High speed stereo imaging techniques for flame studies

Engineering

Research proposal, Engineering and Construction High-speed stereo imaging techniques for flame studies Department: submission:

Introduction

The field of engineering has seen many successful researches in the previous decades. Many inventions have been made that are applicable in many fields. The medical field has benefited a lot due to the invention of efficient diagnostic methods. These methods require modification to suit the user's needs in terms of cost and efficiency. This research proposal explores the properties and behavior of some inventions used for high speed imaging diagnostic purpose. It includes novel laser sources, detectors and optical systems.

Properties and Behavior of Novel Laser Sources

Developing novel laser sources has been one of the active researches since the invention of the first laser more than five decades ago. Researchers have invented several laser sources currently in use for several purposes. According to Blaum (2003), these first laser sources are expensive though efficient; hence the need to improve them in terms of reducing the cost while maintaining efficiency. Caspani (2013) says examples of novel laser sources include optical parametric oscillators (OPOs) and diode-pumped Nd lasers. These laser sources have certain properties and behavior as explained in the following paragraphs.

Optical parametric oscillators involve optical cavities that resonate at comb frequencies. They have ultra-small volume due to their optical cavities with dimensions in microns. The ultra-small volume results in increased sensitivity to heat induced by a pump laser; hence shifting the cavity resonance. Chang

(2010) says this needs continuous manipulation of the pump wavelength in order to track the thermal drift. When pumped by an appropriate external laser, the micro cavities generate multiple, equally spaced new frequencies through nonlinear optical processes.

Diode-pumped Nd lasers include Nd: YVO4, Nd: GdVO4, Nd: FAP, Nd: SFAP, and Nd: SVAP and are all crystals in nature. According to Liu (2014), the crystals belong to two different types of structures. Both Nd: YVO4 and Nd: GdVO4 have the zircon (vanadate) structure which is tetragonal with a space group of141/amd while Nd: FAP, Nd: SFAP and Nd: SVAP have the apatite structure which is hexagonal with space group of P63/m. They all have high emission-section lifetime product, which means they should have a low threshold. According to Wirsig (2010), the temperature dependence (dn/dT) is positive for the vanadates while negative for the apatites meaning the vanadates have higher thermal sensing than the apatites. According to Patterson (1989), the thermal conductivity of the vanadates goes up to 2. 5 times than the apatites; hence giving the poor thermal conductivity limits and power handling capability of apatites. According to Forman (1995), all the apatite structure compounds show one dominant emission line. In terms of crystal growth, all melt congruently and successfully grown by using melt-pulling method.

Properties and Behaviors of Detectors

Detectors use radio signals to relay information. Several types of detectors exist and each used for different function including light detection, radio waves, mobile phones, magnetic resonance imaging and X-ray detection among others. Infrared light detectors can be attached to contact lenses and mobile phones because of their tiny structure. They contain a single layer of carbon atoms called Graphene that senses infrared spectrum together with visible and ultra-violet light. Reinhardt (2010) says detectors are always connected to other devices that record their ability to detect light photons from objects. Usually, a photon passes through an apparatus and interacts with the detector, which is connected to another device, for example, a camera that shows the object has been detected. Detectors are used to produce images of solid objects in the body such as tumors. The radio waves relay information that can be printed in a special paper (Forman et al., 1995).

Optical Systems

Optical systems involve apparatus that use light sources to visualize objects. Many sophisticated visualizing equipments have been invented and includes microscopes and fiber optics tubes. According to Hiraoka and Sedat (1990), microscopes have unique properties such as the ability to allow scientists observe biological specimens examined as living samples or under surroundings that closely simulate living conditions. Three-dimensional images are obtained by sequentially increasing the position of the focal plane. The behavior of objective lens, which is the principle image-forming component, dominates the optical properties of a microscope system. Egelhaaf and Borst (1989) agree that fiber optic tubes use light to transmit information over narrow tubes instead of electricity. They form useful diagnostic equipment in medicine such as endoscope, which provide non-invasive images of internal body organs.

Conclusion

The discussions above show that imaging techniques have greatly improved due to the invention of several methods. The inventions of optical systems, laser, and detectors have enabled experts to obtain quality and fast images for diagnostic purposes. Nevertheless, these inventions require modification and invention of new techniques to increases efficiency.

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