

Modeling a slicer mirror using Zemax user-defined surface

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Abstract

A slicer mirror is a complex surface composed by many tilted and decentered mirror sub-surfaces. The major difficulty to model such a complex surface is the large number of parameters used to define it. The Zemax's multi-configuration mode is usually used to specify each parameter (tilts, curvatures, decenters) for each mirror sub-surface which is then considered independently. Otherwise making use of the user-defined surface (UDS-DLL) Zemax capability, we are able to consider the set of sub-surfaces as a whole surface. In this paper, we present such a UDS-DLL tool comparing its performance with those of the classical multi-configuration mode. In particular, we explore the use of UDS-DLL to investigate the cross-talk due to the diffraction on the slicer array mirrors which has been a burden task when using multi-configuration mode.

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1. Introduction

Since several years a research and development activity on image slicer system for integral field spectroscopy is conducted with already in-use instrumentations, such as GEMINI/GNIRS (Dubbeldam et al., 2000), and future applications for major ground-based (VLT second-generation instruments (Henault et al., 2003)) and space (JWST

(Prieto et al., 2003), SNAP (Ealet et al., 2002)) observatories.

An image slicer system is usually composed of a slicer mirror array associated with rows of pupil mirrors and slit mirrors. These components are formed by a segmented assembly of several tilted and spherical mirrors. Making use of optical design software ZEMAX®, the classical modeling method consists of using the multi-configuration mode. However, the use of such a mode implies that each mirror is independently computed compared with each other. Furthermore, such classical modeling is

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time-consuming because ZEMAX® has to compute a large number of parameters (i.e., curvatures, tilts, decenters for each sub-mirror) and configurations (one by sub-mirror) to consider the whole instrument.

Taking advantage of UDS-DLL Zemax capability, we present an easier method to simulate segmented surfaces (slicer mirror array and rows of mirrors).

2. Slicer mirror user-defined surface

For those cases where a specialized surface is required, ZEMAX® supports a user-defined surface (UDS). All the properties of such a surface are defined in a separate C or C++ program, compiled and linked into ZEMAX® using a Windows® dynamic link library (DLL). The DLL contains functions which compute and return to ZEMAX® all the data required to draw the surface, trace rays, compute refraction angles, etc.

The UDS-DLL lends itself to model slicer mirrors by offering a complete description of their segmented surfaces. Fig. 1 shows two complex surfaces modeled using two different UDS-DLL: a micro-lenses array as included in ZEMAX® and a slicer mirror array here developed (called LAM-DLL).

2.1. A slicer mirror

The LAM-DLL allows to model a slicer mirror array where each individual mirror has a rectangular clear aperture and could be spherical or flat in shape. One may specify the number of slices and their dimensions as well as curvatures and tilts for each slices. Their *X* and *Y* positions (Fig. 2) are directly controlled by the LAM-DLL while their *Z* position along the current optical axis may be specified for each slice individually. Surface sag and ray propagation are computed, and basically a closed loop with ZEMAX® is established in order to determine which segment of the slicer mirror array is struck by the rays on the one hand, and on the other, to use the local curvature and tilts to compute the properties of the reflected rays.

In such a way, a slicer mirror array is correctly described by two sets of data parameters specified in the Lens Data Editor or in the Extra Data Editor described as follows.

2.2. Parameter data

Making use of Lens Data Editor, the user may specify parameters defining the whole component such as the number of slices and their dimensions in both *X* and *Y*

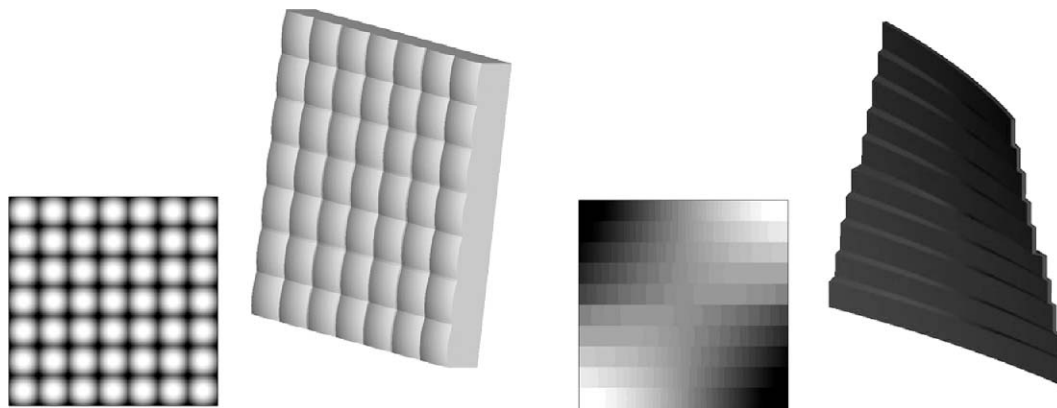


Fig. 1. At left, a lens array user-defined surface included with ZEMAX® (3D-view and surface sag). At right an example of slicer mirror array modeled using the LAM-DLL here developed.

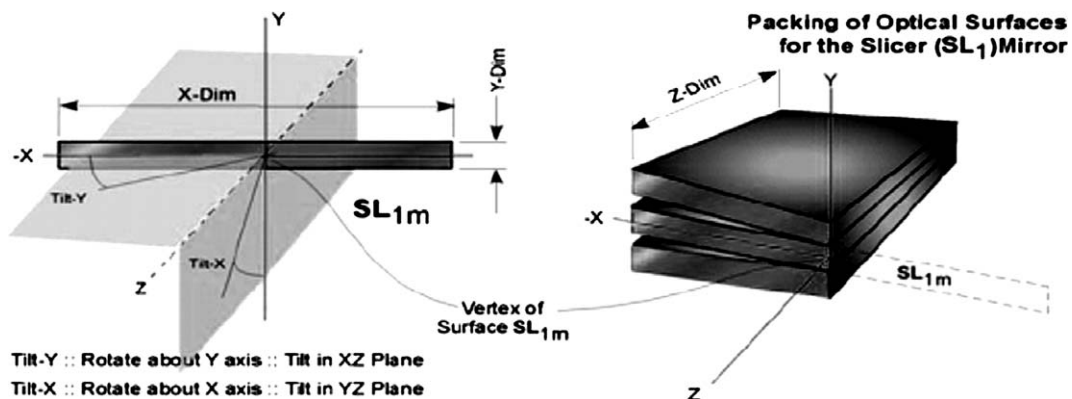


Fig. 2. Slicer mirror array optical specifications and notations.

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