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Imaging hyperspectrometer-consol

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Abstract

Produced imaging hyperspectrometer is used as a consol. Due to minimized design, the spectrometer consists only of a diffraction grating and diaphragm, so it becomes a very inexpensive device. A diffraction grating with a period of 6 μm was made using the technology of direct laser beam recording on chromium. Microrelief with the depth of 580 nm was produced as a result of etching liquid. This hyperspectrometer used as an add-on device to any photorecorders, which allows to use it in hyperspectral mode.

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Keywords: imaging hyperspectrometer; diffraction grating; hyperspectrometer-consol

1. Introduction

New methods of obtaining and analyzing spectroscopic information about the object are recently developed in applied spectroscopy. A number of applied problems grow and it requires the analysis of hyperspectral information. At the same time hyperspectral images are often received not with Earth observation satellites, but with small aircrafts. Therefore, there is a need to minimize hyperspectral tools for ease of use. One of the ways to make it more compact is to reduce the number of structural elements of the optical system. There are plenty of imaging spectrometers schemes [1-3].

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There are compact constructions which are based on diffractive lens [4-6] and the grating lens [7, 8]. Gathering of the information in such structures is complicated by high complexity of processing algorithms and it is often impossible to obtain sufficient spectral resolution.

Dyson [9] and Offner [10-12] schemes are costly due to the large number of items and the manufacture of diffraction gratings on spherical surfaces.

Optical schemes of the most modern spectrometers contain a dispersive element such as diffraction grating, which involves the usage of first order diffraction to decompose the image into spectrum. For example, such approach is suitable for the tasks of remote sensing. For the formation of hyperspectral images in the field a relatively compact hyperspectrometer is needed. Thus, it is desirable to get the hyperspectral images of acceptable quality [13, 14].

In this regard, there is a need to produce low-cost hyperspectrometers of a small size. In this work, we will consider hyperspectrometer-consol for the cameras.

2. Imaging hyperspectrometer-consol

Increasingly there is a need for a rapid obtaining of hyperspectral images in different areas. Various constructions of hyperspectrometer are produced to satisfy these requirements, but most often these devices are too complicated and expensive. In this paper we consider hyperspectrometer in the form of attachment to the photorecorders. Fig. 1 illustrates the scheme of hyperspectrometer-consol, where it is attached to the device – 1 which has a photosensitive matrix (CCD matrix), 2 – the lens (standard lens), 3 – diffraction grating, 4 – diaphragm, i.e. the design of the spectrometer is a diffraction grating, slit aperture and outer hull which connects these two elements.

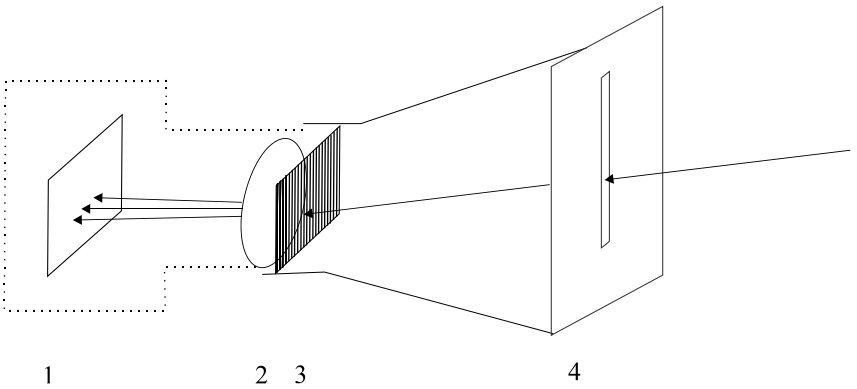

Fig. 1. Construction of hyperspectrometer – consol, where 1 is CCD matrix, 2 – lens, 3 – diffraction grating, 4 –diaphragm.

As a dispersive element, a diffraction grating with a period of 6 μm was made using the technology of direct laser beam recording on chromium. Template entry was carried out on a chromium with a thickness of 45 nm, and then were etched to a depth of 580 nm. Figure 2 presents forms of the microrelief as the results of the measurements on the white light interferometer ZYGO New View 5000.

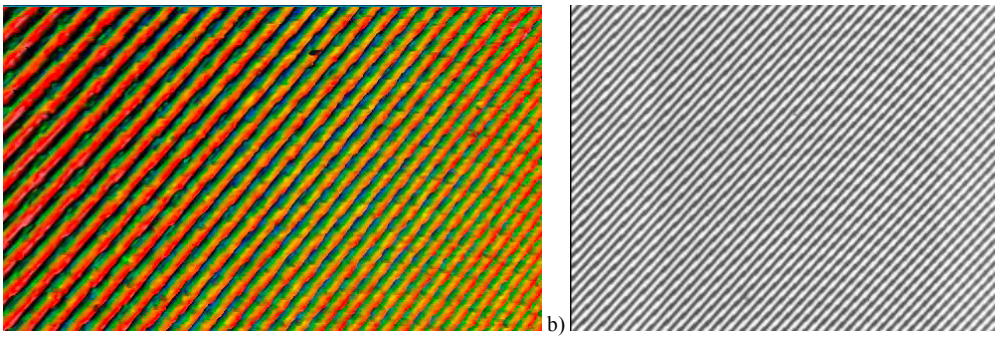

Fig. 2. Part of the phase function of the diffraction grating: a) 3D image of the area; b) the image obtained through the optical microscope.