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NYU-SCOPE 3 CENTRAL SUBROUTINE DOCUMENTATION

TITLE

PURE JOY PERSPECTIVE VIEWS OF A FUNCTION OF TWO VARIABLES,

USAGE

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CALL PURE JOY (Z,KX,KY,IDIM,CAMLOC,XYLIM,JBEAM,ISCALE,MARPLOT,KFRAME,
               NUMGRID)
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Z TWO-DIMENSIONAL ARRAY OF FUNCTION VALUES. THE FIRST INDEX REPRESENTS VARIATION OF X, THE SECOND OF Y,

KX NUMBER OF ARRAY POINTS IN THE X DIRECTION, I.E., RANGE OF FIRST INDEX OF Z,

KY NUMBER OF ARRAY POINTS IN THE Y DIRECTION; RANGE OF SECOND INDEX OF Z,

IDIM COLUMN LENGTH OF ARRAY Z. IN THE CALLING PROGRAM, Z IS DIMENSIONED Z(IDIM,N), WHERE IDIM ≥KX, N≥KY,

CAMLOC ONE-DIMENSIONAL ARRAY WITH COORDINATES OF CAMERA AND AIMING POINT,
CAMLOC(1),(2),(3) = X,Y,Z COORDINATES IN THE LABORATORY SYSTEM OF THE ≠CAMERA LENS,≠ I.E., THE PROJECTION POINT.
CAMLOC(9),(10),(11) = X,Y,Z COORDINATES OF CAMERA AIMING POINT, THIS POINT ESTABLISHES THE TRANSFORMATION FROM LAB TO FILM PLANE, TOGETHER WITH THE CONVENTION THAT THE PICTURE X AXIS WILL BE KEPT HORIZONTAL IN SPACE. IT NEED NOT LIE IN THE BOX OR ON SURFACE Z(X,Y), AS ONLY ITS DIRECTION RELATIVE TO THE CAMERA LENS IS IMPORTANT. OTHER WORDS OF CAMLOC ARE IGNORED.

XYLIM ARRAY OF DIMENSIONS XYLIM(2,6) WITH SCALING PARAMETERS,
XYLIM(1,1),(2,1) = MINIMUM AND MAXIMUM X COORDINATE, RESP., OF BOX CONTAINING SURFACE,
XYLIM(1,2),(2,2) = MIN. AND MAX. Y COORDINATE OF BOX,
XYLIM(1,3),(2,3) = MIN. AND MAX. Z COORDINATE OF BOX,
THE ABOVE SETS OF COORDINATES ARE IN THE LABORATORY COORDINATE SYSTEM, AND THEY FIX THE SIZE OF THE IMAGINARY BOX CONTAINING THE SURFACE SURFACE,
XYLIM(1,4),(2,4) = LOWER AND UPPER Z CUTOFF, RESP. THESE NUMBERS ARE IN ARE IN THE UNITS OF ARRAY Z. HOW THEY ARE USED TO SCALE ARRAY Z TO THE BOX DIMENSIONS IN XYLIM(1,3) AND XYLIM(2,3) DEPENDS ON THE SCALING OPTION CHOSEN. (SEE ISCALE)
XYLIM(1,5),(2,5) = PLOT WIDTH AND HEIGHT, RESP., IN INCHES ON CALCOMP PAPER,
XYLIM(1,6),(2,6) = PLOT ORIGIN, COORDINATES IN CALCOMP INCHES OF LOWER LEFT CORNER OF PICTURE,

ISCALE SCALING METHOD FOR SCALING Z ARRAY TO BOX HEIGHT, INTEGER FROM 1 TO 5,

1: SCALES SO THAT THE RANGE OF Z FROM LOWER TO UPPER CUTOFF GIVEN IN XYLIM(1,4) AND XYLIM(2,4) EXACTLY FITS BETWEEN TOP AND BOTTOM HALF OF THE BOX; I.E., SCALES TO THE RANGE XYLIM(1,3), XYLIM(2,3) IN THE LAB SYSTEM. SOME Z ARRAY ENTRIES MAY, OF COURSE, LIE OUTSIDE THIS RANGE. IN SCALING THE PICTURE TO THE CALCOMP, THESEOUTSIDE POINTS ARE NOT CONSIDERED, BUT IF THEY FALL IN THE PICTURE SPACE, THEYWILL BE DRAWN.

