Aber

Software for optical system design

Version 1.04 [106]

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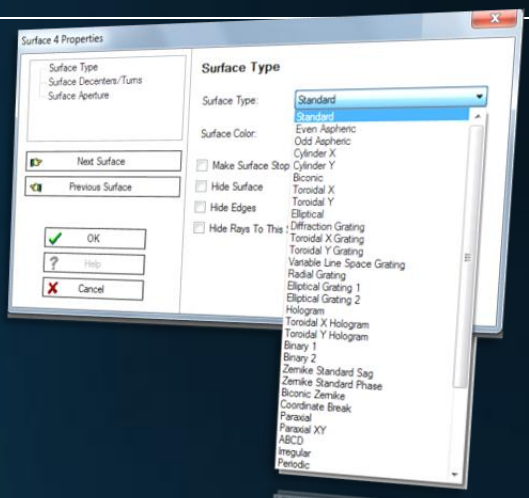
Program Destination:

Modeling, analysis, optimization, and tolerancing of centered, decentered, and spatial optical systems with constant and variable parameters, having refractive and/or reflective surfaces of different types.

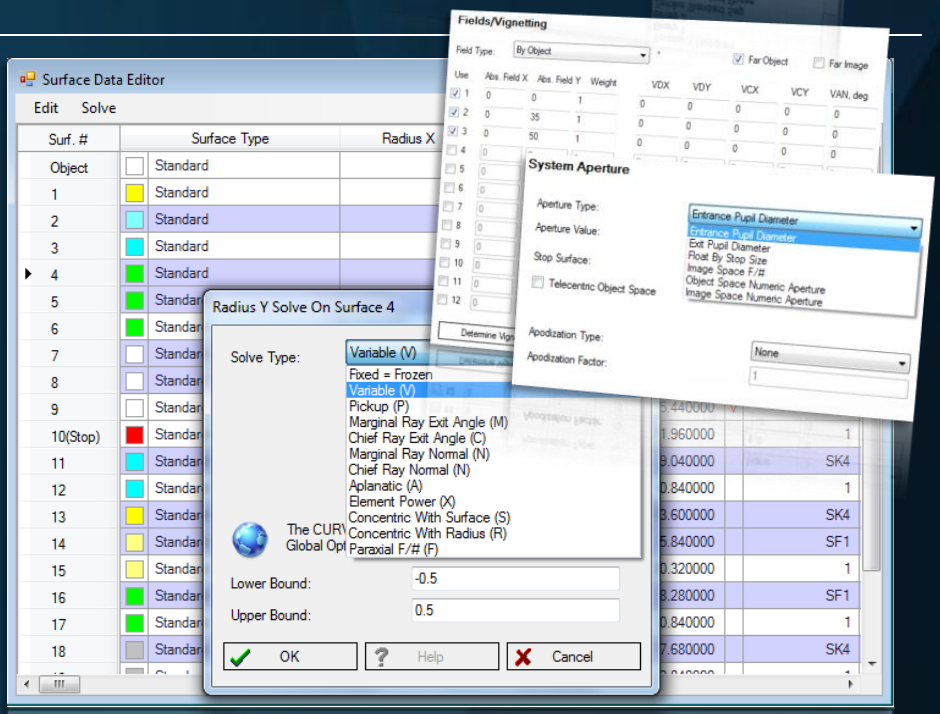
Surface Types:

- Standard (plane, spherical, 2-nd order aspherical);
- Cylindrical;
- High-order aspherical (biconic, odd asphere, even asphere, elliptical, toroidal, Zernike, polynomial);
- Phase;
- Diffraction (straight-line ruled or radial gratings, with constant or variable grating line spacing);
- Hologram;
- Binary;
- etc. (total more than 35 types).



