

ZEMAX光学设计 软件介绍

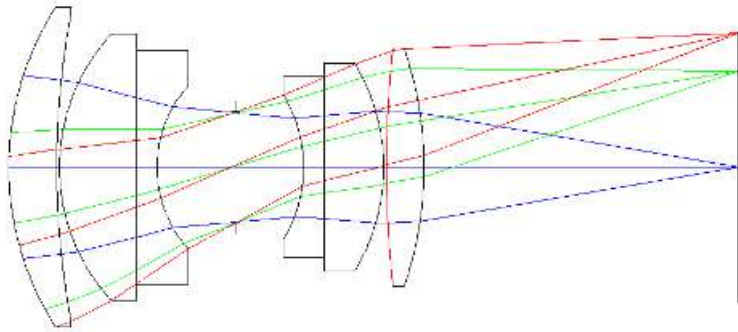
- What does ZEMAX do?

ZEMAX is a program which can **model**, **analyze**, and **assist** in the design of optical systems.

模拟、分析、优化

一个计算器

Surf : Type		Radius	Thickness	Glass	
OBJ	Standard	Infinity	Infinity		
1	Standard	54.1532	8.7467	SK2	
2	Standard	152.5219	0.5000		
3	Standard	35.9506	14.0000	SK16	
4	Standard	Infinity	3.7770	F5	
5	Standard	22.2699	14.2531		
STO	Standard	Infinity	12.4281		
7	Standard	-25.6850	3.7770	F5	
8	Standard	Infinity	10.8339	SK16	
9	Standard	-36.9802	0.5000		
10	Standard	196.4173	6.8582	SK16	
11	Standard	-67.1476	57.3145		
IMA	Standard	Infinity	-		

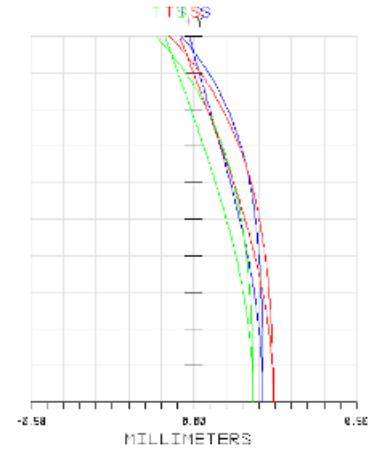


LAYOUT

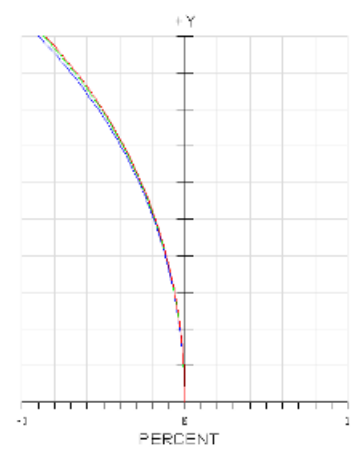
DOUBLE GAUSS
 MON DEC 29 2014
 TOTAL AXIAL LENGTH: 132.99842 MM