2: SCALE SO THAT THE ENTIRE RANGE OF VALUES IN ARRAY Z JUST FITS THE BOX, (THE Z CUTOFF VALUES XYLIM(1,4), XYLIM(2,4) ARE IGNORD

3: SCALE SO THAT Z = 0 IN THE Z ARRAY SCALES TO Z = 0 IN THE LAB SYSTEM. ADJUST THE SCALE FACTOR TO KEEP THE SURFACE WITHIN THE BOX, IN GEN., THIS WILL MEAN THAT THE SURFACE TOUCHES THE TOP OR BOTTOM OF THE BOX, BUT NOT BOTH--UNLESS THE BOX IS LOCATED JUST RIGHT W/ RESPECT TO THE PLANE Z = 0 IN THE LAB. THE Z CUTOFF VALUES ARE IGNORED.

4: SCALE AS IN OPTION 1, BUT IF ANY Z VALUES EXCEED THE Z CUTOFF VALUES, REPLACE THEM BY THE APPROP CUTOFF.

5: SCALE AS IN OPTION 3, BUT IF ANY Z VALUES EXCEED THE Z CUTOFF VALUES, REPLACE THEM BY THE APPROP CUTOFF VALUE.

6: USE CUTOFF VALUES FOR SCALING:
Z(LAB) = XYLIM(1,4) + XYLIM(2,4 * Z(ARRAY)

SCALING TO PLOTTER:

A SINGLE SCALE FACTOR CORRESPONDING TO THE FOCAL LENGTH OF A CAMERA SETS THE PICTURE SIZE ON THE PLOTTER PAPER. IF ISCALE IS NEGATIVE, THE SCALING FROM Z-ARRAY TO LAB IS DONE AS DESCRIBED ABOVE FOR /ISCALE/, BUT THE ≠FOCAL LENGTH≠ IS ALWAYS ADJUSTED TO FIT THE ENTIRE BOX EXACTLY INTO THE PLOTTER PICTURE SPACE. THIS OPTION IS RECOMMENDED WHENEVER A SERIES OF PLOTS ARE TO BE INTER-COMPARED, SINCE THEY WILL THEN ALL HAVE THE SAME OVERALL SCALE FACTOR IF ISCALE = -1, -4, OR -6.

IF ISCALE IS POSITIVE, THE FOCAL LENGTH IS ADJUSTED TO FIT IN THE PART OF THE SURFACE THAT LIES WITHIN THE BOX. THIS METHOD GIVES THE LARGEST POSSIBLE PICTURE OF THE SURFACE, BUT ALLOWS THE OVERALL SCALE FACTOR TO VARY FROM ONE PLOT TO ANOTHER.

EXCEPT FOR SCALING OPTIONS 4 AND 5, ONLY THE LOWER 3 BITS OF ENTRIES IN THE Z-ARRAY ARE CHANGED BY THE PROGRAM. THE LOWER 3 BITS ARE USED TO STORE VISIBILITY INFORMATION IN FINDING THE HIDDEN PARTS OF THE SURFACE.

MARPLOT IF ZERO, ALL POINTS OF THE SURFACE ARE DRAWN, EVEN IF THEY ARE HIDDEN BEHIND OTHER PARTS OF THE SURFACE. NONZERO = HIDDEN PARTS ARE NOT DRAWN.

KFRAME IF NONZERO, A BORDER IS DRAWN AROUND THE PICTURE.

NUMGRID ARRAY OF DIMENSION 4 WITH PARAMETERS FOR DRAWING COORDINAT GRIDS ON THE WALLS OF THE BOX. IF NUMGRID(1) 0, NO GRIDS ARE DRAWN.