Input Data:

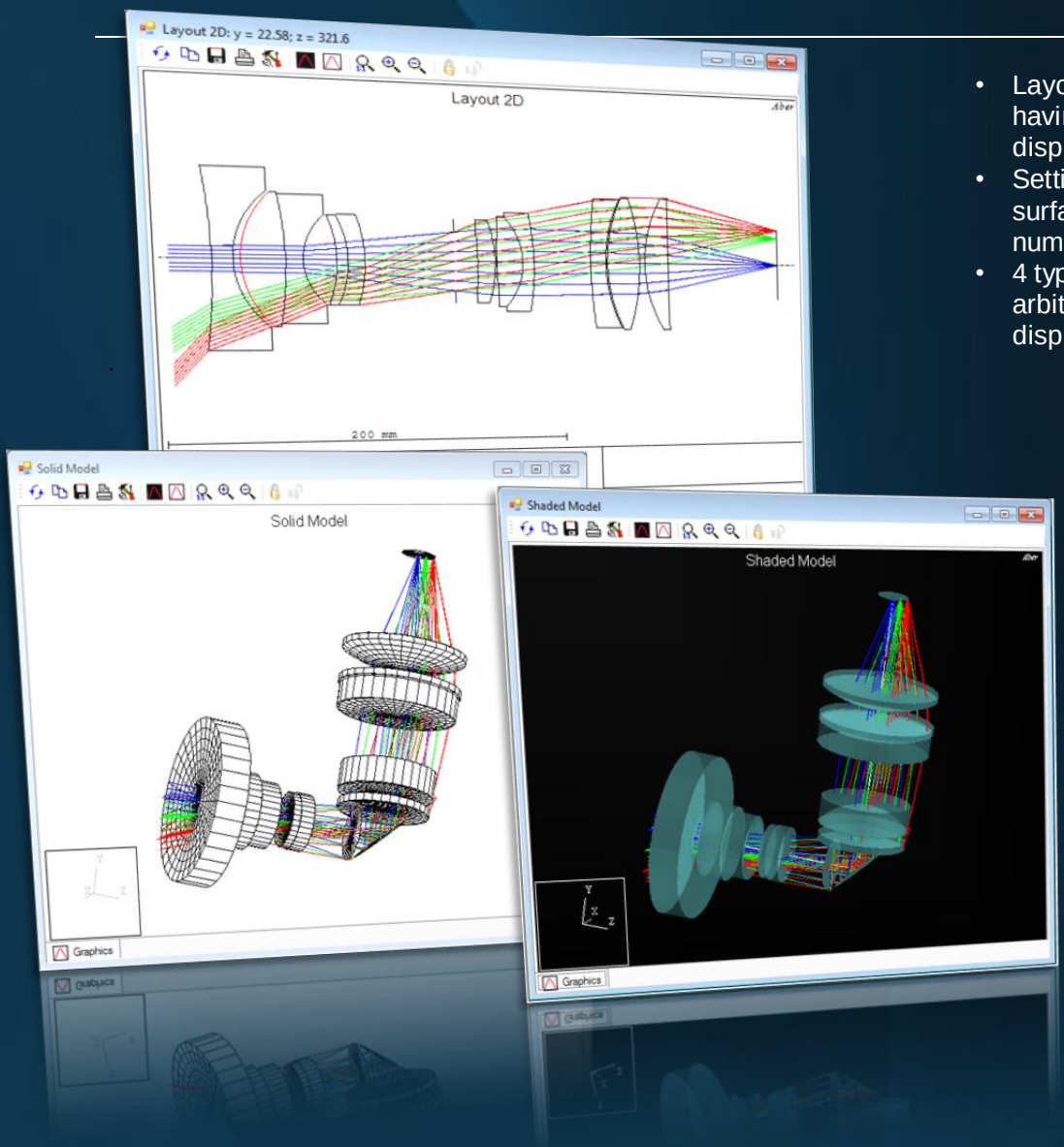
- System aperture may be set by entrance/exit pupil, aperture stop directly, object/image space numerical aperture, or focal ratio;
- Fields are set by object or image values in linear or angular units with vignetting factors;
- Surface Editor with various solves;
- Multi-Configuration Editor;
- The maximum number of wavelengths is 12.