DOUBLE GAUSS 28 DEGREE FIELD.ZMX
 CONFIGURATION 1 OF 1

FIELD CURVATURE



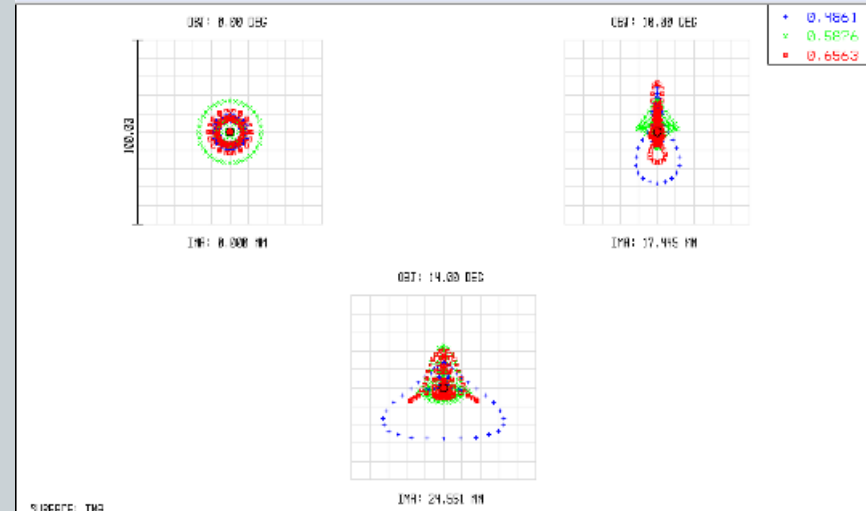
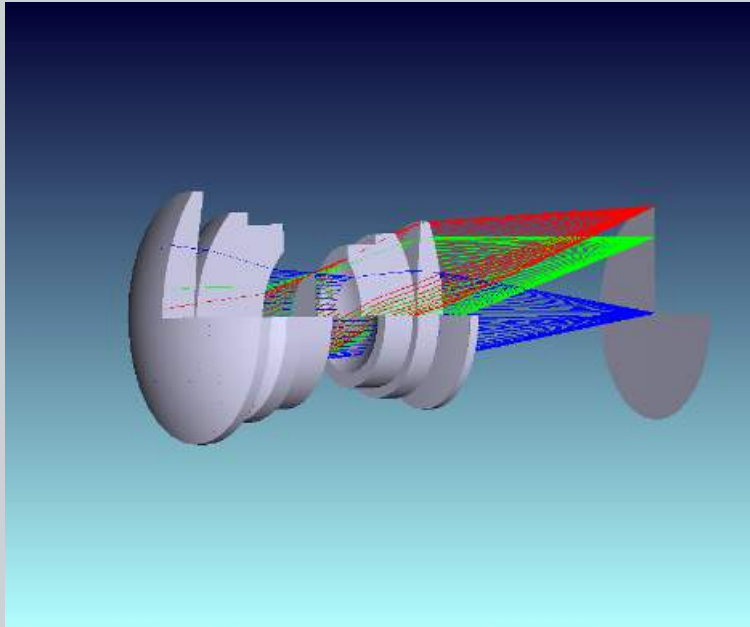
DISTORTION



FIELD CURVATURE / F-TAN(THETA) DISTORTION

DOUBLE GAUSS
 MON DEC 29 2014
 MAXIMUM FIELD IS 14.000 DEGREES
 WAVELENGTHS: 0.4861 0.5896 0.6563

DOUBLE GAUSS 28 DEGREE FIELD.ZMX
 CONFIGURATION 1 OF 1



SURFACE DIA

SPOT DIAGRAM

DOUBLE GAUSS
 MON DEC 29 2014 UNITS ARE UM. AIRY RADIUS : 2.135 UM
 FIELD : 1 2 3
 RMS RADIUS : 8.473 10.879 11.700
 GEO RADIUS : 16.694 26.839 35.333
 SCALE BAR : 100 REFERENCE : CHIEF RAY

