

QUA-Quadrant Detector Analysis

The Quadrant Detector Analysis option (QUA) lists the scanned response of a quadrant detector to the image at each field. Diffraction is ignored.

When to Use the Quadrant Detector Analysis Option

A quadrant detector is a sectored semiconductor photodiode device used to provide image alignment information, as determined by comparisons of the illumination levels of opposing quadrants of the detector at the image plane (Donald C. O'Shea, *Elements of Modern Optical Design*, John Wiley & Sons, New York, 1985, p. 358).

The Quadrant Detector Analysis option (QUA) lists the scanned response of a simulated quadrant detector to the image at each field. The listed computation is the ratio of responses from the two halves of the detector as a function of scan position. Scanning is done for both X and Y directions, and assumes proper coupling of the quadrants. Diffraction is ignored; only the geometrical image is analyzed.

Default Operation

None; no calculation is possible without at least one **Step Scanning Size** setting, or STE command. With a Step Scanning Size setting, a listing is generated for each field and zoom position and for the depth-of-focus values defined in the LDM (FFO, IFO, NFO); the listing gives the ratio of the two halves of the detector, assuming proper coupling of the quadrants, as a function of the X and Y scan positions.

Command Mnemonics (alphabetical)

GAU

NRD

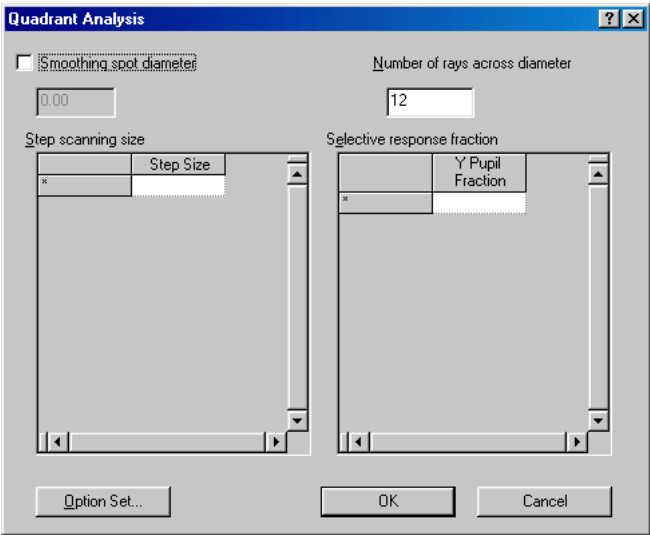
QRE

STE

Defining Quadrant Detector Analysis Settings

To define settings for the Quadrant Detector Analysis option (QUA), choose the **Analysis > Geometrical > Quadrant Analysis** menu. The **Quadrant Analysis** dialog box displays. Define the controls in this dialog box as described in the table below.

For more details about how these controls are used, go to “Scan Step Size - At Least One Required” on page 19-377 , “Smoothing” on page 19-377, and “Selective Response Fraction” on page 19-377.



Command Syntax		
Screen Control	Explanation	Default
NRD num_rays_across_diameter....z		
Number of rays across diameter	Number of rays across grid traced through pupil for the wavelength with the largest weight. The default is that a total of approximately 316 rays are traced. The relative number of rays traced for each wavelength is determined by the wavelength weights. For a single wavelength, this corresponds to a value of 20 for the number of rays across the diameter.	
GAU smoothing_spot_diam No....z		
Smoothing spot diameter	Selects the 50% intensity diameter for Gaussian spot used in smoothing the image. Smoothing is always done; alter the default value for other smoothing characteristics or to simulate imaging of a Gaussian object cascaded with the image.	1/200 of image height or width, whichever is greater.

Command Syntax		
Screen Control	Explanation	Default
STE scan_step_size....z		
Step Scanning Size	Required. The Step Size field specifies step size for scanning the image, in lens units. Up to 20 step sizes may be given, to generate a selection of sizes.	Required. At least one scanning step size must be given.
QRE selective_response_fraction No....z		
Selective response fraction	Allows you to obtain a listing of quadrant detector positions for a requested fractional response and its reciprocal. Y Fraction Specifies the fractional response and its reciprocal. For example, 0.25 will give the scan position for responses of 0.25 and 4.0 in both X and Y. You can specify up to 20 values. Type No in this field to omit the selective response fraction calculation for the specified zoom position.	No.

