

Claims

1. An apparatus comprising
an equipment for use on board a first ground transportation entity,
the equipment having
 - 5 (a) a receiver for information generated by a sensor of the environment of the first ground transportation entity,
 - (b) a processor, and
 - (c) a memory storing instructions executable by the processor to generate and send safety message information to a second ground transportation entities based on the information
10 generated by the one or more sensors.
2. The apparatus of claim 1 in which the instructions are executable by the processor to generate a prediction for use in generating the safety message information.
3. The apparatus of claim 2 in which the prediction is generated by a predictive model.
4. The apparatus of claim 3 in which the predictive model is configured to predict a
15 dangerous situation involving one or more of the first ground transportation entities, one or more of the second ground transportation entities, or one or more other ground transportation entities.
5. The apparatus of claim 4 in which the dangerous situation involves a crossing of a lane of a road by one or more of the second ground transportation entities.
6. The apparatus of claim 5 in which the one or more of the second ground transportation
20 entities comprise one or more vehicles, and the dangerous situation comprises a skidding across the lane by the one or more vehicles.
7. The apparatus of claim 5 in which the one or more second ground transportation entities comprise one or more pedestrians or one or more other vulnerable road users crossing a road.
8. The apparatus of claim 7 in which one or more vulnerable road users are crossing the
25 road at an intersection.
9. The apparatus of claim 7 in which the vulnerable road user is crossing the road other than at an intersection.

10. The apparatus of claim 4 in which the predicted dangerous situation comprises a predicted collision between a third ground transportation entity and the second ground transportation entity.
11. The apparatus of claim 3 in which the first ground transportation entity comprises a vehicle and the second ground transportation entity comprises a pedestrian or other vulnerable road user.
12. The apparatus of claim 10 in which the third ground transportation entity is following the first ground transportation entity and a view of the third ground transportation entity from the first ground transportation entity is occluded.
- 10 13. The apparatus of claim 10 in which the third ground transportation entity is in a lane adjacent a lane in which the first ground transportation entity is traveling.
14. The apparatus of claim 1 in which the instructions are executable by the processor to determine motion parameters of a third ground transportation entity.
15. The apparatus of claim 3 in which the second ground transportation entity has only an obstructed view of the third ground transportation.
- 15 16. The apparatus of claim 3 in which the second ground transportation entity comprises a pedestrian or other vulnerable road user.
17. The apparatus of claim 1 in which the safety message information sent by the processor comprises a basic safety message.
- 20 18. The apparatus of claim 1 in which the safety message information sent by the processor comprises a virtual basic safety message.
19. The apparatus of claim 1 in which the safety message information sent by the processor comprises a personal safety message.
20. The apparatus of claim 1 in which the safety message information sent by the processor comprises a virtual personal safety message.
- 25 21. The apparatus of claim 1 in which the safety message information sent by the processor comprises a virtual basic safety message sent on behalf of a third ground transportation entity.

22. The apparatus of claim 21 in which the third ground transportation entity comprises an unconnected ground transportation entity.
23. The apparatus of claim 1 in which the safety message information sent by the processor comprises a virtual personal safety message sent on behalf of the third ground transportation
5 entity.
24. The apparatus of claim 1 in which the equipment has a receiver for information sent wirelessly from a source external to the first ground transportation entity.
25. The apparatus of claim 1 including the first ground transportation entity.
26. The apparatus of claim 1 in which the safety message information comprises a virtual
10 intersection collision avoidance message (VICA).
27. The apparatus of claim 1 in which the safety message information comprises an intersection collision avoidance message (ICA).
28. The apparatus of claim 1 in which the safety message information comprises a virtual combined safety message (VCSM).
- 15 29. The apparatus of claim 1 in which the safety message information comprises a combined safety message (CSM).
30. An apparatus comprising
- an equipment for use on board a first ground transportation entity,
- the equipment having
- 20 (a) a receiver for first position correction information sent from a source external to the first ground transportation entity,
- (b) a receiver for information representing a parameter of position or motion of the first ground transportation entity,
- (c) a processor, and
- 25 (d) a memory storing instructions executable by the processor to generate updated position correction information based on the first position correction information and on the

information representing the parameter of motion, and send a position correction message to another ground transportation entity based on the updated position correction information.

31. The apparatus of claim 30 in which the position correction information sent from the source external to the first ground transportation entity comprises a position correction message.

5 32. The apparatus of claim 30 in which the position correction information sent from the source external to the first ground transportation entity comprises a radio technical commission for maritime (RTCM) correction message.

