Three Laser Beams Overlapped To Produce A Elements Of W And The Four Measurements Are Performed By Three Dimensional Filed According To The Present Invention

Methods, systems and apparatus for characterizing the polarization properties of radiation or optical fields which fluctuate three-dimensionally

UCF engineering professors have designed a novel device capable of simultaneously measuring properties of radiation occurring in three different directions. The data provide detailed information concerning both the radiation emission processes and the intricate interaction between light and matter. Using probes that couple all three components of the field, the polarized and unpolarized components are extracted to produce what can be called “three-dimensional polarimetry”. Instead of superimposing three dipole-like detectors, this method uses a single probe placed within the three-dimensional (3D) field. The result is a linear combination of the measurements possible with three independent dipoles. Using a sufficient number of independent measurements, one can retrieve the entire polarimetric information about an incoming beam with prior knowledge of its direction. Such novel technology is of high interest for various sensing applications, such as: microscopy, remote sensing, defense and homeland security.

Polarization is significant in areas of science and technology such as optics, seismology, telecommunications and radars. It is characterized by the direction of propagation and orientation of light, as well as frequency range and intensity. In many remote-sensing applications one has to determine the polarization properties of the radiation that is scattered from a distant or near target. The detected radiation is usually a complex mixture of components that originate from a target (e.g., oceanic suspensions, clouds, snow fields, bio-liquids), background, or some other source. In addition, different manifestations exist in which a direction for the net flow of energy cannot be assigned because these radiations occur in three dimensions.

Technical Details

The complete determination of the characteristics of a 3D field requires simultaneous measurements of the properties of the field in three different directions. This could be realized by using three orthogonal dipole-like probes which are overlapped spatially and which detect simultaneously. However, in the optical domain, this approach cannot be implemented because an ensemble of three dipoles which can be read independently simply does not exist. Additionally, prior art devices and parameters used were limited only to radiations fluctuating in two dimensions. Therefore, there is a need for a novel approach for characterizing the polarization properties of an electromagnetic field which fluctuates three-dimensionally.
Benefits

- Easily integrates into any surface shape, increasing accuracy and sensitivity in different environments
- Couples to an optical fiber for remote intensity detection
- The sensor is small in size, light weight and low in power consumption

Applications

- Medical field for fluorescence and multi-photon microscopy to study the structure of tissues, cells, sub-cellular structures, proteins and DNA
- Near-field optics to resolve features of much smaller size (in nanometers) as well as reveal the complex interaction of light and matter
- Defense, as an imaging device to provide improved visions for objects or targets embedded in dense scattering media (e.g., clouds and aerosols)

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