# Robot Localization with Kalman Filters

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Project Objective

- Estimate a robot's position in the presence of uncertainty
- Integrate information from diverse sensors
  - GPS (low precision, slow)
  - Accelerometer (fast, drifts over time)
- How can we optimally update our beliefs in the presence of conflicting and uncertain sensor measurements?
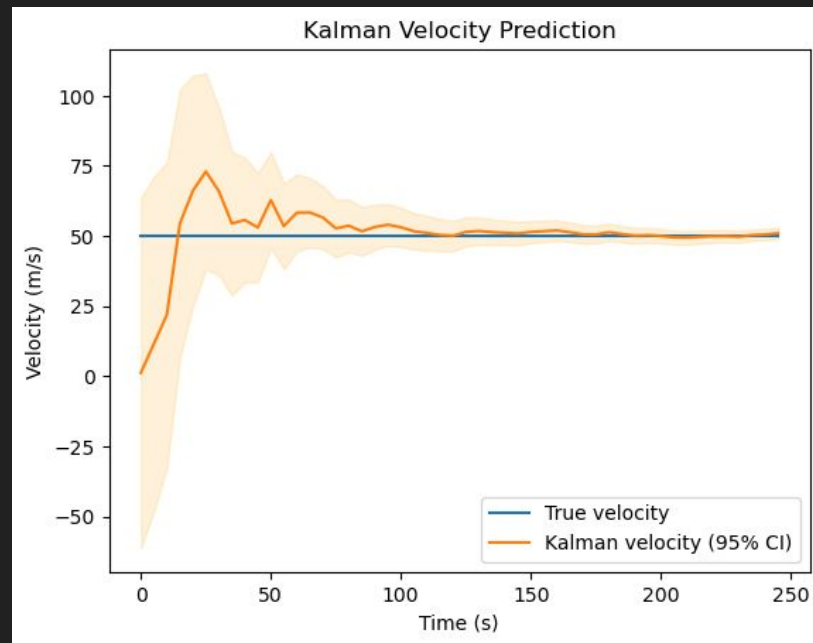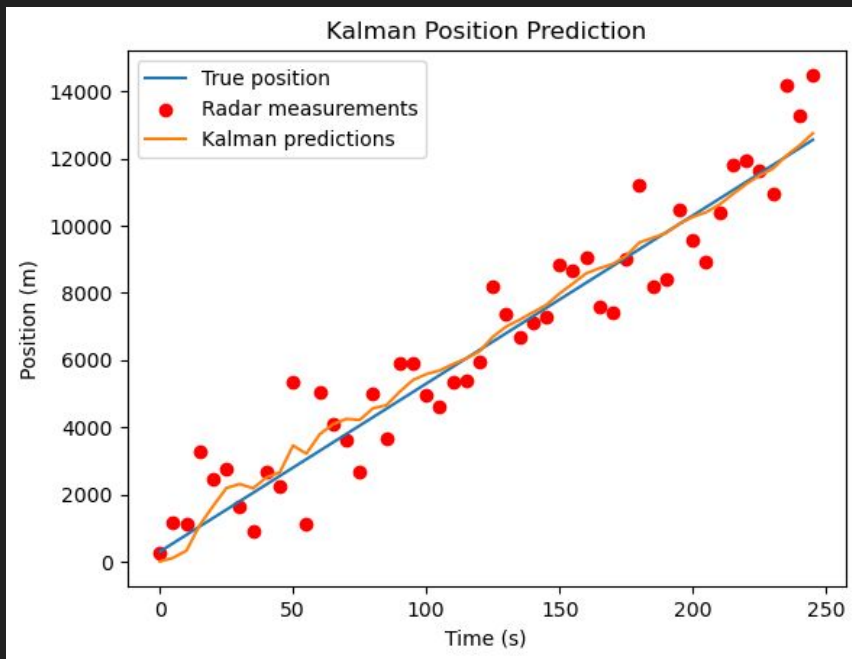
Kalman Filters

1. Model robot (or other system) as a set of linear differential equations
2. Given probability distribution of initial states, predict next state based on dynamic model
3. Use sensors as evidence to update beliefs in Bayesian fashion
4. Repeat

