# Extended Kalman Filter

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## 1 Edited Files

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|---|---|
| **agotterba_ekf_writeup.pdf** | **This Document** |
| **src/** | **Edited code** |
| **FusionEKF.cpp** | |
| **FusionEKF.h** | |
| **kalman_filter.cpp** | |
| **kalman_filter.h** | |
| **main.cpp** | |
| **tools.cpp** | |

## 2 Notes

This project doesn't ask for a writeup, but I wanted to include some notes, for my future self, if nothing else.

### 2.1 Radar Debugging

I had a bug with the radar measurements, but I also had a bug in my debug code (trying to run the filter with only radar, ignoring laser measurements, so I can isolate the issue). Everything worked once I fixed that, but I don't know what the first issue with radar was, since I was trying a bunch of things that didn't overcome the other bug.

### 2.2 Handling Division by Zero

Most of the examples set outputs to zero when division by zero is detected, but I perfer to set the divisor to a small value and compute the output. This is closer to taking the limit as the divisor approaches zero, and in the worst case, will make the output zero in cases where the numerator was also approaching zero, which isn't any worse than setting it to zero in the first place.

## 2.3 Coordinate System

The coordinate system the simulator uses seems to be objective, but in the context of a self driving car, it would make more sense to be if it were subjective, with the car always at the origin, and the x-axis running down the center of the car.  That way, we wouldn't have to track the car's position in addition to other objects.  We could easily add the car's acceleration and movement to the filter for more accurate predictions of their positions and velocities of other objects, relative to the car.

## 2.4 Tracking Acceleration

One idea I had for improving accuracy was to add acceleration terms, in addition to velocity. As turning can be regarded as continual acceleration, this would make prediction of position more accurate, even if the object's (scalar) speed isn't changing.  I didn't do this because it would be a lot of work, and most of my time went into debugging radar.  Also, it sounds like the unscented Kalman filter works towards this direction.