Discussion of Input and Computations

What to Include in the LDM Data

No added LDM data is required. The **NRD** command and the wavelength weights determine the number of rays traced.

Scan Step Size - At Least One Required

You must specify at least one step size (**Step Scanning Size** or **STE**) for scanning the image in terms of lens units (e.g. mm, if that is how the lens system has been specified in the LDM). Up to 20 step sizes may be given, to generate a selection of sizes.

Smoothing

Smoothing is done with the equivalent of an extremely small spot of Gaussian shape at all times. The default value is approximately 1/200 of the image height or width. If other smoothing characteristics are required, or to simulate the imaging of a Gaussian object cascaded with the image (such as a CRT display), you may alter the default by selecting the diameter at which the intensity is 50% of the peak for the Gaussian spot used in smoothing the image (**Smoothing spot diameter** or **GAU**).

Selective Response Fraction

A listing of quadrant detector positions for a requested fractional response and its reciprocal can be obtained (**Selective response fraction** or **QRE**). For example,

QRE 0.25

will give the two scan positions for which the response is 0.25 and 4.0. Results are given in both X and Y directions. Up to 20 **QRE** commands may be used.

Description of Output

With an **STE** command, a listing is generated for each field and zoom position and for the depth-of-focus values defined in the LDM (FFO,IFO,NFO). The form of the listed output is compact, including the radial and tangential responses for all focus positions of one field angle on one page. For each step in the image scan, the ratio of responses from the two halves of the detector as a function of scan position is listed.

Examples

Example 1. Minimum input example for a triplet.

Shows, at each of the 3 fields, the relative response in each of the two halves of the detector (quadrants coupled in X for Y shift, in Y for X shift) for an image shift of 0.02 lens units away from the chief ray position; the first column is the position of the detector center (in X or Y) and the second column is the ratio of response for the two detector halves. Also gives the shift needed to produce 50% response of one detector half with respect to the other.

RAY STATISTICS FOR FIELD 1 ZOOM 1:

WAVELENGTH	WEIGHT	POINTS TRACED	POINTS ATTEMPTED
656.3	1	156	188
546.1	2	316	360
486.1	1	156	188

FOR FIELD HT OF 0.00 AND FOCUS POSITION OF 0.0000

ENERGY RATIOS FOR A DELTA X SHIFT OF 0.200000E-01
WITH A 50 PERCENT VALUE OF 0.363524E-11

0.000000	1.000000
----------	----------

Command inputs:
RES CV_LENS:COOKE1

QUA
STE 0.02
GO

FOR FIELD HT OF 0.69 AND FOCUS POSITION OF 0.0000

ENERGY RATIOS FOR A DELTA Y SHIFT OF 0.200000E-01
WITH A 50 PERCENT VALUE OF -0.296075E-02

-0.062961	164.909393
-0.042961	17.381893
-0.022961	5.779535
-0.002961	0.999852
0.017039	0.113272
0.037039	0.042303
0.057039	0.000290
0.077039	0.000000

ENERGY RATIOS FOR A DELTA X SHIFT OF 0.200000E-01
WITH A 50 PERCENT VALUE OF -0.407855E-09

-0.020000	139.993805
0.000000	1.000000
0.020000	0.007143

FOR FIELD HT OF 1.00 AND FOCUS POSITION OF 0.0000

ENERGY RATIOS FOR A DELTA Y SHIFT OF 0.200000E-01
WITH A 50 PERCENT VALUE OF -0.301065E-02

-0.043011	0.000000
-0.023011	63.881805
-0.003011	1.000079
0.016989	0.221146
0.036989	0.014817

ENERGY RATIOS FOR A DELTA X SHIFT OF 0.200000E-01
WITH A 50 PERCENT VALUE OF 0.463521E-10

-0.020000	33.370331
0.000000	1.000000
0.020000	0.029967

QUA - Quadrant Detector Analysis

Description of Output