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Predict next
state
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Update beliefs
based on sensors
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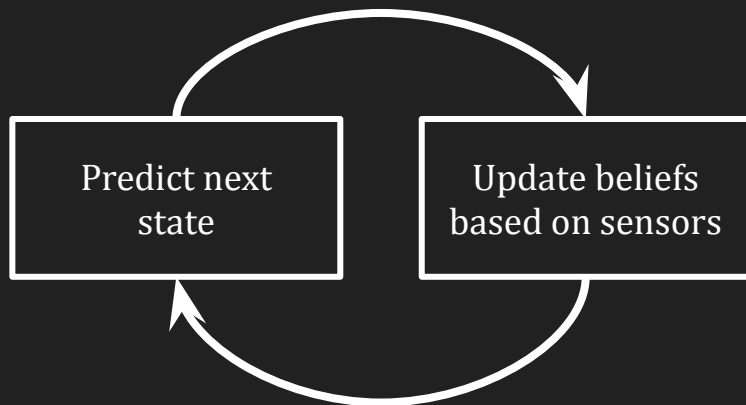
# Testing Environment

- Model position and velocity of an aircraft in one dimension
- Measure position with simulated radar (gaussian sampling)
- Track estimated position, estimated velocity, and the variance and covariance for each
- For each radar measurement:
  - Predict the new position of the aircraft based on the passage of time
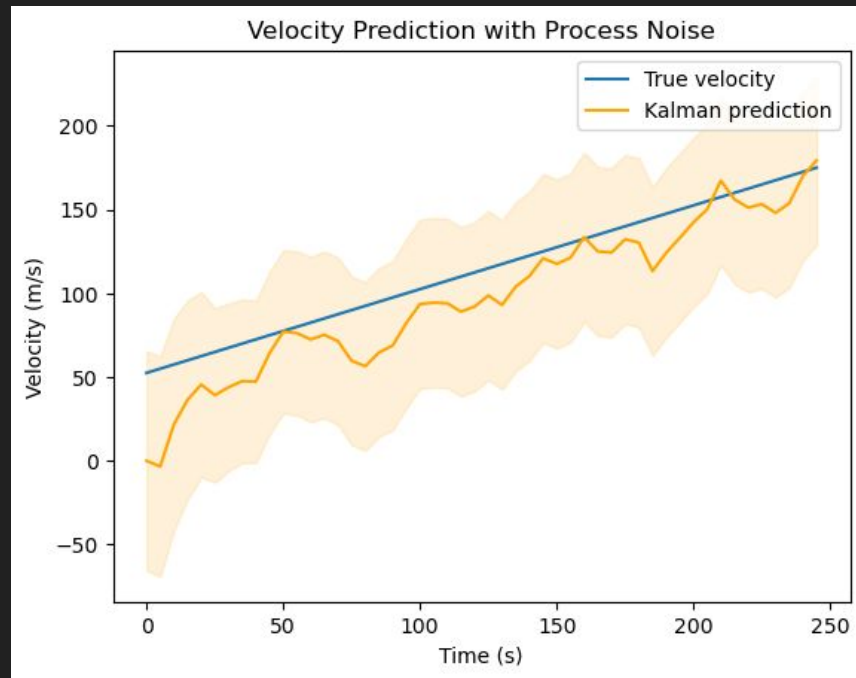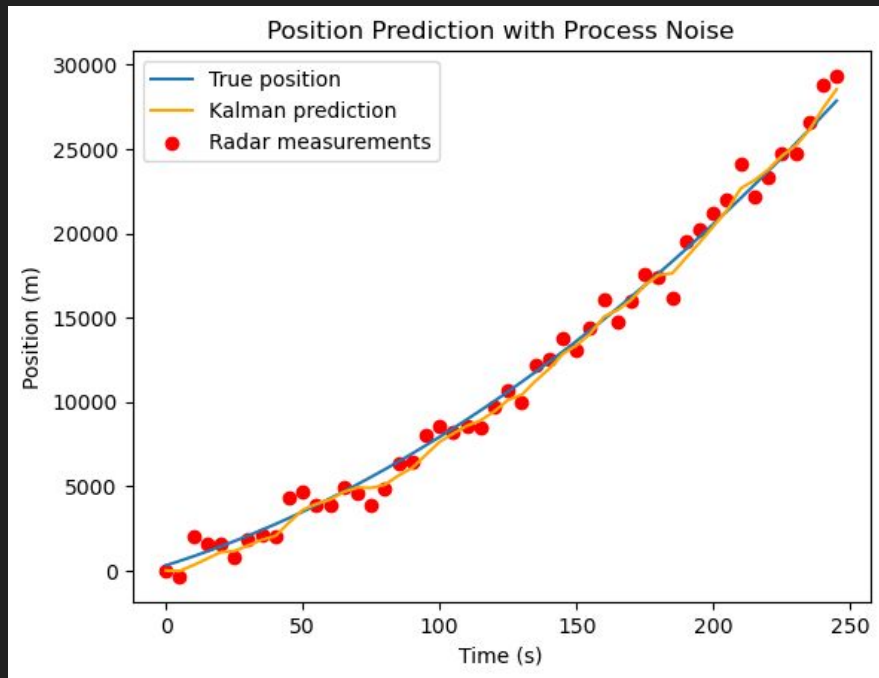  - Combine that prediction with the radar's uncertain measurement

