**Extended Kalman Filter**

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# Disclaimer

This document is not intended to be a source of truth. It is meant to help with understanding. It is possible that there are mistakes in this document.

# State Vector

Note:

* North is due north not magnetic north.

# Predict Steps

Where

## Gyro Predict

That is, we Euler integrate the gyro readings into the quaternions. Note that it may be possible to also integrate the velocities in this step despite no sensor reading.

Where:

This gives the Jacobian:

And Q matrix:

## Accelerometer Predict

Note that must be rotated into the NED:

This gives the Jacobian:

And Q matrix:

# Correct Steps



## Accelerometer Correct

Where:

A math equations on a white background

Description automatically generated

## Barometer Correct

Note that:

* is input upon initialization.
* is measured at the beginning as an “anchor pressure.”
* is measured at the beginning as the “anchor altitude.”

## GPS Correct

Note that:

* is measured at the beginning as the “anchor latitude.”
* is measured at the beginning as the “anchor longitude.”
* is measured at the beginning as the “anchor altitude.”
* Assumes that GPS altitude is approximately AMSL.
* R is the radius of the Earth.

## Magnetometer Correction

Where:

Note:

* This is magnetic field vector for Melbourne approximately.
* Should be checked for different flights.
* Also need to do some pre-calibration of the magnetometer for hard and soft iron offsets.

# Notes Specifically for Strelka

* Gyro 1 and Accel 1 are much better.
  + Don’t saturate as easily, less noise.
  + Have also noticed that Accel 2 has a bit of bias which is annoying.
* LPF baro, mag, gyro, and accel before passing it through the EKF.
* Normalisation needs to be done on the quaternions to ensure that the magnitude does not become ridiculous.
* Turn off gps, accel, and mag update during launch.