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GRAPHIC KIOWA

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ABSTRACT

SIAC KIOWA can make histograms, scatter plots, and Gaussian ideograms on graphic devices such as the Cal-Comp plotter and Tektronix 4013 terminals. Output is for any of the non-interactive devices known to the SLAC Unified Graphics System.

Working Paper

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I. Introduction

A subroutine package has been written¹ for SLAC KIOWA² which will plot histograms, scatter plots, and Gaussian ideograms using the SLAC Unified Graphics System.³ Graphic output can be produced for any of the non-interactive devices known to the Unified Graphics System.

Additions must be made to the user's JCL and Linkage Editor input, to define additional files and to process the load modules for the additional KIOWA routines and for the Unified Graphics System routines. Necessary changes are discussed in section II.

No changes in the user's FORTRAN are necessary, although there are options for more elaborate labeling and superimposed curves which are not available in the line-printer output. Each plot is put out on both line-printer and graphic device, unless suppressed by the user. FORTRAN additions are discussed in section III.

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1) The original KIOWA with graphics was written for the LRL (Berkeley) CDC-6600. (Friedman and Rittenberg, CRT KIOWA for the CDC-6600. Group A Programming Note No. P-173, 1968) This version has been rewritten, but many of the original ideas and methods remain.

2) Chaffee and Friedman, SLAC KIOWA, CGTM No. 146, January 1973.

3) Beach, The SLAC Unified Graphics System, Version II. CGTM No. 143, January 1973.

II. Necessary Changes

The information in this section is dependent on the environment that SLAC KIOWA lives in. The Unified Graphics System, and WYLBUR are used, in addition to the Triplex system.

The changes to an operating KIOWA job which are necessary for it to produce graphic output, involve the following problems:

1.) The KIOWA graphic routines must be loaded by the Linkage Editor. (The Loader does not do it properly.)

2.) The Unified Graphics System routines must be specified and loaded. This involves additional datasets for LKED.SYSLIB and GO.STEPLIB.

3.) Two more files must be defined. One, with the ddname "PT19F001", is a scratch file which is used whenever scatter plots are drawn. The other, with ddname "UGDEVICE", depends on the device used for the pictures.

4.) The output device must be specified in FORTRAN.

Sections A and B below have information which applies to any GRAPHIC KIOWA job, regardless of the output device. Subsequent sections deal with specific devices.

A. The Easy Way

There is a WYLBUR execfile which will change a standard SLAC KIOWA job into a GRAPHIC KIOWA job. Set up a KIOWA job, ready to run, in the active file, and
EXECUTE FROM WYL.CG.REC.LIB(GRAPHICS) ON CATALOG CLEAR

B. General

FORTRAN_Changes

The proper device name must be set for the initial call to the Unified Graphics package. This name is eight Hollerith characters long, and is set in a COMMON block.

```
COMMON /PXUNIT/ DEVICE
REAL*8 DEVICE /8Hunitname/
```

Unitname	Equipment
CALDRSM*	10" Cal-Comp
CALDRLG*	Large Cal-Comp
PDS4013*	Tektronix 4013 terminal
PDSPDEV*	U. G. internal elements
CAINU16*	16-mm Unsprocketed Film
CALFICH*	105-mm Microfiche
PDS300Q*	Gencom 300-Q Terminal
VEP1100*	Versatec Electrostatic Plotter (Model 1100A)
VEP12FF*	On-Line Plotter (Fanfold Paper)
VEP12CR*	On-Line Plotter (Continuous Roll)

The DDNAME for the output file in the JCL must correspond to the device name in the FORTRAN, or the job will be killed by the Unified Graphics package.

(The information in this common block, plus the option FULSCR, is used as the options list for the call to UGOPEN. Normally only the device is necessary, but other options could be included.)