# Results

# Model Uncertainty
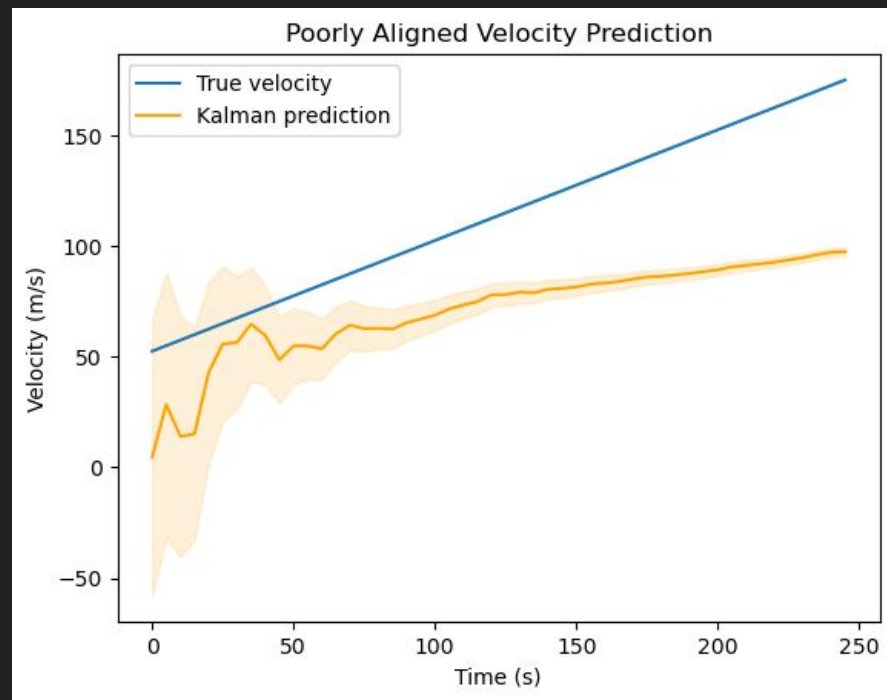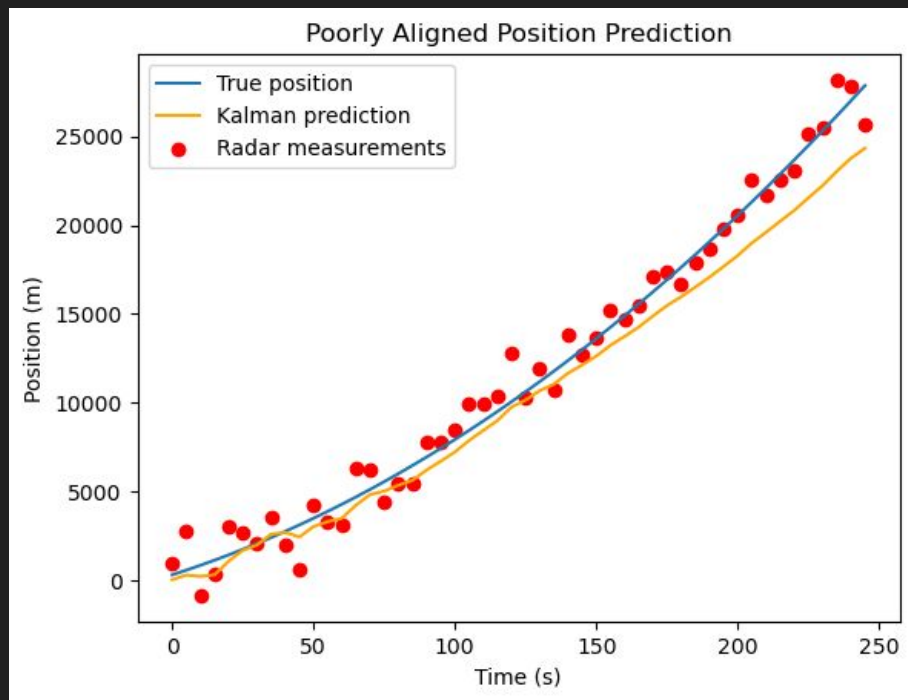
# Process Noise

# Takeaways

- The Kalman filter accurately tracks the plane's position despite noisy measurements
- The filter can accurately predict the plane's velocity despite having no direct way to measure it
- These capabilities rely on an accurate model of the dynamical system

# Future Work

- Extend localization into multiple dimensions
- Improve robustness to differences between the physical model of the Kalman filter and the behavior of the system