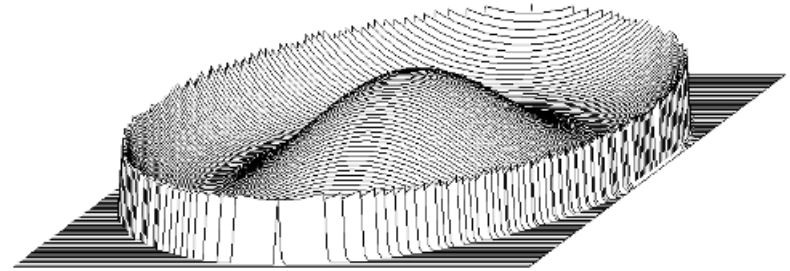
DOUBLE GAUSS 28 DEGREE FIELD.ZMX
 CONFIGURATION 1 OF 1



POLYCHROMATIC DIFFRACTION MTF

DOUBLE GAUSS
 MON DEC 29 2014
 DATE FOR 0.4861 TO 0.6563 μm .
 SURFACE: IMAGE

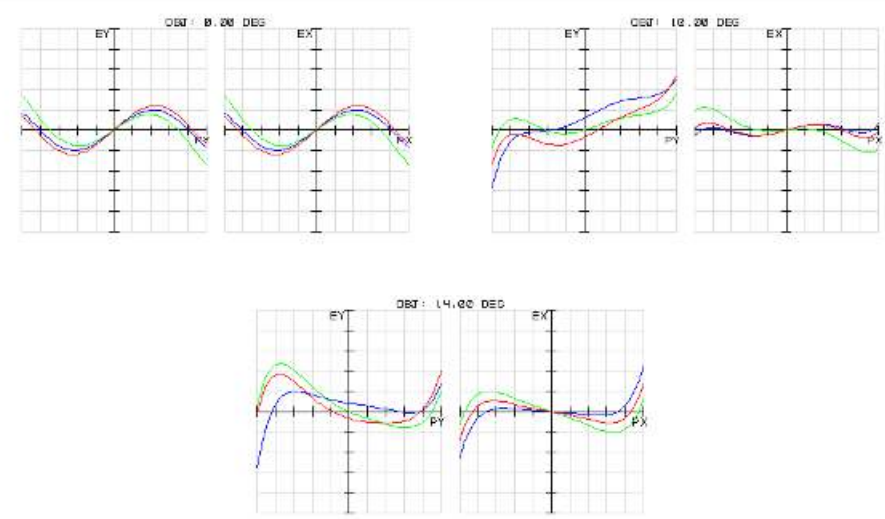
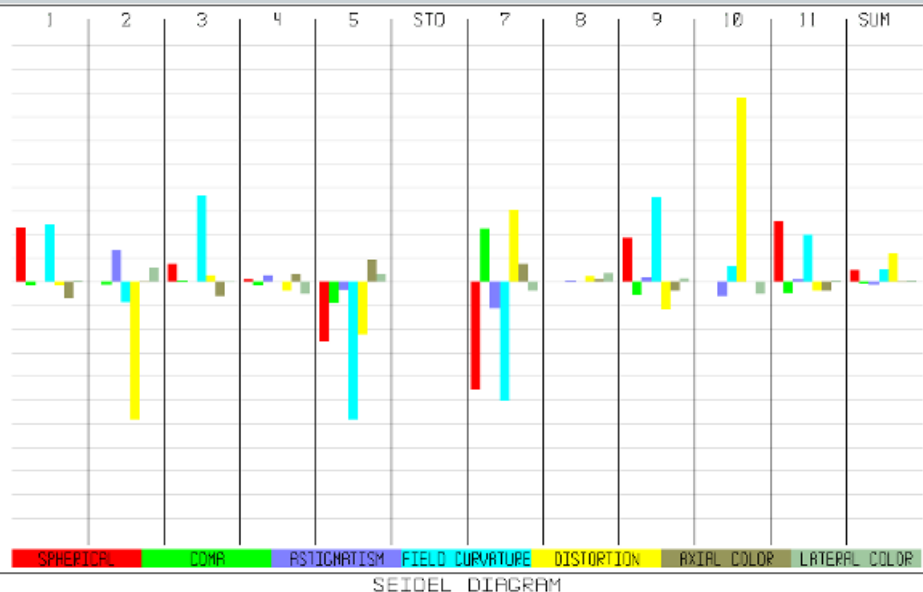
DOUBLE GAUSS 28 DEGREE FIELD.ZMX
 CONFIGURATION : OF 1



WAVEFRONT FUNCTION

DOUBLE GAUSS
 MON DEC 29 2014
 0.5878 μm AT 0.00 DEG
 PEAK TO VALLEY = 0.9942 WAVES, RMS = 0.2602 WAVES.
 SURFACE: IMAGE
 EXIT PUPIL DIAMETER: 3.6258E+001 MILLIMETERS

DOUBLE GAUSS 28 DEGREE FIELD.ZMX
 CONFIGURATION : OF 1



TRANSVERSE RAY FAN PLOT

- What doesn't ZEMAX do?

ZEMAX will not will teach you how to design lenses or optical systems, **you are still the designer.**

软件只是工具

设计光学系统还是要依靠坚实的理论知识。

工欲善其事，必先利其器。

设计实例

焦距：50mm

F/#：2.5

视场： $\pm 20^\circ$

可见光波段

MTF在50线对处高于0.2

双高斯物镜

初始结构数据

焦距： 1.378inch

F/#： 3

视场： $\pm 23^\circ$

表格中结构数据
单位为英寸

TABLE 6.1
Double Gauss Lens

Surface	Radius	Thickness	Material	Diameter
1	0.9377	0.1258	N-LAK33	0.960
2	2.3033	0.0150		0.960
3	0.5241	0.1185	N-LAK33	0.760
4	0.9235	0.0783	SF1	0.760
5	0.3714	0.1466		0.520
6	Stop	0.1109		0.368
7	-0.6206	0.0600	F5	0.500
8	1.5225	0.1311	N-LAK33	0.680
9	-0.9137	0.0175		0.680
10	3.6353	0.2956	N-LAK33	0.860
11	-2.0103	0.7500		0.860

Distance from first lens surface to image = 1.849, distortion = 1.6%.

