High Resolution 3D Reconstruction Using a Hexacopter Drone

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High Resolution 3D Reconstruction Using a Hexacopter Drone

Introduction

Many projects in the Vision Lab utilize aerial data, and the hexacopter drone is an effective way to obtain this aerial data. The TurboAce Cinewing 6 hexacopter carries a Canon 5D Mark III on board and has a flight time of up to 25 minutes. It is lightweight and easy to maneuver during flight making it an efficient way to collect aerial data.

Methodology

We utilize a 3D reconstruction algorithm designed to support various automation and navigation applications. The algorithm used focuses on the 3D reconstruction of a scene using only a single moving camera. Utilizing video frames captured at different points in time allows us to determine the depths of a scene.

Data Collection Procedure

A fully charged hexacopter flies for 20-25 minutes and collects imagery at 30 frames per second. For our experiments we select a target and fly around/along it to obtain the imagery needed to create a 3D model. Video recordings of the flight are extracted into individual frames to be used by the structure from motion algorithm. Noisy and redundant frames are discarded.

Results

Test 1: Single Car Model

Input Imagery

3D Point-Cloud Model

Test 2: Stonemill Street Model

Input Imagery

3D Point-Cloud Model

Future Direction

In the future, we plan to incorporate autonomous control signals that will utilize the real time 3D models to determine the best flight path. The ultimate goal of the projects is create a fully autonomous Unmanned Aerial Vehicle (UAV).

Hardware Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>TurboAce Cinewing 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>6 x 15” Ultra Stiff Carbon Fiber Propellers</td>
</tr>
<tr>
<td>Camera</td>
<td>Canon 5D Mark III</td>
</tr>
<tr>
<td>Lens</td>
<td>Canon TS-E 17mm f4 L Tilt-Shift Lens</td>
</tr>
<tr>
<td>Flight Time</td>
<td>25 Minutes</td>
</tr>
<tr>
<td>Maximum Payload</td>
<td>10lbs</td>
</tr>
<tr>
<td>Battery</td>
<td>10,000mAh 25C 6S (22.2V) LiPo</td>
</tr>
<tr>
<td>Transmitter</td>
<td>NAZA V2</td>
</tr>
<tr>
<td>Flight Capabilities</td>
<td>Manual, GPS Course Lock, Return-to-Home</td>
</tr>
</tbody>
</table>

Algorithm

Progressive for Noise Removal
- Noise Reduction
- Bilinear Interpolation
- Video Restoration

- Super Resolution
- 3, SURF Extraction
- 2, Feature Matching

- Optical Flow Formulation
- 4, Disparity Map
- 5, Depth Map

- Plane Localization
- 6, Point Cloud Model
- 8, Database Registration

- Noise Suppression

Camera paths during data collection