

and IDIM2 must be greater than or equal to the IMAGE dimensions (NCOL and NROW, respectively). A <CR> response will generate DEFAULT values corresponding with the smallest allowable FFT size. IDIM1 and IDIM2 may be set equal to or larger than the DEFAULT values. If only IDIM1 is specified, IDIM2 is automatically set equal to IDIM1 (if allowed). Please note that some EM* programs are presently only designed to work with 512 by 512 size FFTs.

4. Specify a filename for storing the output FFT data.

5. Type an optional header (up to 72 characters in length) if the input data is a single (INTEGER*2 type) IMAGE file. When the input data arise from a BYTE-packed file, the header for the IMAGE data is automatically used as the FFT file header.

C. PROGRAM EFFICIENCY

The following table is a guide to execution times on a VAX 11/750 with 8 Mbyte of memory, a floating point accelerator, and no additional users. For the 1024x1024 size FFTs, the total time is subdivided into the time required for the first and second dimensions of the 2D FFT. For IMAGE sizes smaller than those in the table, the FFT should execute in less time. Please note the times given are CPU times: actual running time will depend on the overall demand for the CPU. Also, FFTs where IDIM1 and IDIM2 are not equal (eg. 128x512 or 512x256) can be calculated, but appropriate entries are not included in the table.

CPU TEST OF EMIMGFFT ON PURDUE VAX 11/750 MAY 6, 1987
(NOTE: The 8550 is about 4-6 times faster).

	FFT SIZE			
IMAGE SIZE	128x128	256x256	512x512	1024x1024
128x128	6s	22s	1m32s	43s+4m28s = 5m11s
256x256	---	26s	1m37s	1m31s+4m30s = 6m 1s
512x512	---	---	2m 3s	3m18s+4m34s = 7m52s
1024x1024	---	---	---	7m32s+4m26s = 11m58s

The program types out the value of FZERO (of interest mainly to those who use the CHANGE BACKGROUND option).

The output FFT file (direct access, unformatted) contains (IDIM2/2)+2 records: a header record followed by the unique structure factors (IDIM1 real and IDIM1 imaginary parts in each record: REAL*4 values). For further details of the program operation, consult the FORTRAN listing of the program ([TSB.FOR]EMIMGFFT.FOR). For details about the FFT file format, see [TSB.DOC]EMPROGS.DOC. For example BATCH command procedures, see [TSB.FOR]EMIMGFFT.BCH.

D. EXAMPLE EMIMGFFT BATCH JOB

```
!    SAMPLE COMMAND FILE FOR RUNNING EMIMGFFT PROGRAM IN BATCH
!    MODE
!
!    THE INPUT ARE AS FOLLOWS:
!
!    1. INPUT IMAGE FILENAME (DEFAULT FILE EXTENSION = .IMG)
!       IF INPUT FILE CONTAINS IMAGE DATA IN BYTE-PACKED FORMAT,
!       THEN ENTER THE FIRST,LAST AND INCREMENT FOR IMAGES TO BE
!       FOURIER TRANSFORMED (3I).
!    2. SET BACKGROUND VALUE? Y/(N) [TOUCH-KEY INPUT]
!       IF "Y", THEN INPUT BACKGROUND VALUE (I FORMAT)
!    3. FFT SIZE: (2I) (DEFAULT DEPENDS ON SIZE OF IMAGE)
!    4. NAME OF OUTPUT FILE FOR STORING FFT (NO DEFAUILT)
!    5. OPTIONAL HEADER (18A4) FOR FFT FILE (NOTE: THIS INPUT IS
!       ONLY REQUESTED IF THE INPUT DATA ARE *.IMG TYPE)
!
!    EXAMPLES ARE GIVEN BELOW FOR EACH OF THE TWO POSSIBLE MODES
!    OF RUNNING THE PROGRAM.
!
!    NOTE: THE FIRST DCL COMMAMD (TKEY_CMD_MODE:= "COMMAND") IS
!    REQUIRED TO ALLOW TOUCH-KEY INPUT.
!
!
!    EXAMPLE #1: *.IMG INPUT DATA
!
$ TKEY_CMD_MODE:= "COMMAND"
$ SET DEFAULT USER5:[TSB.SV40]
$ RUN USER5:[TSB.EXE]EMIMGFFT.EXE
USER5:[TSB.SV40]7007A0.IMG
N
512,512
USER5:[TSB.SV40]7007A0.FFT
512 by 512 FFT of SV40 image 7007A0
$ EXIT
!
!
!    EXAMPLE #2: *.PCK INPUT DATA
!
$ TKEY_CMD_MODE:= "COMMAND"
$ SET DEFAULT USER5:[TSB.SV40]
$ RUN USER5:[TSB.EXE]EMIMGFFT.EXE
```

```
USER5:[TSB.SV40]7007_IMG.PCK
1,66,2
N
128,128
USER5:[TSB.SV40]7007.FFT
$ EXIT

==================================================================
FORTRAN code:  DEXTRO3:[TSB.FOR]EMIMGFFT.FOR.
Documentation: DEXTRO3:[TSB.FOR.DOC]EMIMGFFT.DOC       27-Nov-89
------------------------------------------------------------------
```

E. FLOW CHART FOR EMIMGFFT PROGRAM

```
***************
*    MAIN     *
* (emimgfft)  *
***************
     *           |-- STRING_UPPER
     *-- IMG_OPEN --|-- FILE_CHECK
     *
     *-- IMG_PACK_FIND
     *
     *-- GET_YESNO
     *
     *-- FFT_SETDIM
     *
     *-- STRING_UPPER
     *
     *-- IMG_FILL
     *
     *-- IMG_PACK_FILL
     *
     *-- IMG_FFT_FILL -- FFT_CLEAR
     *
        *-- FFT_2D -- FOURT -- L6TO9
        *
     *-- FFT_STATS
     *
     *-- FFT_WRITE -- STRING_UPPER
     *
     *-- IMG_FFT1 -- FOURT -- L6TO9
     *
     *-- IMG_FFT2 -- FOURT -- L6TO9
```