Paraxial Optics:

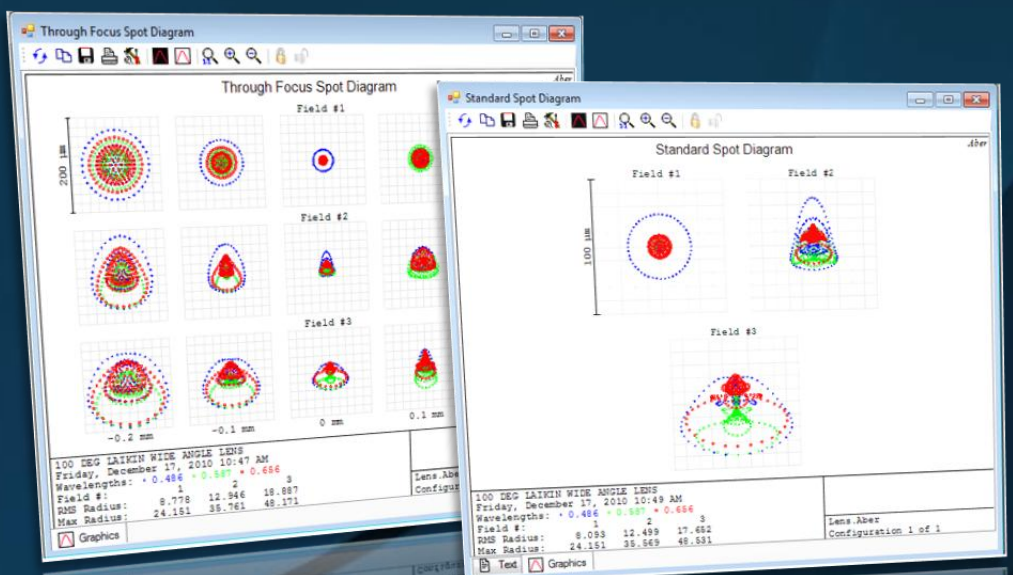
- Cardinal parameters of lens and its components (effective focal length, back focal length, etc.);
- Size and position of pupils, object, and image (classical and generalized, proposed by S. A. Rodionov);
- Angles and heights of zero rays;
- Zeidel sums and chromatic sums;
- Basic coefficients of monochromatic and chromatic aberrations, introduced by V. D. Andreeva.

Layouts:



- Layout 2D for optical systems having an axial symmetry with displaying aspherical surfaces;
- Setting the first and last surfaces to be shown, a number of rays, etc.;
- 4 types of Layout 3D with an arbitrary spatial orientation and displaying aspherical surfaces.