Linkage Editor Input

The Linkage Editor input must contain a statement invoking the "PIX" loadmodule, as well as any other statements that the usual KIOWA job requires:

```
//LKED.SYSIN DD *
INCLUDE SYSLIB(PIX)
```

JCL

JCL must point to the Unified Graphics load modules, as well as the standard KIOWA modules. The following EXEC statement will do.

```
// EXEC FORTHCLG,
//      LKEDLB3='WYL.CG.RBC.LOADMODS',
//      LKEDLB4='WYL.CG.RCB.UGFTNLIB',
//      GOSL1='WYL.CG.RCB.UGRUNLIB',
//      GORGN=300K
```

A scratch file, in addition to the usual FT03F001 file, must be provided if scatter plots are made:

```
//FT19F001 DD UNIT=SYSDA,SPACE=(CYL,(1,1)),
// DCB=(RECFM=VBS,LRECL=1805,BLKSIZE=3614)
```

And finally, a dataset must be defined for the graphic output. The details depend on the device type. The correct JCL is given in each separate section below.

C. Cal-Comp Plots

A FORTRAN block data routine should contain

```
COMMON /PXUNIT/ DEVICE
REAL*8 DEVICE /8HCALDRSM*/
```

or

```
COMMON /PXUNIT/ DEVICE
REAL*8 DEVICE /8HCALDRLG*/
```

for the 10-inch and 33-inch plots, respectively.

The correct JCL for the output dataset is

```
//GO.UGDEVICE DD DSNAME=8&PLOT,DISP=(NEW,PASS),
//      VOL=SER=PLOT,UNIT=T9-1600,LABEL=(1,SL),
//      DCB=(RECFM=F,LRECL=480,BLKSIZE=480,DEW=3)
```

You must also submit a Job Instruction Card with the word "PLOT TAPE" under Volume Mounting Instructions. Put your **CAMPUS** account number, the plot size (10" or 33"), pen width (0.5 is okay), and paper desired (plain), under user comments. Weekend Cal-Comp operators on campus are sometimes less experienced than the usual weekday staff. Plot tapes made in the morning may be returned by the afternoon of the following day, but 48-hour service is more usual. The process can sometimes be speeded by taking the tape to the campus computer center yourself.

D. Unified Graphics Elements

A FORTRAN block data routine should contain
 COMMON /PXUNIT/ DEVICE
 REAL*8 DEVICE /8HPDSPDEV*/

Possible JCL for the output dataset is
 //GO.UGDEVICE DD DSN=WYL.XY.ABC.DISKPDS,DISP=(NEW,KEEP),
 // VOL=SER=SCRO01,UNIT=2314,SPACE=(TRK,(5,1,3)),
 // DCB=(RECFM=U,BLKSIZE=3520)

The Unified Graphics System plot elements, which can subsequently be translated by the U.G. system into a plot for any allowed device, can be saved in a partitioned data set. The member names are PICT001, etc., and are the same as for the plots for the 4013 terminal. The advantage of this type of output is that the plots can be viewed with a simple program on any available device, such as 4013 or 2250, and selected plots then put out on Cal-Comp or any other device without re-running the KIOWA job.

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1) See, for instance Chaffee, UGLOOK--Programs to Display Plots Saved by the Unified Graphics System in Partitioned Datasets. CGTM No. 151.

E. Plots for Tektronix 4013 Terminals.

A FORTRAN block data routine should contain
 COMMON /PXUNIT/ DEVICE
 REAL*8 DEVICE /8HPDS4013*/

Possible JCL for the output dataset is
 //GO.UGDEVICE DD DSN=WYL.XY.ABC.WYL4013,DISP=(NEW,KEEP),
 // VOL=SER=SCRO01,UNIT=2314,SPACE=(TRK,(5,1,3)),
 // DCB=(RECFM=PB,LRECL=80,BLKSIZE=1600)