NUMGRID(1)

NUMGRID(1): IF NEGATIVE OR ZERO, THE REST OF NUMGRID IS IGNORED, AND NOTHING SPECIAL HAPPENS. IF POSITIVE, NUMGRID(2),(3),(4) GIVE THE NUMBER OF STRIPES INTO WHICH THE X, Y, AND Z DIRECTIONS ARE TO BE DIVIDED, AND COORDINATE GRIDS ARE DRAWN ON ALL FACES OF THE BOX THAT DO NOT LIE BETWEEN THE CAMERA AND THE SURFACE. FOR THE LATTER BOX FACES, ONLY THE EDGES ARE DRAWN.
EXAMPLE: IF NUMGRED(2) = 4, COORDINATE GRIDS WILL BE RULED WITH THE X DIRECTION DEVIDED INTO 4 STRIPES. THIS MEANS THAT 5 LINES

ARE DRAWN, ONE AT THE BEGINNING AND 4 MORE TO MARK OFF 4 DIVISIONS IN THE X DIRECTION.

DESCRIPTION

TO CLARIFY THE MATTER OF SCALING AND PERSPECTIVE, IMAGINE THAT THE SURFACE FITS INSIDE A BOX OF HANDY DIMENSIONS, WITH ITS EDGES PARALLEL TO THE LABORATORY X,Y,Z AXES. THE ACTUAL VALUES OF PHYSICAL VARIABLES X AND Y DO NOT MATTER, ONLY THE X AND Y DIMENSIONS OF THE BOX. LIKEWISE, THE NMUMBERS STORED IN ARR AY Z WILL BE SCALED THE BOX. LIKEWISE, THE NUMBERS STORED IN ARRAY Z WILL BE SCALEDTO THE Z DIMENSION OF THE BOX. THE USER IS NOW FREE TO PLACE THE ≠CAMERA LENS≠ ANYWHERE, AND TO AIM IT AT ANY POINT, IN ORDER TO MAKE A PICTURE OF THE SURFACE, (EXCEPT THAT NO PART OF THE SURFACE CAN LIE BEHIND THE PROJECTION POINT.) THE PROPORTIONS OF THE BOX AND THE RELATION BETWEEN THE CAMERA LOCATION, THE AIMING POINT, AND THE DIMENSIONS OF THE BOX WILL DETERMINE WHAT PART OF THE SURFACE IS SEEN, AND HOW PRONOUNCED THE PERSPECTIVE EFFECTS WILL BE. IF THE CAMERA IS PLACED CLOSE TC THE BOX, IN TERMS OF THE BOX DIMENSIONS, THE EFFECTS ARE EXAGGERATED; WHILE IF IT IS ESSENTIALLY AT INFINITE DISTANCE, AN ORTHOGRAPHIC PROJECTION WITH NO FORESHORTENING OR OTHER SPECTACULAR AFFECTS WILL RESULT.

THE USER MAY ALSO SPECIFY THE WIDTH AND HEIGHT OF THE PLOT IN INCHES ON THE PAPER. THE PICTURE IS SCALED TO FILL THIS SIZE AS WELL AS POSSIBLE, BUT ALWAYS WITH THE SAME SCALE FACTOR FOR BOTH THE X AND Y PLOTTER AXES; THUS, IN GEN, THE PICTURE COMPLETELY FILLS JUST ONE DIMENSION OF THE ALLOWED SPACE. THE X-AXIS OF THE PICTURE IS ALWAYS HORIZONTAL IN SPACE.

RESTRICTIONS

THE FUNCTION TO BE PLOTTED MUST BE A SINGLE-VALUED FUNCTION OF TWO VARIABLES; Z(X,Y), GIVEN IN THE FORM OF A TWO-DIMENIONAL ARRAY OF VALUES Z(J,K). THE FIRST INDEX, $1 \leq J \leq KX$, RUNS IN THE +X DIRECTION AND THE SECOND INDEX, $1 \leq K \leq KY$, RUNS IN THE +Y DIRECTION. PICTURE THE XY-PLANE RULED INTO A GRID OF KX BY KY LINES, AND SUPPOSE THAT AT EACH MESH POINT IN THE GRID WE PULL THE PLANE UP OR DOWN UNTIL THE ALTITUDE AT THAT POINT IS Z(X,Y). THE PLOT WILL CONSIST OF A PICTURE OF THE SURFACE Z(X,Y) RULED IN THIS MANNER.

