Report Information from ProQuest

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目录

Correction: Robust low threshold full-color upconversion lasing in rare-earth activated nanocrystal-in-glass microcavity

Progress on intelligent metasurfaces for signal relay, transmitter, and processor

摘要 (ENGLISH)

Pursuing higher data rate with limited spectral resources is a longstanding topic that has triggered the fast growth of modern wireless communication techniques. However, the massive deployment of active nodes to compensate for propagation loss necessitates high hardware expenditure, energy consumption, and maintenance cost, as well as complicated network interference issues. Intelligent metasurfaces, composed of a number of subwavelength passive or active meta-atoms, have recently found to be a new paradigm to actively reshape wireless communication environment in a green way, distinct from conventional works that passively adapt to the surrounding. In this review, we offer a unified perspective on how intelligent metasurfaces can facilitate wireless communication in three manners: signal relay, signal transmitter, and signal processor. We start by the basic modeling of wireless channel and the evolution of metasurfaces from passive, active to intelligent metasurfaces. Integrated with various deep learning algorithms, intelligent metasurfaces adapt to cater for the ever-changing environments without human intervention. Then, we overview specific experimental advancements using intelligent metasurfaces. We conclude by identifying key issues in the practical implementations of intelligent metasurfaces, and surveying new directions, such as gain metasurfaces and knowledge migration.
This article offers a unified perspective on how intelligent metasurfaces facilitate wireless communication in the ways of signal relay, transmitter, and processor.

Deep learning enhanced light sheet fluorescence microscopy for in vivo 4D imaging of zebrafish heart beating

摘要 (ENGLISH)

Time-resolved volumetric fluorescence imaging over an extended duration with high spatial/temporal resolution is a key driving force in biomedical research for investigating spatial-temporal dynamics at organism-level systems, yet it remains a major challenge due to the trade-off among imaging speed, light exposure, illumination power, and image quality. Here, we present a deep-learning enhanced light sheet fluorescence microscopy (LSFM) approach that addresses the restoration of rapid volumetric time-lapse imaging with less than 0.03% light exposure and 3.3% acquisition time compared to a typical standard acquisition. We demonstrate that the convolutional neural network (CNN)-transformer network developed here, namely U-net integrated transformer (UI-Trans), successfully achieves the mitigation of complex noise-scattering-coupled degradation and outperforms state-of-the-art deep learning networks, due to its capability of faithfully learning fine details while comprehending complex global features. With the fast generation of appropriate training data via flexible switching between confocal line-scanning LSFM (LS-LSFM) and conventional LSFM, this method achieves a three- to five-fold signal-to-noise ratio (SNR) improvement and ~1.8 times contrast improvement in ex vivo zebrafish heart imaging and long-term in vivo 4D (3D morphology + time) imaging of heartbeat dynamics at different developmental stages with ultra-economical acquisitions in terms of light dosage and acquisition time.
The CNN-Transformer parallel network UI-Trans enables high-quality light sheet zebrafish heartbeat imaging, with ultra-economical acquisitions in terms of light dosage and acquisition time.

An achromatic metasurface waveguide for augmented reality displays

ProQuest 文档链接

摘要 (ENGLISH)

Augmented reality (AR) displays are emerging as the next generation of interactive platform, providing deeper human-digital interactions and immersive experiences beyond traditional flat-panel displays. Diffractive waveguide is a promising optical combiner technology for AR owing to its potential for the slimmest geometry and lightest weight. However, severe chromatic aberration of diffractive coupler has constrained widespread adoption of diffractive waveguide. Wavelength-dependent light deflection, caused by dispersion in both in-coupling and out-coupling processes, results in limited full-color field of view (FOV) and nonuniform optical responses in color and angular domains. Here we introduce an innovative full-color AR system that overcomes this long-standing challenge of chromatic aberration using a combination of inverse-designed metasurface couplers and a high refractive index waveguide. The optimized metasurface couplers demonstrate true achromatic behavior across the maximum FOV supported by the waveguide (exceeding 45°). Our AR prototype based on the designed metasurface waveguide, exhibits superior color accuracy and uniformity. This unique achromatic metasurface waveguide technology is expected to advance the development of visually compelling experience in compact AR display systems.

Microcavity optomechanical magnetometry with picotesla-sensitivity

ProQuest 文档链接

摘要 (ENGLISH)

A new microcavity magnetometry with FeGaB thin film achieves 1.68pT/$Hz^{1/2}$ sensitivity, which is two orders of magnitude improvement over previous work. Corona current detection has been demonstrated using this magnetometer.

Dispersive optical activity for spectro-polarimetric imaging

ProQuest 文档链接

摘要 (ENGLISH)

A spectro-polarimetric imaging approach leverages optical rotatory dispersion in natural crystals to encode spectral information into polarization states. The system demonstrates effectiveness in laboratory and outdoor field experiments, showing potential for biological microscopy, machine vision, and remote sensing applications.

Innovations in bulk photovoltaics: design strategies for boosted photocurrent

ProQuest 文档链接

摘要 (ENGLISH)

The limitations imposed by low contact resistance, restricted polarization access, and tensile strain in bulk photovoltaic systems were mitigated by the engineering and optimization of edge semimetal contacts using Bi/Au. Improved bulk PV photocurrent and intriguing prospective applications are made possible by this effort.

Compact and reciprocal probe-signal-integrated rotational Doppler velocimetry with fiber-sculpted light

ProQuest 文档链接

摘要 (ENGLISH)

In recent years, with the clarification of the mechanism of the rotational Doppler effect (RDE), there has attracted extensive attention to its development of applications, especially in the detection of the angular velocity of rotating objects. On the other hand, optical fiber technology is widely applied in laser velocimetry from beam delivery to scattered light collection, aiding the miniaturization of instruments. Here we report the first all-fiber rotational Doppler velocimetry (AF-RDV) with a single probe based on a fabricated mode-sculpted fiber-optic element. The constructed AF-RDV can be operated in two reciprocal schemes wherein exchanging the illuminating mode and detected mode. Using this, we experimentally demonstrate the mode-changing dependent nature of the RDE. Particularly, the results suggest that the rotational Doppler shift can be observed by mode-filtering the scattered signal even with a non-twisted probe light. We also show the achromatic property of the RDE by scanning the incident wavelength, enabling the AF-RDV within an ultra-broadband operation range. The AF-RDV exhibits favorable performance for detecting spinning rough surfaces. It may provide an exciting new practical sensing instrument with significant prospects for monitoring angular motion in both research and industry.