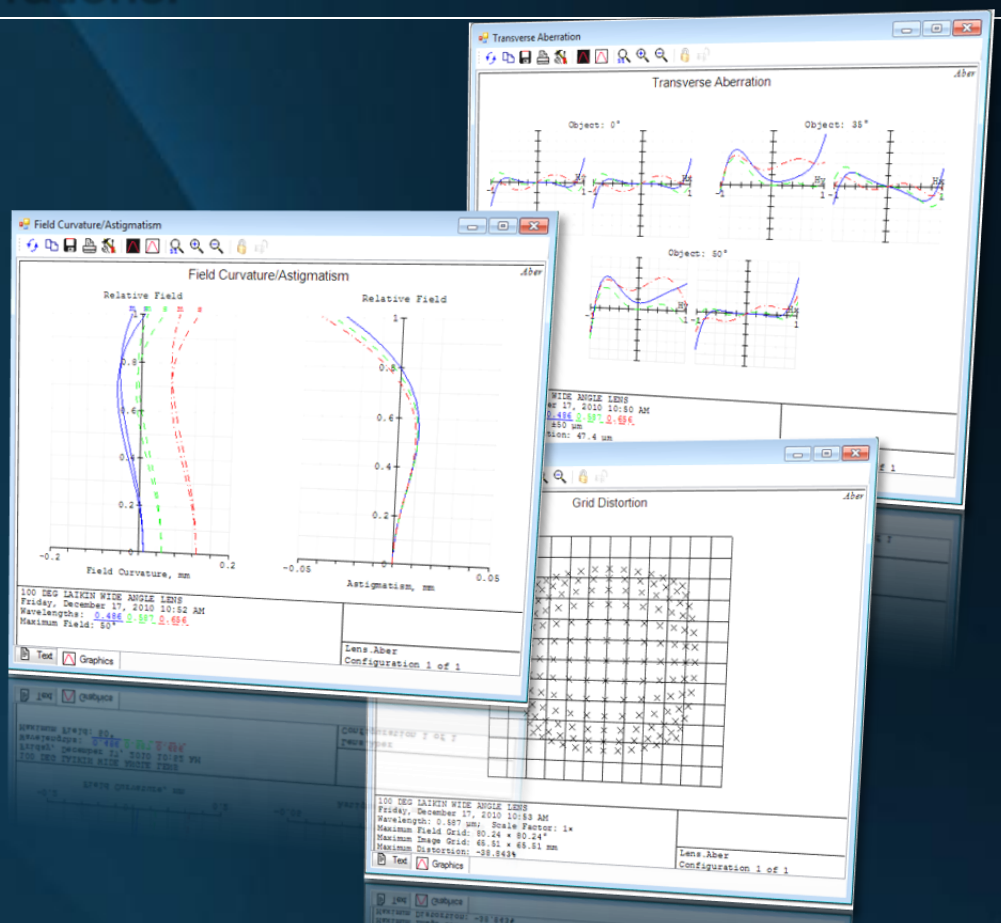
Spot Diagrams:



- Standard;
- Through Focus;
- Wavelength Matrix;
- Configuration Matrix;
- Full Field (all field points on a common scale).

Basic Aberrations:

- Transverse;
- Optical Path Difference;
- Spherical (Longitudinal and Transverse);
- Astigmatism;
- Field Curvature;
- Distortion (Absolute or Relative);
- Grid Distortion;
- Chromatic Focal Shift;
- Lateral Color.



Wavefront:

- Displayed as a 3D-surface or a color map;
- Peak-To-Valley and RMS values;
- Interferogram;
- Zernike coefficients, which approximate wavefront.

