Autonomous Quadrotor Risk Minimization for Law Reinforcement Applications

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Abstract

The focus of the research is to develop an on-board adaptive quadrotor algorithm for localization and navigation system in both GPS accessible and denied locations. The practical implementation is to upgrade police system software for law endorsement during search and rescue, hovering, traffic examinations, target locking and following.The fully functional algorithm is dependent on a inertial measurement unit (IMU), vision-based sensor and a navigation system for precise and reliable coordinates.

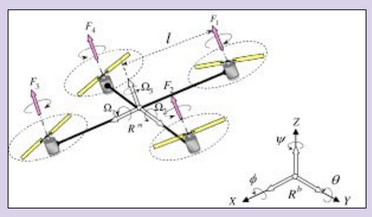
Introduction

Motivation :

How do we control law endorsement robots in both GPS accessible and denied locations

OR

Quadrotor law reinforcement localization and navigation system.



A vision-based sensor is used for motion tracking, object detection, monitoring horizontal motion and speed. The optical flow is computed using Lucas-Kanade algorithm coupled with a rich texture point detector(Shi & Tomasi corner detector). The quadrotor state is measured by the IMU while the GPS sensor computes the position of the robot from connected GPS or previously downloaded obit data. This favourable characteristics allows it to function without any connection.

Using concepts of sensor fusion, the kalman filter is used to compute the process covariance matrix and state (position and velocity) of the robot between consecutive frames using data from all sensors.

Results and Discussion

Work In Progress

Algorithm 1 : Hovering And tagert following

Input: Video
Output: x, y, Vx, Vy

1. look for features to track <- Shi & Tomashi detector
2. **for** Video input exist **do**
3. track feature points optical flow with LK
4. pass the position and velocity of tracked feature to Kalman Filter
5. **end for**

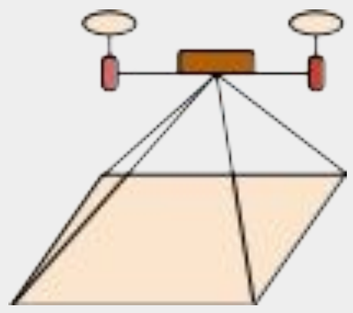


Fig 1: representation of downward online camera visualization

Assumptions:

- object pixel intensity do not change between frames
- neighboring pixels have similar motion

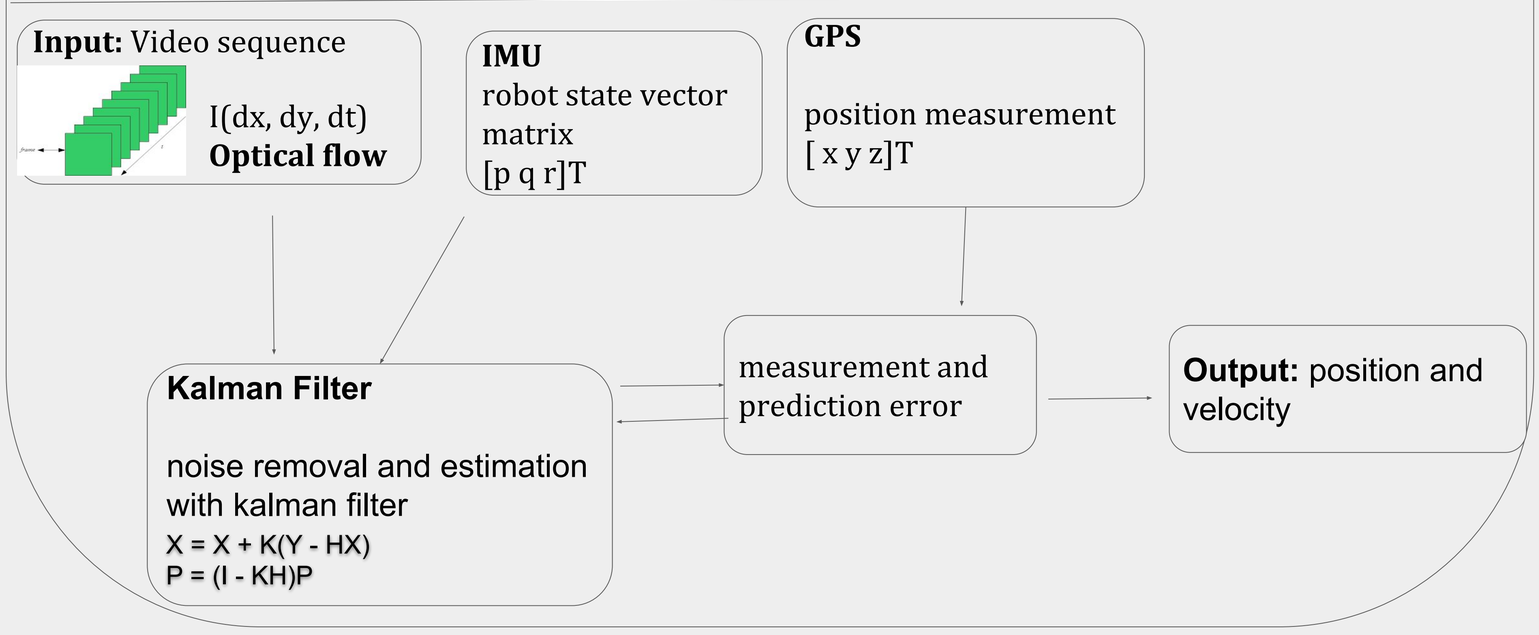
Challenges:

- only applicable for slow motion
- if pyramidical motion mapping is used for large motion then small motions are removed.

Fig 2:White pixel tracking using Shi& Tomasi corner detector

Fig 2: Tracked features with optical flow

Fully fuctional Algorithm:



Aims/Objectives

- Online mapping and localization system.
- Use concepts of sensor fusion for navigation.
- operating without internet and satellite connections.

Conclusions

Shi & Tomasi dectector and optical flow with LK was able to find feature points and track them constantly. The KF implies the measured sensor data and expected system response of the dynamic model. Currently the results of the algorithm are based on other related researches. Therefore, further expirements are required to validate the proposed model.

References

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[2] Shen C, Bai Z, Cao H, Xu K, Wang C, Zhang H, Wang D, Tang J, Liu J. Optical flow sensor/INS/magnetometer integrated navigation system for MAV in GPS-denied environment. Journal of Sensors. 2016;2016.

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