Theorem 1 Birkhoff curve contains the only fixed point.
K. Kuratowski (1928) proved that an indecomposable continuum cutting a plane into two regions turns out to be monostratic (monostratique) [1]. Therefore, the Birkhoff curve has the only fixed point with an index being equal to zero. It is simple. So that, the Birkhoff curve is consisted to be nonwandering indecomposable continuum turning out to be two invariant regions boundary with respect to dynamic system acting on the plane. The Birkhoff curve geometric model has been constructed based on the Knaster example indecomposable continuum having two composants [2]. Endpoints (0,0) and (0,1) of the Knaster's continuum are glued by the formula $(y-7/20)e^{2\pi x} \mapsto x+iy$.
Now, on the assumption of the principle of constructing the Birkhoff curve geometric model, geometric models of the nonwandering continua turning out to be three regions common boundary have been constructed. The continua turn out to be three regions common boundary. Moreover, these constructions turn out to be more adapted to dynamic systems.

[1] Kuratowski, C. *Sur la structure de fronti'eres communes 'a deux r'egions*. Fund. Math., **12** (1), *21-42* (1928)
[2] Knaster B. *Un continu dont tout sous-continu est indécomposable*, Fund. Math. **3**, *247-286* (1922).
[3] Serow, D.,W. *Nonwandering Continuum Possessing the Wada Property*. Theor. and Math. Phys., **207**, 3, *841-853* (2021).

Dynamic holography for light fields transformation and materials diagnostics of advanced photonics and electronics

A.L.Tolstik
Belarusian State University, Minsk, Belarus

The report presents a review of the theoretical and experimental studies in the field of dynamic holography, its history and the development stages are considered, new trends in its applications in science and engineering are indicated with the use of the obtained results. The classical holography aspects are treated along with the nonlinear-optical approach based on multiwave interaction schemes in the case when the third-order and higher-order nonlinearities are involved. Special attention is given to the use of dynamic holograms for the control of laser beams and for the real-time wave front transformation of light beams, singular including. The techniques to realize the topological charge inversion and multiplexing as well as the frequency transformation of images, showing much promise for 3D image visualization and for data coding when using the light-bean polarization and topological charge as information parameters, have been proposed. New schemes of contactless diagnostics for functional materials have been suggested on the basis of the dynamic grating method. The possibility to separate different nonlinearity mechanisms due to variations in the wave length of laser radiation and in the grating period is shown. The methods of measuring the parameters of bulk and thin-film semiconductors and also of the activated crystals (thermo-optical coefficient, thermal diffusivity, lifetime of the carriers, lifetime of the excited state, and so on) are considered.

A detailed study of the Bragg diffraction on the regular domain structures with inclined walls in 5%MgO:$LiNbO_3$ crystals

S.M. Shandarov[1], E.N. Savchenkov[1], A.V. Dubikov[1], D.E. Belskaya[1], S.V. Smirnov[1], N.I. Burimov[1] , M.A. Chuvakova[2], A.R. Akhmatkhanov[2], V.Ya. Shur[2]
[1]Tomsk State University of Control Systems and Radioelectronics, Tomsk, Russia,
[2]Ural Federal University, Ekaterinburg, Russia

Regular domain structures (RDS) in lithium niobate crystals provide nonlinear transformations of the spectral characteristics of laser radiation in the quasi-phase-matched regime as well as controlling thereof temporal, spatial and polarization parameters with high efficiency. The linear Bragg diffraction on RDS is the nondestructive method to study of their quality and parameters. We report the results of an experimental study and theoretical analysis of Bragg diffraction on RDS with inclined walls in a sample of 5%MgO:LiNbO3 at different positions of the center of an elliptical probe laser beam with a waist size of about 25 μm along the polar Z axis. From the experiments it has been found that the diffraction efficiencies for different spatial harmonics of perturbations of the optical properties created by the walls of the RDS in the crystal are characterized by nonmonotonic behavior. Under theoretical analysis of the observed features of Bragg diffraction we have used an approach based on the Fourier decomposition of dielectric tensor perturbations created by inclined walls of the RDS in discrete spatial harmonics with coefficients determined by the components of the continuous angular spectrum.

Plasmon-Enhanced Optical Nanolithography

S.Kurilkina, *N. Khilo*
Institute of Physics of the NAS of Belarus, Minsk, Belarus
s.kurilkina@ifanbel.bas-net.by

In this report, we propose and investigate a scheme for optical nanolithography of the interference type based on the use of excitation of counter-propagating surface plasmon-polaritons at a flat interface of a metal-dielectric nanostructure. A detailed calculation of the optical nanolithography scheme designed to form sinusoidal diffraction gratings is performed. It is shown that the use of an input prism with a large refractive index allows increasing the gain of the field formed in the photoresist by more than an order of magnitude. The conditions are analyzed for which maximal gain of the field (the penetration depth into photoresist, respectively) and maximal resolution of created gratings are achieved. It is found that by changing the thickness of the layers of the metal-dielectric structure, it is possible to change the wave number at which the plasmon resonance condition is realized, and thereby to control the period of the formed gratings and the depth of field penetration into the photoresist.

The possibility of application of proposed scheme (with certain modifications) for creating two-dimensional and circular gratings, as well as gratings of arbitrary shape is discussed.

Transverse structure of interfering laser beams in canonically conjugate coordinates

V.V. Kabanov, *A.O. Nehryienka*
Institute of Physics of the NAS of Belarus, Minsk, Belarus
v.kabanov@ifanbel.bas-net.by

Analysis and control of the transverse structure of laser beams (LB) is an important task, new approaches to the implementation of which are opened by adaptive digital holography. Here, along with highly efficient optoelectronic devices, such as digital cameras and spatial light modulators, numerical methods for processing data on the transverse structure of interfering LB are widely used. The paper considers the implementation of an off-axis scheme for recording the interference pattern (IP) with subsequent discrete Fourier analysis in canonically conjugate coordinates, which allows the IP to be decomposed in the frequency representation into individual components, including those responsible for the formation of the object and phase-conjugate LB. It has been experimentally demonstrated that increasing the IP resolution in frequency coordinates by increasing the Fourier transform array ultimately reaches the resolution level in canonically conjugate spatial coordinates. In this case, decreasing the sampling step in the frequency representation allows resolving the spectral components of the speckle structure detuned from the spectrum of the original LB with greater reliability. It also significantly reduces the error in reconstructing the true phase of the original signal caused by the mismatch between the real value of the carrier frequency and the discrete detuning of the spectral components by ±1 orders, determined with an accuracy of up to one step. It has been shown that analysis and processing of a digital hologram with a high resolution in canonically conjugate coordinates allows reconstructing the wave front of the signal beam with a high degree of accuracy, correcting the interference introduced by both individual optical-electronic units of the holographic system and those formed by the speckle structure.