THE USING PROGRAM MUST SET UP THE PLOTTING FILE BY CALLING /PLOTS/ AND CLOSE IT BY CALLING /FIN/ BEFORE THE JOB TERMINATES. IT MUST WRITE THE TITLE, IF ONE IS REQUIRED. IT MUST ALSO ADVANCE THE FILM OR PAPER BY CALLING /PLOT/ WHEN A FRAME IS COMPLETE. IT IS PERFECTLY ALL RIGHT TO DRAW MORE THAN ONE PURE JOY PLOT IN A SINGLE FRAME, OF COURSE.

METHOD

THE METHOD USED IS DESCRIBED IN: B. KUBER, J. SZABO, AND S. GIULIERI, THE PERSPECTIVE REPRESENTATION OF JUNCTIONS OF TWO VARIABLES, JACM, 15 (APRIL, 1968), NO.2, 193.

WE USE A DIFFERENT METHOD FOR PROJECTING THE FIGURE TO A PLANE, BUT WE FOLLOW THEIR METHOD FOR SIMPLIFYING THE REMOVAL OF HIDDEN PARTS OF THE SURFACE. THE USER IS REFERRED TO THE JACM ARTICLE

FOR FURTHER DESCRIPTION OF THE METHOD.

STORAGE

THE PURE JOY PACKAGE REQUIRES 5100(8) LOCATIONS, NOT COUNTING THE SPACE REQUIRED BY THE USUAL CALCOMP PLOTTING ROUTINES AND BUFFER FOR THE PLOTTER TAPE.

TIME

TIME VARIES UP TO A FACTOR OF 2 WITH THE COMPLEXITY OF THE SURFACE IT IS ROUGHLY PROPORTIONAL TO THE NUMBER OF GRID POINTS, AND A REASONABLE ESTIMATE IS FROM 3 MSEC. PER POINT FOR SIMPLE SURFACES SUCH AS A PYRAMID, UP TO 5 OR 6 MSEC. FOR SURFACES WITH MANY BULGES, THESE ESTIMATES DO NOT INCLUDE COORDINATE GRIDS, ADDING GRIDS ADDS 60 TO 70 TO THE TIME--SINCE THE GRID LINES ALSO HAVE TO BE CHECKED TO REMOVE HIDDEN PARTS.

ONE WOULD EXPECT THE TIME PER POINT TO INCREASE SLIGHTLY AS THE GRID SIZE INCREASES BECAUSE MORE EDGES OF THE SURFACE MUST BE TESTED TO SEE WHETHER THEY HIDE A GIVEN POINT, IN PRACTICE, THIS EFFECT HAS BEEN NEGLIGIBLE UP TO MESH SIZES OF 191 BY 191; CERTAINLY, IT DOES NOT AFFECT THE ORDER OF MAGNITUDE QUOTED ABOVE.

NOTE

PURE JOY IS ENTIRELY IN FORTRANIV, THE SOURCE DECK WILL BE FOUND ON THE MATHLIB FILE OF THE CIMLIB TAPE: DECK NAME, NYU025, PURE JOY CALLS 10 ROUTINES: CAMEROT, CHOP4, DRAWBOX, DRAWPQ, DRAW3D, GAUFFRE, GNOMON, IVIS, MIRBANE, ROTATE.

AUTHOR

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  09/29/72 ,NYU SCOPE 3,2/19B    PL3.2/I+       72183 OP=MOORE
13,09,19,00000006 INPUT CARDS  CR16
13,09,19,CG01137
13,09,20, 113307,T20,CM50000,LOUIS BAUER
13,09,20,CIMGET(WRITEUP=OLDPL)
13,09,21,CYCLE 01, SYSTEM////CIMLIB////WRITEUP
13,09,21,FILE HAS BEEN ATTACHED
13,09,21,OBTAINING WRITEUP
13,09,21,UPDATE(Q,D,8,C=OUTPUT,O=JUNK)
13,09,22,READING INPUT
13,09,35,UPDATE COMPLETE
13,09,37,CP   002,864 SEC,
13,09,37,PP   011,286 SEC,
                     CG01137  //// END OF LIST ////     00000259 LINES
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