Plots for the Tektronix 4013 terminals are made as members of a partitioned data set. The first plot, histogram number 1, is made as member PICT001, and replaces any existing member with that name. As with a replacement from WYLBUR, the discarded space is not available until the dataset is condensed. Subsequent histograms, then all the scatter plots, then all the Gaussian ideograms, are named PICT002, PICT003, and so on. The plot of histogram number 1 is also given the alias HIST001, and may be referred to by that name. Similarly, the scatter plot members are given aliases starting with PLOT, and the ideogram members are given aliases starting with GRAM. To display a plot which has been made by a KIOWA batch job, the user must be signed onto WYLBUR using a 4013 terminal. Fetch the plot with

the standard WYLBUR command
USE WYL4013#PICT001 ON SCR001 CLE
and then "list" it:
LIST UNN CLEAN

Histograms fill the space of about a dozen 80-column cards. Scatter plot storage depends on the number of points, and requires one 80-column card for each six or seven points. Plots may be manipulated with standard WYLBUR commands.

F. The CalComp Microfilm Plotter

This output is processed without a user tape, on the SLAC site. One-day service is promised except on weekends, and it is generally much better than that.

16-mm Unspocketed Film

```
A FORTRAN block data routine should contain
COMMON /PXUNIT/ DEVICE
REAL*8 DEVICE /8HCAL16MU*/
```

```
Possible JCL for the output dataset is
//GO.UGDEVICE DD SYSOUT=X,
//      DCB=(RECFM=F,LRECL=1480,BLKSIZE=1480)
```

105-mm Microfiche

```
A FORTRAN block data routine should contain
COMMON /PXUNIT/ DEVICE
REAL*8 DEVICE /8HCALFICH*/
```

```
Possible JCL for the output dataset is
//GO.UGDEVICE DD SYSOUT=Z,
//      DCB=(RECFM=F,LRECL=1480,BLKSIZE=1480)
```


G. Gencom Terminals

A FORTRAN block data routine should contain
COMMON /PXUNIT/ DEVICE
REAL*8 DEVICE /8HPDS300q*/

Possible JCL for the output dataset is
//GO.UGDEVICE DD DSN=WYL.KY.ABC.WYLDTC,DISP=(NEW,KEEP),
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=1600),
// VOL=SER=SCROO1,UNIT=2314,SPACE=(TRK,(5,1,3))

Use is the same as with the 4013 terminals. Fetch the plot with the standard WYLBUR command
USE WYLDTC#PICT001 ON SCROO1 CLE
and "list" it:
LIST UNN CLEAN NONL

The Versatec Plotter Model 1100A

A FORTRAN block data routine should contain
COMMON /PXUNIT/ DEVICE
REAL*8 DEVICE /8HVEP1100*/

Possible JCL for the output dataset is
//GO.UGDEVICE DD DSN=88PLOT,DISP=(NEW,PASS),
// UNIT=T9-800,VOL=SER=ABCDEF,LABEL=(1,SL),
// DCB=(RECFM=FB,LRECL=130,BLKSIZE=4160,DEN=2)

Use of the Data Analysis Group's Versatec plotter is on an informal basis. You must supply your own 9-track, 800 BPI tape (volume ABCDEF in the above example), and arrange to plot it yourself.

I. On-Line Versatec Plots

In-Core Sort

A FORTRAN block data routine should contain
 COMMON /PXUNIT/ DEVICE
 REAL*8 DEVICE /8HVEP12FF*/

or
 COMMON /PXUNIT/ DEVICE
 REAL*8 DEVICE /8HVEP12CR*/
 for fan-fold or continuous roll, respectively.

The JCL needed to make on-line plots with the Unified Graphics System has not been decided at this writing. Consult the Computer Services Bulletin.