3.5、优化

①建立优化函数Merit Fucntion

②选择变量

③运行优化

④人工干预，重复①②③，直到系统的指标达到要求

3.5、优化

①选择变量

- 光学系统中各原件的半径、厚度、空气间隔、后截距、**光学材料**。
- 设置变量快捷键：Ctrl+Z
- 不能把所有变量一下子都给出来

3.5、优化

②构建优化函数Merit Function

优化函数是一种数值表示，用来表示当前系统的性能与目标之间的差距。

ZEMAX以一个操作数（operand）列表的形式来描述对整个系统的约束和要求，这些操作数有对像质的要求，对系统结构参数的要求，对光线的要求，对像差的要求等等。

Editors-->Merit Function或F6

优化函数值的计算方法:

W_i: 权重weight

V_i: 当前值value

T_i: 目标值target

$$(MF)^2 = \frac{\sum_i W_i (V_i - T_i)^2}{\sum_i W_i}$$

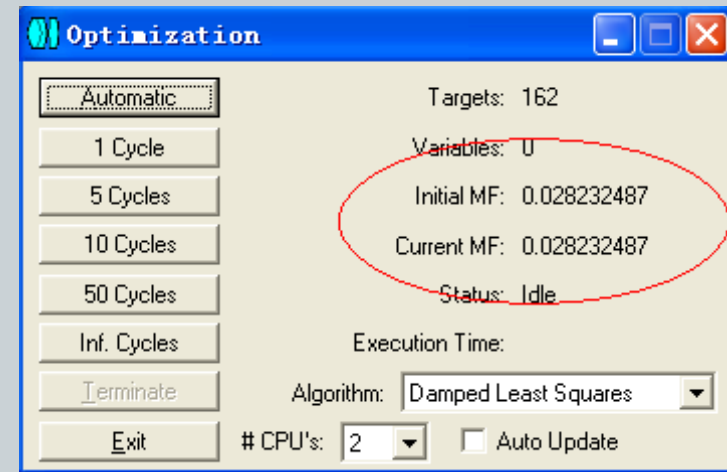
Merit Function Editor: 2.823249E-002

Edit Tools View Help

Oper #	Type		Wave			Target	Weight	Value	% Contrib
1	EFFL	EFFL		1		0.000000	0.000000	39.999995	0.000000
2	SPHA	SPHA	0	1		0.000000	0.000000	22.058112	0.000000
3	COMA	COMA	0	1		0.000000	0.000000	36.877492	0.000000
4	DMFS	DMFS							
5	BLNK	BLNK	Default merit function: RMS spot radius centroid GQ 3 rings 6 arms						
6	BLNK	BLNK	No default air thickness boundary constraints.						
7	BLNK	BLNK	No default glass thickness boundary constraints.						
8	BLNK	BLNK	Operands for field 1.						
9	TRAC	TRAC		1		0.000000	0.016160	7.580213E-003	0.055624
10	TRAC	TRAC		1		0.000000	0.025857	0.029269	1.326854
11	TRAC	TRAC		1		0.000000	0.016160	0.022291	0.481001
12	TRAC	TRAC		1		0.000000	0.016160	7.580213E-003	0.055624
13	TRAC	TRAC		1		0.000000	0.025857	0.029269	1.326854
14	TRAC	TRAC		1		0.000000	0.016160	0.022291	0.481001
15	TRAC	TRAC		1		0.000000	0.016160	7.580213E-003	0.055624

②构建优化函数Merit Function

理想状态下，Merit Function的值为零，即所有的约束、要求都精确的满足。优化过程，就是使整个Merit Function的值尽量小的过程。



Merit Function Editor: 2.823249E-002

Edit Tools View Help

Oper #	Type	Wave	Target	Weight	Value	% Contrib
1	EFL	1	0.000000	0.000000	39.999995	0.000000
2	SPHA	0	0.000000	0.000000	22.058112	0.000000
3	COMA	0	0.000000	0.000000	36.877492	0.000000
4	DMFS					
5	BLNK	Default merit function: RMS spot radius centroid GQ 3 rings 6 arms				
6	BLNK	No default air thickness boundary constraints.				
7	BLNK	No default glass thickness boundary constraints.				
8	BLNK	Operands for field 1.				
9	TRAC	1	0.000000	0.016160	7.580213E-003	0.055624
10	TRAC	1	0.000000	0.025857	0.029269	1.326854
11	TRAC	1	0.000000	0.016160	0.022291	0.481001
12	TRAC	1	0.000000	0.016160	7.580213E-003	0.055624
13	TRAC	1	0.000000	0.025857	0.029269	1.326854
14	TRAC	1	0.000000	0.016160	0.022291	0.481001
15	TRAC	1	0.000000	0.016160	7.580213E-003	0.055624