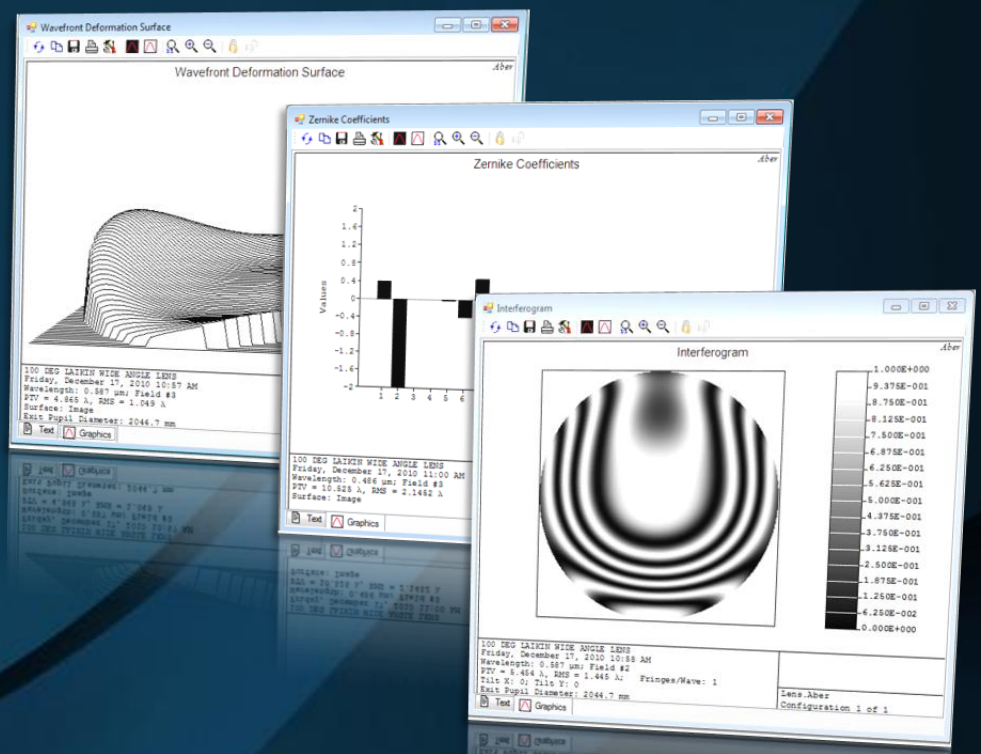
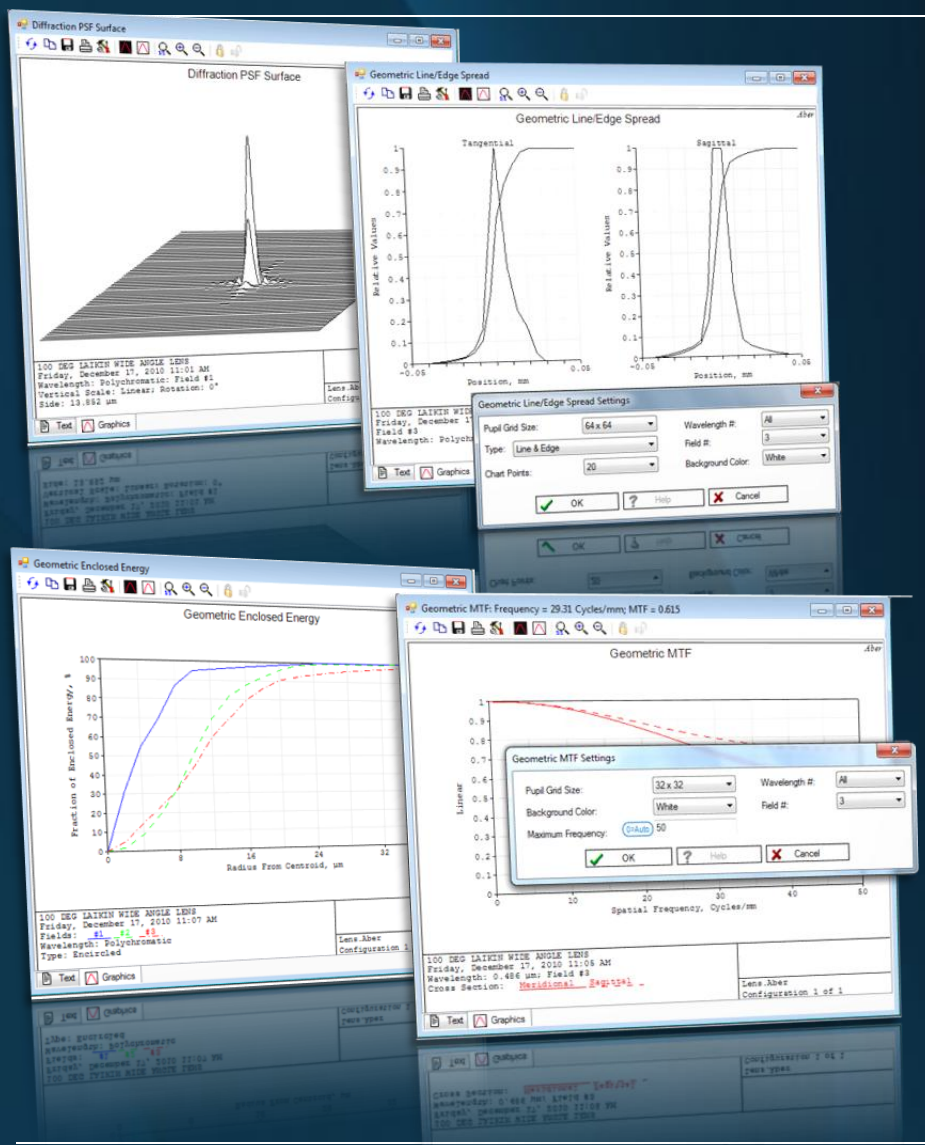
