Obstacle Detection Using Monocular Camera for

Low Flying Unmanned Aerial Vehicle

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Thesis Defence Revisions

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Prof. Miodrag Bolic

* Your background review states that the slam algorithm for obstacle detection was used for simulation results why didn’t you compare these simulations to your work
* How do you qualify your work as one of the first [DONE]
  + When it come to processing real data, most research have forward looking camera for land robot, and downward looking camera for aerial vehicles. Forward looking camera used in aerial vehicle for obstacle detection is rare. (add a sentence or 1 in PROBLEM STATEMENT). [DONE]
* Regarding obstacle detection, the UAV is above the obstacles. It looks like the primary goal is observing landmarks as opposed to obstacle detection (Answer the way to detect them is the same). Is the title correct?
  + Mention it somewhere in the flight test result. (The way to detect them is the same)[DONE]
* How did you determine the landmarks?
  + This should be touched in introduction, maybe problem statement? [DONE, stated in beginning of chapter 4]
* How does the algorithm behave when it misses some of edges due to light conditions?
  + Add in algorithm description, the predicted landmark coordinate is fed to visual tracking algorithm, and reduce matching error, increase matching speed, reduce the probability of losing a landmark under light change. [DONE, added paragraph in Chapter 4 Flowchart section]
* In the beginning of Chapter 6, page 52, error caused by slam algorithm due to non-linearity but this is not shown in the algorithm
  + Revisit in “ideal case” and stating that error caused by non-linearity is very small, and is good [DONE, explained in the summary of “ideal case”]
* One other source of error is that the model can be improved
  + Add this at the beginning of chapter 6 error source discussion [DONE]
* Regarding the results, is there a way to summarize the results? In some graphs you have a very large number of graphs. Could you give, for example the mean square of the error? This will help quantify the results through a table or a summary
  + Add a table or two to summarize landmark error and distant. [DONE].
  + Optional: bundle the distance plot, and highlight the drifting features. [DONE Chapter5]
* Page 48; is this the real terrain map? Why aren’t they matching? What is an acceptable error in this application?
  + Give more description on the terrain map comparison. [DONE]
* Why didn’t you use map joining from the beginning?
  + Clarify in Q&A, not added into thesis.
* Did you consider particle filtering as opposed to Kalman filtering?
  + Particle filter take more computing power, and are in general slower. Clarify in Q&A, not added to thesis.

Prof. Mohamed El-Tanany

* When you talk about the implementation, you elected to use Python as opposed to matlab; why? Does it offer you advantages in terms of processing speed?
* What was your ultimate objective?
* It will be good to mention the real-time requirements of your algorithm
  + Will runs some test, and add a table [DONE]
* Monocular vs binocular. A lot of pixels in the image are not relevant. Is the use of a camera the most appropriate for obstacle detection (compared to sonar, …)
  + This was touched in sensor review in the thesis. No further action.
* Impact of landmark shape and distribution
* Given your experimental setup, it looks like the kind of resolution that you are looking for is quite high whereas the ground truth data is only 100 meters
  + Add accuracy of the ground truth [DONE]
  + Ground truth was interpolated [DONE]
  + Provide a reference to evaluate the accuracy of the estimated landmark
* You noticed some discrepancies with the slam algorithm so you used simulation to investigate specific error source. How did you model the errors and run the SW long enough to assess its impact
  + Add some text describing the purpose of the simulation, and the use of it. Clarify the simulation is to mimic the scenario seen in flight, and to analyze them independently. [DONE]

Prof. Paul Straznicky

* You mentioned several times the oscillation of the UAV. It affects the results. Was it a feature of the towed bird or would it be present in the actual UAV? The frequency of 1 Hz is too high for an actual UAV. If the frequency is reduced, how would it affect the error that you have predicted?
  + Add text to mention the varying amplitude in sine wave simulate the rate of change of rotation. 1Hz sine with varying amplitude covers a big range in rate of change in the analyzed motion [DONE, added in introduction of 6.2]
  + A more appropriate approach is to do frequency analysis. That’s a whole new series of work, won’t be added in the thesis. Maybe comment in future work?

Prof. Miodrag Bolic

* I was expecting that the manual landmarks will lead to better results. This is not the case in your thesis? Answer: because they are at the edge. Why didn’t you use some in the middle?
* Variance: Figure 5.5, why does the variance increase this way?
  + Explained in the thesis. Clarify in Q&A. No further action.
  + Add unit to the variance plot, (and any plots that’s missing unit) [DONE]

Prof. Mohamed El-Tanany

* The analog image was recorded in the UAS. Why was the camera and data acquisition system so big? Do you know how fast your recording sampling rate was?
  + Include some text stating the sample rate\* [DONE, included in chapter 3, 2nd paragraph]
* Could you run your algorithms in fixed point as opposed to floating point?

Prof. Paul Straznicky

* Did you see any stand out landmark such as a single tall tree in your experiment in Gatineau? I am sure that the system would detect a tower or a tall tree.
* The landmarks that leave the field of view are deleted. How to deal with this problem?
  + The deleted landmark remain were recorded into a database, and get updated based on the estimated UAV location. No further correction is done.