External Sort

In case of large numbers of points in scatter plots, the memory requirements may be excessive, and the external sort option of the U.G. system will be needed. In this case, the FORTRAN will be

```
COMMON /PXUNIT/ DEVICE
REAL*8 DEVICE (2)
DATA DEVICE /8HVEP12FF, , 8HEXTSORT*/
```

or

```
COMMON /PXUNIT/ DEVICE
REAL*8 DEVICE (2)
DATA DEVICE /8HVEP12CR, , 8HEXTSORT*/
```

In this case, the JCL for the device will be

```
//GO.UGDEVICE DD DSN=&&PLOT1,DISP=(NEW,PASS),
// UNIT=SYSDA,SPACE=(CYL,5),
// DCB=(RECFM=FB,LRECL=12,BLKSIZE=1440)
```

The entire KIONA step will be followed by a sort step and a "print" step. Again, consult the Computer Services Bulletin, or the U.G. writeup, when the details are known.

III. Optional Features

This section describes the features available in GRAPHIC KIOWA which are not available in the line-printer output. They are strictly internal to KIOWA, and do not depend explicitly on the SLAC environment.

A. Axis Labels

GRAPHIC KIOWA has an option for inserting abscissa and ordinate labels on histograms, scatter plots, and Gaussian ideograms. Plot titles for the graphic displays are inserted in the same way as for the line-printer output, that is, by storing the titles in the appropriate locations in the common blocks /HISTLB/, /PLOTLB/, or /GRAMLB/, and setting ILABEL(I)=1, where I = 1,2, or 3 for histograms, scatter plots, and Gaussian ideograms. ILABEL is found in COMMON/ULABEL/ILABEL(3)

Axis labels are inserted in an analogous manner. To make x-axis labels, as well as titles, on all histograms, set ILABEL(1)=2 by a replacement statement before the statement CALL COCHIS, or in a BLOCK DATA routine. To insert y-axis labels, as well as x-axis labels and titles, on all histograms, set ILABEL(1)=3. Axis labels for scatter plots and Gaussian ideograms are set up similarly; the flag for scatter plots is ILABEL(2), and that for Gaussian ideograms is ILABEL(3).

The abscissa labels are stored in the following labeled common blocks:

COMMON/HISTLX/HX(8,NHISTS)	for histograms;
COMMON/PLOTLY/PX(8,NPLOTS)	for scatter plots;
COMMON/GRAMLY/GX(8,NGRAMS)	for Gaussian ideograms.

The ordinate labels are stored in the following labeled common blocks:

COMMON/HISTLY/HY(8,NHISTS)	for histograms;
COMMON/PLOTLY/PY(8,NPLOTS)	for scatter plots;
COMMON/GRAMLY/GY(8,NGRAMS)	for Gaussian ideograms.

B. Superimposed Curves

GRAPHIC KIOWA allows an arbitrary number of user-coded curves to be plotted on each histogram or scatter plot. User-coded curves may not be superimposed on Gaussian ideograms.

HISTOGRAMS

If no more than one curve is to be drawn on each histogram, then the user-coded functions are superimposed in the same manner as for the line-printer version. In order to put more than one curve on a histogram, the following FORTRAN statement must be included in the UFUN routine:

```
COMMON/UFUNH/MULT
```

The program will set MULT=0 for the first entry into the UFUN routine for each plot. Before returning, the user must set MULT to the total number of curves to be drawn for the plot. MULT then is the flag indicating which curve the calling program is plotting on each successive entry. MULT will have integer values decreasing from the number set by the user at the first entry down to 1.

When all curves have been plotted on a given histogram, the calling program will set MULT=0 and call UFUN for the next histogram which requires a curve. The user can set MULT to the number of curves for this next plot, and so on.