②构建优化函数Merit Function

•②添加默认评价函数Merit Function

Merit Function Editor-->Tools-->Default merit function

四个关键的选项:

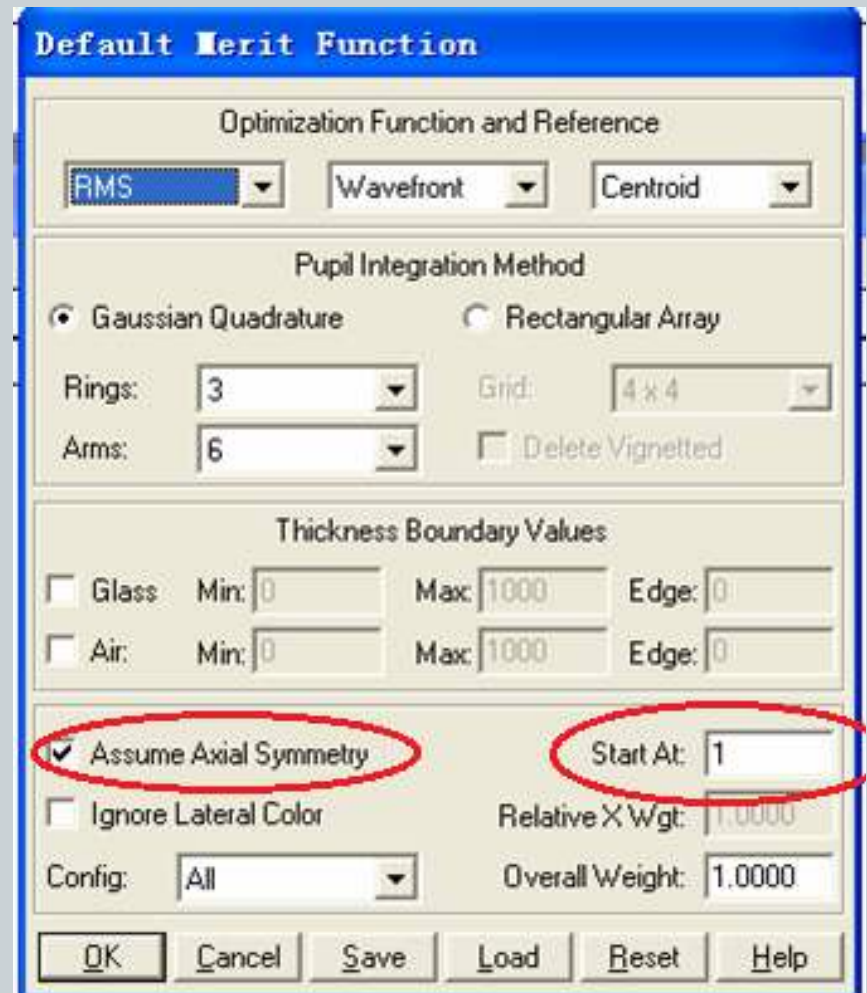
优化类型 optimization type

数据类型 data type

参考点 reference point

综合方法 pupil integration

method



②构建优化函数Merit Function

- **优化类型** optimization type

RMS:Root-Mean-Square的缩写，最常用优化类型。

PTV:Peak-to-valley的缩写。用于对像差的最大值有要求，而不注重平均值的情况。

数据类型：

Wavefront

Spot radius

Spot X

Spot Y

Spot X and Y

以下三种多用于无焦系统：

Angular Radius

Angular X

Angular Y

参考点：

Centroid

Chief ray

Unreferenced--仅用于wavefront模式下

② 构建优化函数 Merit Function

设计不同光学系统时 Default Merit Function 的设定

- 一、针对大像差系统（照相物镜和目镜），使用 RMS+ Spot Radius 来优化。
- 二、针对小像差系统（望远物镜和显微物镜），使用 RMS+ Wavefront 来优化。
- 三、这两种方法可以交替使用

以上内容仅为本文档的试下载部分，为可阅读页数的一半内容。如要下载或阅读全文，请访问：<https://d.book118.com/468017125041006112>