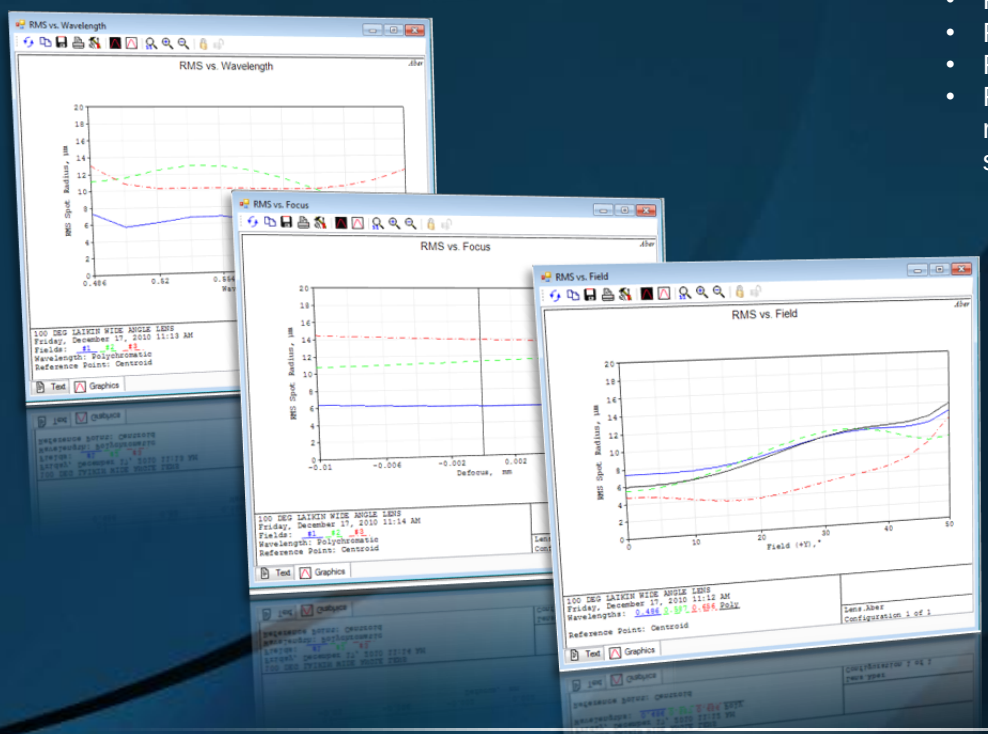