Consider the following example: suppose the functions x^2 , x^3 , x^4 , and x^5 are to be superimposed on the third histogram, and $\sin^2 x$ and $\cos^2 x$ are to be plotted on the fifth. The UFUN routine could be coded as follows:

```

FUNCTION UFUN(X,N)
COMMON /UFUNH/ MULT
IF (N.EQ.3) GO TO 1
IF (N.EQ.5) GO TO 10
RETURN
1 IF (MULT.EQ.0) MULT = 4
  GO TO (2,3,4,5) ,MULT
2 UFUN = X**2
  RETURN
3 UFUN = X**3
  RETURN
4 UFUN = X**4
  RETURN
5 UFUN = X**5
  RETURN
10 IF (MULT.EQ.0) MULT = 2
   GO TO (11,12) ,MULT
11 UFUN = SIN(X)**2
   RETURN
12 UFUN = COS(X)**2
   RETURN
END

```

Scatter Plots

User-coded curves are superimposed on scatter plots in a manner similar to that for the line-printer version. However, there are two more restrictions:

1. Each curve must close back upon itself.
2. A curve must not intersect itself. However, a curve may intersect other curves on the plot any number of times.

The second may be circumvented by plotting separate parts of a curve as separate curves.

If no more than one curve is to be drawn on each scatter plot, then the UPLOT routine is coded the same as for the line-printer version of KIONA. If there are multiple curves to be drawn on one plot, then the curves must be numbered with a scheme like that for histograms. The following FORTRAN statement must be inserted:

```
COMMON/UPLOTM/MULT
```

The calling program will set MULT=0 for the first entry into the UPLOT routine for each plot. Before returning the user must set MULT to the total number of curves to be drawn on the plot. MULT then is the flag indicating which curve the calling program is plotting on each successive entry. MULT will have integer values decreasing from the number set by the user at the first entry down to 1.

As in the line-printer version, UPLOT should be set to 1.0 or to the Hollerith constant 4HMON1 for those scatter plots which are not to have any curves.

Consider the following example. Suppose the user wants to draw five concentric circles on the second scatter plot, a Chew-Low envelop on the seventh, and three Dalitz-plot boundaries corresponding to three center-of-mass energies on the tenth. The UPLOT routine could be coded as follows.

```

FUNCTION UPLOT(X,Y,N)
COMMON /UPLOTH/ MULT
DIMENSION E(3), R(5)
DATA E,R /2.1,2.2,2.3,0.25,0.2,0.15,0.1,0.05/
DATA ECM,A1,A2,A3 /2.0,0.140,0.938,0.135/
DATA HNONE /4HNONE /
UPLOT = HNONE
IF (N.NE.2) GO TO 10
  IF (MULT.EQ.0) MULT = 5
  UPLOT = X**2 + Y**2 - R(MULT)**2
  RETURN
10 IF (N.NE.7) GO TO 20
  UPLOT = CHEWLO(X,Y,ECM,A1,A2,A1,A2,A3)
  RETURN
20 IF (N.NE.10) GO TO 30
  IF (MULT.EQ.0) MULT = 3
  UPLOT = DALITZ(X,Y,E(MULT),A1,A2,A3)
30 RETURN
END

```

C. Plot Suppression.

There is a common block
 COMMON /FLAGS/ FLAG(20)
 in which KIOWA looks to find various flags. FLAG(2) is assigned for suppression of graphic output. It is set to zero by KIOWA just before each call to USRHST(ARRAY,NO), USRPLT(ARRAY,NO), and USRGRM(ARRAY,NO). (NO is the number of the histogram, scatter plot, or Gaussian ideogram. ARRAY is the contents, in packed format for scatter plots.) If FLAG(2) is non-zero on the return, graphic output is suppressed. FLAG(1) is the analogous flag for line-printer output.

The following coding would suppress graphic output for histograms 3 and 5, and scatter plots 3 through 6.

```

SUBROUTINE USRHST(ARRAY,NO)
DIMENSION ARRAY(1)
COMMON /FLAGS/ FLAG(20)
IF (NO.EQ.3) FLAG(2)=1.
IF (NO.EQ.5) FLAG(2)=1.
RETURN
END
SUBROUTINE USRPLT(ARRAY,NO)
DIMENSION ARRAY(1)
COMMON /FLAGS/ FLAG(20)
IF (NO.GE.3 .AND. NO.LE.6) FLAG(2)=1.
RETURN
END

```