33. The apparatus of claim 30 in which the position correction information comprises GNSS position correction.

10 34. The apparatus of claim 30 in which the parameter of position or motion comprises a current position of the first ground transportation entity.

35. The apparatus of claim 30 in which the source external to the first ground transportation entity comprises a RSE or an external service configured to transmit position correction messages over the Internet.

15 36. The apparatus of claim 30 in which the instructions are executable by the processor to confirm a level of confidence in the updated position correction information.

37. A method comprising

receiving information generated by a sensor, mounted on a first ground transportation entity, of the environment of the first ground transportation entity, and

20 generating and sending safety message information to a second ground transportation entity based on the information generated by the sensor.

38. The method of claim 37 comprising generating a prediction for use in generating the safety message information.

39. The method of claim 38 in which the prediction is generated by a predictive model.

25 40. The method of claim 39 in which the predictive model is configured to predict a dangerous situation involving the first ground transportation entity, the second ground transportation entity, or another ground transportation entity.

41. The method of claim 40 in which the dangerous situation involves a crossing of a lane of a road by the second ground transportation entity.
42. The method of claim 41 in which the second ground transportation entity comprises a vehicle and the dangerous situation comprises a skidding across the lane by the vehicle.
- 5 43. The method of claim 41 in which the second ground transportation entity comprises a pedestrian or other vulnerable road user crossing a road.
44. The method of claim 43 in which the vulnerable road user is crossing the road at an intersection.
45. The method of claim 43 in which the vulnerable road user is crossing the road other than
10 at an intersection.
46. The method of claim 40 in which the predicted dangerous situation comprises a predicted collision between a third ground transportation entity and the second ground transportation entity.
47. The method of claim 40 in which the first ground transportation entity comprises a
15 vehicle and the second ground transportation entity comprises a pedestrian or other vulnerable road user.
48. The method of claim 46 in which the third ground transportation entity is following the first ground transportation entity and a view of the third ground transportation entity from the first ground transportation entity is occluded.
- 20 49. The method of claim 46 in which the third ground transportation entity is in a lane adjacent a lane in which the first ground transportation entity is traveling.
50. The method of claim 37 comprising determining motion parameters of a third ground transportation entity.
51. The method of claim 46 in which the second ground transportation entity has only an
25 obstructed view of the third ground transportation.
52. The method of claim 37 in which the second ground transportation entity comprises a pedestrian or other vulnerable road user.

53. The method of claim 37 in which the safety message information comprises a basic safety message.
54. The method of claim 37 in which the safety message information comprises a virtual basic safety message.
- 5 55. The method of claim 37 in which the safety message information comprises a personal safety message.
56. The method of claim 37 in which the safety message information comprises a virtual personal safety message.
57. The method of claim 37 in which the safety message information comprises a virtual
10 basic safety message sent on behalf of a third ground transportation entity.
58. The method of claim 53 in which the third ground transportation entity comprises an unconnected ground transportation entity.
59. The method of claim 53 in which the safety message information sent by the processor
15 comprises a virtual personal safety message sent on behalf of the third ground transportation entity.
60. The method of claim 37 comprising receiving information sent wirelessly from a source external to the first ground transportation entity.
61. The method of claim 37 in which the safety message information comprises a virtual intersection collision avoidance message (VICA).
- 20 62. The method of claim 37 in which the safety message information comprises an intersection collision avoidance message (ICA).
63. The apparatus of claim 37 in which the safety message information comprises a virtual combined safety message (VCSM).
- 64 The apparatus of claim 37 in which the safety message information comprises a
25 combined safety message (CSM).
65. A method comprising

receiving first position correction information sent from a source external to a first ground transportation entity,

receiving information representing a parameter of motion of the first ground transportation entity,

5 generating updated position correction information based on the first position correction information and on the information representing the parameter of motion, and sending a position correction message to another ground transportation entity based on the updated position correction information.

66. The method of claim 65 in which the position correction information sent from the source
10 external to the first ground transportation entity comprises a position correction message.

67. The method of claim 65 in which the position correction information sent from the source external to the first ground transportation entity comprises a radio technical commission for Maritime (RTCM) correction message.

68. The method of claim 65 in which the position correction information comprises GNSS
15 position correction.

69. The method of claim 65 in which the parameter of motion comprises a current position of the first ground transportation entity.

70. The method of claim 65 in which the source external to the first ground transportation entity comprises a RSE or an external service configured to transmit position correction
20 messages over the Internet.

71. The method of claim 65 comprising confirming a level of confidence in the updated position correction information.