Image Quality:



- PSF (surface and cross section);
- MTF (surface and charts for meridional and sagittal cross sections);
- Enclosed Energy (encircled or ensquared);
- Line and Edge Spread Functions (for meridional and sagittal cross sections);
- In geometrical or diffraction approximation.

RMS:



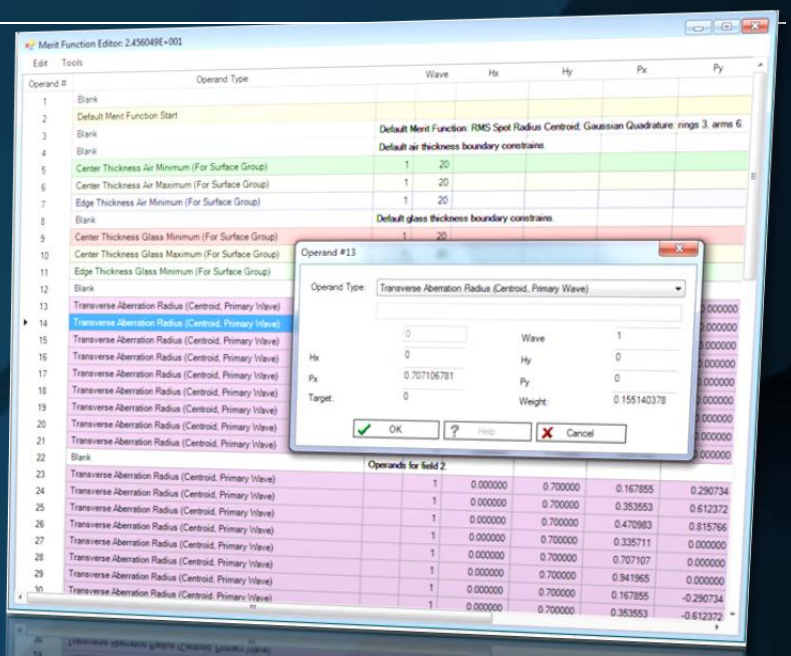
- RMS vs Field;
- RMS vs Focus;
- RMS vs Wavelength;
- For wavefront error, spot radius, spot X size, spot Y size, Strehl ratio.

Glass Catalogs:

- 25+ glass catalogs, including Schott, Corning, Ohara, Sumita, Rad Hard, Infrared, I-Line, Hoya, etc.;
- Comparison of catalogs;
- Abbe diagram;
- Athermal diagram;
- Glass dispersion chart;
- Glass transmission chart;
- Glass Catalog Editor.

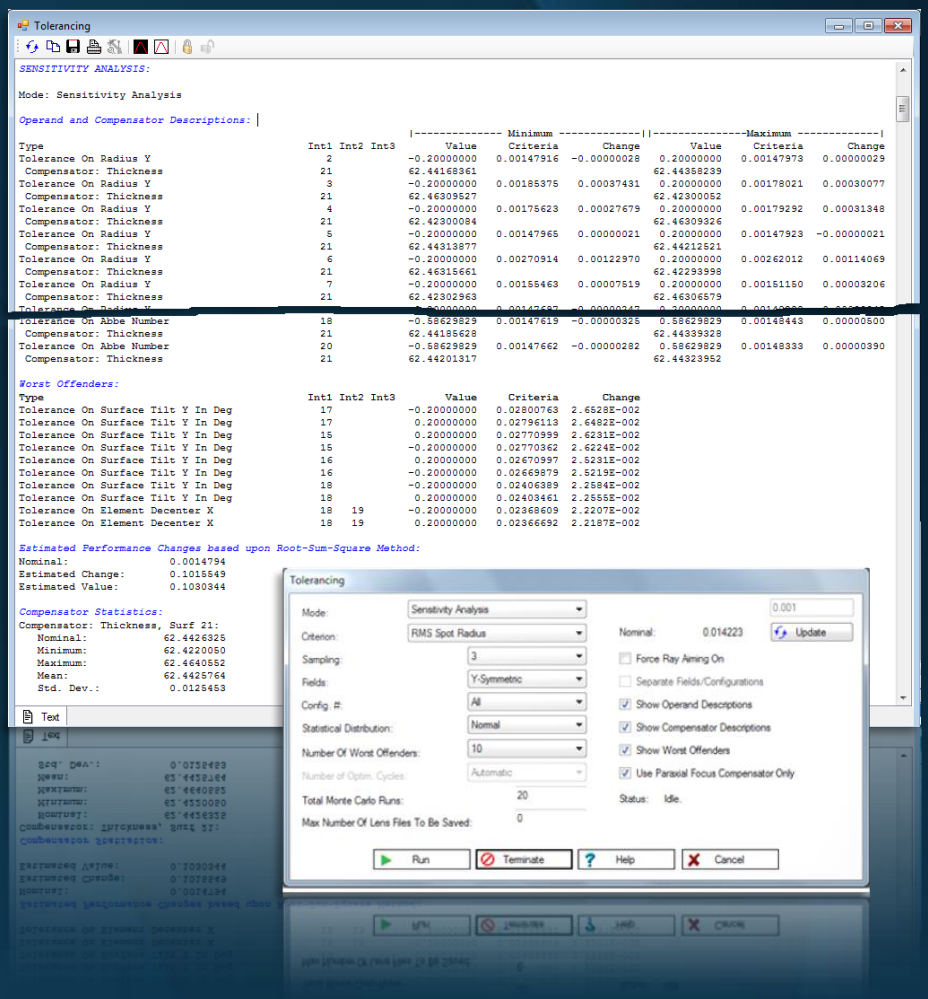
Optimization:

- Local and global optimization with constraints;
- Optimization variables: surface radii, axial thicknesses, conic coefficients, decenters, tilts, specific surface data;
- Merit function operands: various aberrations, lens parameters, constraints on prescription data, etc.;
- Merit Function Editor. A total number of possible operands exceeds 70;
- Default merit functions.



Tolerances:

Tolerance operands include surface radii (in mm or fringes); axial thicknesses; conic coefficients; refraction indices of mediums; Abbe numbers of mediums; surface irregularities; extra (specific) data of surfaces; multi-configuration operands; decenters and turns of surfaces; decenters and turns of optical components. Incorporated tolerancing algorithms are based on computing real rays. An arbitrary number of different compensators is supported.



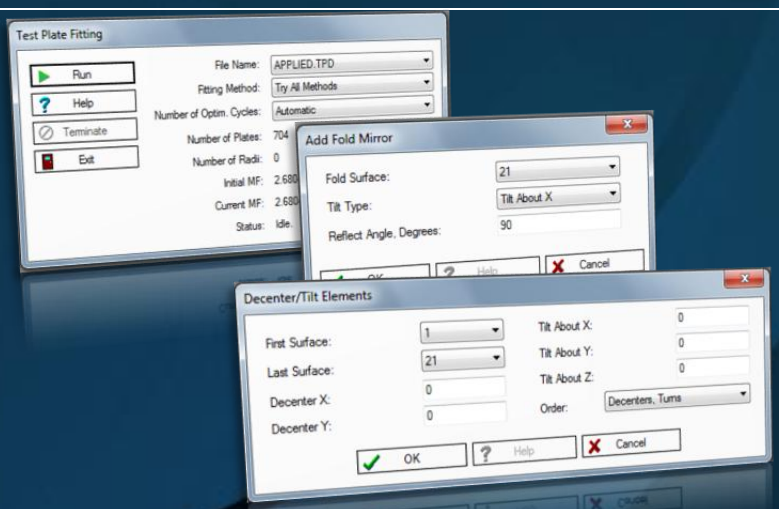
Tolerance criteria:

- RMS Spot Radius;
- RMS Spot X;
- RMS Spot Y;
- RMS Wavefront;
- Boresight Error;
- User's Merit Function.

Tolerance modes:

- Direct Sensitivity Analysis;
- Inverse Sensitivity Analysis;
- Monte Carlo Analysis.

Tools:



- Automatic test plate fitting (4 methods);
- Automatic best aspheric surface search;
- Quick focus;
- Quick adjust (by arbitrary parameter);
- Reverse elements/system;
- Add/delete fold mirrors;
- Decenters and turns of elements;
- Scale the lens;
- Make given focal length;
- Slider.

Program Implementation:

- Microsoft Visual C# from Microsoft Visual Studio 2010;

Microsoft Visual Studio 2010 Ultimate

- To display 3D graphics, Microsoft DirectX and SlimDX are used;
- Multi-window interface;
- Ribbon support;
- Undo/Redo functionality;
- Results are presented as graphics and/or text reports;
- The interface is implemented in three languages: English, Ukrainian, and Russian.

Sample (Spectrometer):

An optical system of a spectrometer shown below contains a slit aperture diaphragm, one diffraction grating, and two tilted mirrors.