

Data Scientist

Question 1:

A collision between two objects is expected to be encountered during a close pass with each other in a 2D motion at time 't', shown in fig 1 along with its error ellipse. The primary object is stationary and secondary object is moving downwards along the direction of the Y-axis. For the given state and covariance matrix of both primary object and secondary object at time 't' below,

1. Explain and justify the process of evaluating the probability of collision for following conditions.
 - Considering uncertainties / covariance for both the objects
 - Considering uncertainties / covariance for the primary object only and secondary object covariance is assumed to be unavailable.
2. Address and briefly explain the validation strategies for the 2D solution defined above.
3. Briefly explain the process of extending the 2D solution to a 3D case.

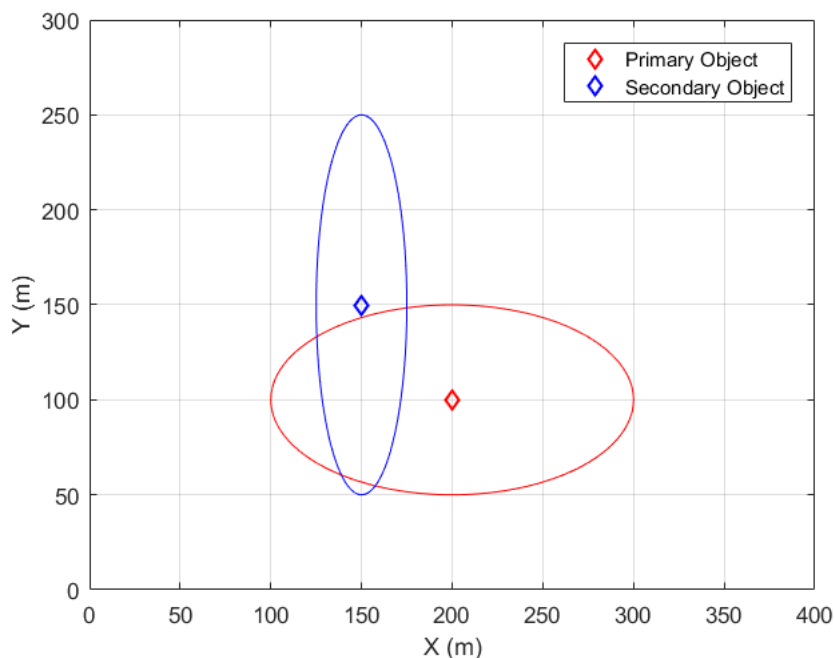


Figure 1: Collision scenario between primary and secondary object.

Parameters:

1. Primary object -
 1. Position State Vector = [200,100] m
 2. Position Covariance matrix = [10000,0 ; 0,2500]
2. Secondary object -
 1. Position State Vector = [150,150] m
 2. Position Covariance matrix = [625,0 ; 0,10000]



Assumptions:

1. Spherical objects with diameter = 1 m
2. 1-sigma uncertainties
3. Relative distance between two objects at time 't' is minimum
4. States are true (no state errors)

Question 2:

Assuming the above problem involves state errors w.r.t the truth for both the objects. Explain the process to assess the conformity of these state errors to the error distributions described by their covariance matrices. Also, address the appropriate methodologies to overcome the non-conformity of state errors to the distribution.

Note:

- List assumptions made, if any
- Avoid generic answers. Answers based on the information provided in the question will be given priority
- Upload answers as a pdf with a strict 5 page limit