Light Field Research

Carson Vogt

PhD

Heriot-Watt University

31 August 2015

Abstract

abstract

List of Figures

Contents

1 Introduction **3**

2 Work Done **5**
2.1 Comparison of Platforms 5
2.2 SLAM 5

3 Proposed Research **6**
3.1 steps 6

Chapter 1

Introduction

What is your hypothesis

"There are many potential formats which could be used for VR video. Light-fields [Levoy and Hanrahan 1996] provide the greatest level of immersion if they can be captured for a suitable volume"

"...a practical solution for this has not yet been demonstrated"

Current light field technology is built on the parameterization put forward by Levoy in 1996. If we go back just five years to the original paper regarding the plenoptic function, we see a critical element missing from the the function: time. There are two major problems associated with light fields currently. The method for data collection is often bulky or slow and limited in its capabilities (cite the papers). The other issue is that it requires a static scene.

We aim to not only improve on the work of (unstructured light fields), but to develop a system that can take time into account for a dynamic light field experience.

Light fields are a rising method for rendering scenes. With the rising popularity of virtual reality, light field technology has the potential to revolutionize the way in which viewers interact with subjects of interest, like sports matches.

WE want to create a system that can capture a light field and effectively turn it back into a 5D problem, where time is one of the specified parameters

2 Review of Light Field Research

The concept behind the light field goes back hundreds of years, stemming from *da Vinci(?)s work with pinhole cameras that allowed him to understand light at a point, a pencil However, it was still not referred to as such. Plenoptic function [1] is a function that describes all of the light in a scene (Go through the derivation for the plenoptic function)

Even after the seminal Light Field Rendering paper, Plenoptic imaging continued

With *Light Field Rendering*, a more reasonable and computable description of the plenoptic function was created in the form of the 4D light field

parameterizations varied

Isaksen's dynamic reparameterization

It's not until 2012 that we see unstructured light fields

Methods for Collection

The light field camera, shown in [13] is an interesting device that makes use of modern CCDs(acronym?) Insert image of one here

Minimizing the amount required to collect(cite review and actual article) Move on to the more recent papers of Sparse lightfields and learning based view synthesis

Unstructured light fields paper also shows a method for collection utilizing a single camera and a SLAM algorithm known as PTAM(cite PTAM paper). Of course, this research is now a bit aged and can be improved in a number of ways, potentially expanding it significantly with the addition of a more robust and wide-ranging(?) SLAM method such as ORB-SLAM2(cite)

ADD FIGURE OF LYTRO CINEMA CAM AND JUMP CAMERA

The current trend for light field cameras seems to be going in the direction of multi-camera mobile aparatus, as shown in figure(blah?) The use cases for these capture methods are limited.

Chapter 2

Work Done

2.1 Comparison of Platforms

2.2 SLAM

Chapter 3

Proposed Research

3.1 steps

Looking at the work utilizing SLAM in unstructured light fields and improving upon it by initially using the superior ORB-SLAM technique, then further by applying the methodology to

PR2 image

Show ardrone image

While there are existing drones that can easily be controlled from the computer and capture data, there is clear lag high risk of data loss due to the transmission method (wifi). Instead, I would propose to make some simple modifications that would allow data capture and control in real time. Drone Image + hardware

Bibliography

[1] Adelson, Edward H. (1991). *The Plenoptic Function and Elements of Early Vision*

[2] *Jump: Virtual Reality Video*

[3] *Plenoptic Sampling*

[4] *Unstructured Light Fields*

[5] *The Lumigraph*

[6] *Principles of Light Field Imaging*

[7] *Dynamically Reparameterized Light Fields*

[8] *Real-Time Surface Light-field Capture for Augmentation of Planar Specular Surfaces*

[9] *An Interactive Tool for Designing Quadrotor Camera Shots*

[10] *Learning-Based View Synthesis for Light Field Cameras*

[11] *A Viewpoint Dependent Stereoscopic Display Using Interpolation of Multi-Viewpoint Images*

[12] *Light Field Rendering*

[13] *Plenoptic Modelling: An Image-Based Rendering System*

[14] *Digital Light Field Photography*

[15] *Time-Lapse Light Field Photography With a 7 DoF Arm*

[16] *Light Field Reconstruction in the Continuous Fourier Domain*

[17] *A Review of Image-based Rendering Techniques*

add ptam, orb-slam,