Chapter 1

Literature Review for the Topic: Visual Servoing for Aerieal Maniputation

1.1 High Accuracy Visual Servoing for Aerial Manipulation using a 7 Degrees of Freedom Industrial Manipulator

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2016 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) Daejeon Convention Center October 9-14, 2016, Daejeon, Korea

1.1.1 Introduction

- System composed of a Flettner-helicopter and 7 DoF manipulator.
- Aerial manipulation systems can be used to do this dangerous, difficult or expensive work in locations that can only be reached while flying. Examples are maintenance and inspection of tall buildings, power lines, chemical plants, bridges or work in mountain areas. Another example is manipulation and in-situ measurements during nuclear, chemical or biological disasters and accidents.
- Successful aerial manipulation and building of complex structures have been presented in [1], [2] and [3].
- An outdoor aerial manipulator using an 7 DoF manipulator and on-board visual perception has been studied in [4].
- A visual servoing control for aerial manipulation using on board cameras and marker detection to grasp a bar achieving 1cm accuracy is presented in [5]. (TODO: Check reference [5]).
- At this scale the flying platform dynamic has a great impact on the accuracy of the manipulator end-effector or tool center point (TCP).
- Attention was payed to the coordinated control of arm and helicopter as well as to the active compensation of the arm movement in the helicopter controller.

- The dominant factor for the accuracy of a flying manipulator however is the time it takes to measure a position difference and to compensate it using the manipulator or the flying platform.

1.1.2 System Overview

- The cameras are mounted to the front of the helicopter looking downwards.
- This position was chosen because the manipulator workspace between the landing skids is inside the field of view of the cameras.

1.1.3 Robust Multi Marker Object Localization

- The view from the on-board camera towards the object will likely be occluded.
- A possible solution would be to mount cameras to the manipulator. This sensor position is problematic when the manipulator is very close to the object. The object could be out of focus or only a very small portion of the object would be in the field of view making localization difficult.
- To compensate object occlusions we propose an algo- rithm that uses the localization of objects from the scene surrounding the target object. When the relative position of the surrounding objects are known this information can be used to indirectly localize the target object. We simplified the object localization task by using known artificial markers which provide in a very low false positive detection rate and accurate 6 DoF localization.

1.1.4 Automatic Hand-Eye Calibration Using Marker Localization

- The transformation from the camera frame to the manipulator base frame has to be known as precise as possible to reduce the static positioning error during visual servoing.

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