Title
Polarization Control Units

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Abstract: Integrated structured light architectures are configurations which control the structure of light by manipulating its parameters, including amplitude, phase and polarization state.

INTRODUCTION

Waves have three different polarization states— linear, circular, and elliptical. Linearly polarized waves are confined to a single plane, circularly polarized waves have the same amplitude and are related by a phase difference of pi/2, and any wave that doesn't meet these conditions falls under elliptical polarization. The polarization of a wave affects its properties and applications. The polarization state of a wave can be entirely determined by the electric field— the magnetic field is not considered.

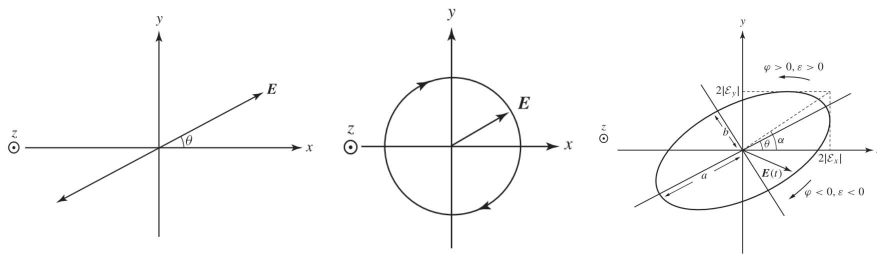

Figure 1: Fields of Different Polarization States

METHODS

The polarization of light is a key element in its structure. The conceptual light bullet generator contains intensity and polarization control units for each beam in the array. The polarization unit in particular contains a half waveplate, quarter waveplate, and a beam splitter as part of its configuration.

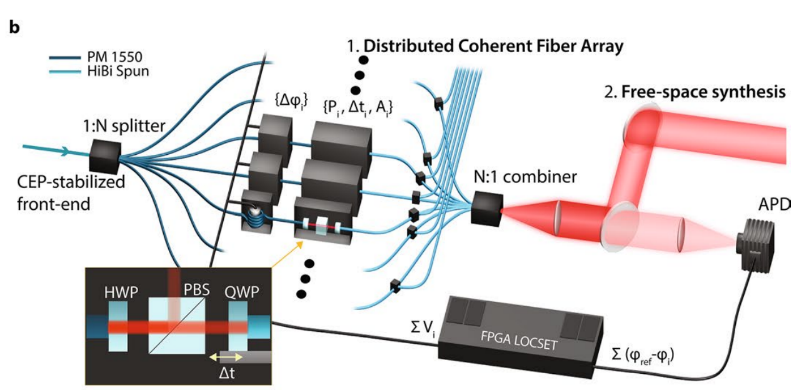

Figure 2: Conceptual Design for Adaptable Light Bullet Generator

The first element, half waveplate, is used to rotate linearly polarized light. The angle of rotation depends on how the axis of the waveplate is aligned in reference to the incident beam of light. The thickness of the plate can be determined with

$$l_{1/2} = \tfrac{1}{2} * (2\pi \ / \ (k^y - k^x)) = \lambda \ / \ 2|n_y - n_x|$$

Odd multiples of this formula also give the same result. For this formula to work, the refractive index of x and y cannot be equal.

The second element is a quarter wave plate, which can convert linearly polarized to circular, or circular to linear. For linear to circular conversion, the wave plate should be arranged so that it makes a 45° angle with the incident light. Any other angle will result in an elliptical polarization. The equation to determine the thickness is similar to the half wave-plate, and it’s odd multiples are also valid:

$$l_{1/4} = \tfrac{1}{4} * (2\pi \ / \ (k^y - k^x)) = \lambda \ / \ 4|n_y - n_x|$$

The last component mentioned is a beam splitter. There are multiple types of beam splitters— those that break down unpolarized light into p (parallel) and s (polarized) components, and those that separate polarized light based on the reflectivity and transmissivity ratio, without altering the polarization state. The paper mentions a polarizing beam splitter, which aligns with the first definition.

RESULTS AND INTERPRETATION

The components used to control the polarization of the wave in this device are intended to be programmable and adaptable. There isn’t much detail about how these control units are operated, but the intent is to create a wide range of possibilities for the final pulse. Each beam in the array has its own polarization control unit, and they don’t all need to have the same configuration, which leads to interesting and unique possibilities even before considering the other parameters which can be manipulated, such as the amplitude and phase.

For example, even without converting any of the waves to a circular polarization, a circularly polarized wave can still be generated as a result, by combining two waves which are linearly polarized in perpendicular directions. The waves can also be polarized and manipulated to interfere with each other, either strengthening or reducing the final output.

CONCLUSIONS

The polarization of light is a crucial aspect when it comes to giving a light structure. Any architecture which seeks to manipulate light should have components to control its polarization state.

REFERENCES

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