CLAIMS

1. A method of determining a future heading of an object, the method comprising:

receiving, by one or more processors, sensor data including information identifying an object in a vehicle's environment and sensor data points corresponding to the object;

identifying, by the one or more processors, an area corresponding to an expected location of a wheel of the object based on the sensor data and a model of wheel locations;

estimating, by the one or more processors, an orientation of the wheel based on the sensor data points having locations within the area; and

determining, by the one or more processors, a future heading of the object based on the estimation.

2. The method of claim 1, wherein estimating the orientation includes fitting any of the sensor data points having locations within the area to a first plane.

3. The method of claim 2, wherein the sensor data further includes a bounding box bounding the data points corresponding to the object, and estimating the orientation includes determining an angular difference between a second plane of a side of the bounding box and the first plane.

4. The method of claim 3, wherein estimating the orientation of the wheel is further based on sensor data points having locations that are outside of the bounding box and within the area.

5. The method of claim 1, wherein identifying the area is further based on a prior estimated trajectory of the object determined over a period of time.

6. The method of claim 5, wherein identifying the area is further based on a type of the object.

7. The method of claim 1, further comprising: generating a notification based on the future heading; and providing the notification to a passenger of the vehicle indicating that the object is moving towards the vehicle.

8. The method of claim 7, wherein the notification requests that the passenger take control of one or more of the steering, acceleration, and deceleration of the vehicle.

9. The method of claim 1, further comprising, using the future heading to control the vehicle in an autonomous driving mode.

10. The method of claim 1, wherein the sensor data further includes a bounding box bounding the data points corresponding to the object, and identifying the area further includes inputting dimensions of the bounding box into the model.

11. The method of claim 1, wherein the model is based on a fixed wheel radius.

12. The method of claim 1, further comprising: receiving an image of the object; and analyzing the image to identify a possible wheel location, and wherein identifying the area is further based on the possible wheel location.

13. A system for predicting that an object is going to enter into a trajectory of a vehicle, the system comprising one or more processors configured to:

receive sensor data including information identifying an object in a vehicle's environment and sensor data points corresponding to the object;

identify an area corresponding to an expected location of a wheel of the object based on the sensor data and a model of wheel locations;

estimate an orientation of the wheel based on the sensor data points having locations within the area; and

determine a future heading of the object based on the estimation.

14. The system of claim 13, wherein the one or more processors are further

configured to estimate the orientation by fitting any of the sensor data points having locations within the area to a first plane.

15. The system of claim 14, wherein the sensor data further includes a bounding box bounding the data points corresponding to the object, and the one or more processors are further configured to estimate the orientation by determining an angular difference between a second plane of a side of the bounding box and the first plane.

16. The system of claim 15, wherein the one or more processors are further configured to estimate the orientation based on sensor data points having locations that are outside of the bounding box and within the area.

17. The system of claim 13, wherein the one or more processors are further configured to: generate a notification based on the future heading; and provide a notification to a passenger of the vehicle indicating that the object is moving towards the vehicle.

18. The system of claim 13, further comprising the vehicle.

19. A non-transitory computer readable recording medium on which instructions are stored, the instructions when executed by one or more processors, cause the one or more processors to perform a method for predicting that an object is going to enter into a trajectory of a vehicle, the method comprising:

receiving sensor data including information identifying an object in a vehicle's environment and sensor data points corresponding to the object;

identifying an area corresponding to an expected location of a wheel of the object based on the sensor data and a model of wheel locations;

estimating an orientation of the wheel based on the sensor data points having locations within the area; and

determining a future heading of the object based on the estimation.

20. The system of claim 18, wherein the one or more processors are further configured to use the future heading to control the vehicle in an autonomous driving mode.