CLAIMS

1. An amusement park ride system, comprising:

a ride vehicle positioned on a ride path and configured to move along the ride path;

a plurality of retro-reflective markers positioned on the ride vehicle, along the ride path, or both;

an emission subsystem configured to emit electromagnetic radiation toward the plurality of retro-reflective markers;

a detection subsystem configured to detect a pattern of retro-reflection of the electromagnetic radiation from the plurality of retro-reflective markers while filtering electromagnetic radiation that is not retro-reflected; and

a control system communicatively coupled to the detection subsystem and comprising processing circuitry configured to:

monitor the pattern of retro-reflection of the electromagnetic radiation from the plurality of retro-reflective markers for changes; and

track movement of the ride vehicle in space and time based on changes in the pattern of retro-reflected electromagnetic radiation detected by the detection subsystem.

2. The system of claim 1, wherein the detection subsystem comprises at least one detection camera having at least one optical filter and an overhead view of the ride path, wherein the at least one optical filter is configured to filter electromagnetic radiation that is not retro-reflected while not filtering electromagnetic radiation that is retro-reflected by the plurality of retro-reflective markers.

3. The system of claim 1, wherein the ride path comprises a rail system, and the plurality of retro-reflective markers comprises retro-reflective markers positioned on the rail system wherein the processing circuitry of the control system is configured to

monitor retro-reflected electromagnetic radiation from the retro-reflective markers on the track for a change from a first pattern of retro-reflected electromagnetic radiation to a second pattern of retro-reflected electromagnetic radiation.

4. The system of claim 3, wherein the processing circuitry of the control system is configured to:

correlate portions of the first pattern no longer present in the second pattern with a pattern of retro-reflective markers on the track occluded by the ride vehicle over time; and

determine a vector orientation of the movement of the ride vehicle on the track based on the pattern of retro-reflective markers on the track occluded by the ride vehicle.

5. The system of claim 4, wherein the processing circuitry is configured to maintain a predetermined relationship between the vector orientation and the track.

6. The system of claim 3, wherein the processing circuitry of the control system is configured to:

correlate portions of the first pattern no longer present in the second pattern with a pattern of retro-reflective markers on the track occluded by the ride vehicle;

compare the pattern of retro-reflective markers on the track occluded by the ride vehicle with a stored geometry of the ride vehicle; and

identify whether the stored geometry of the ride vehicle and the pattern of retro-reflective markers on the track occluded by the ride vehicle have a predetermined geometric relationship.

7. The system of claim 6, wherein the processing circuitry of the control system is configured to control at least one operating parameter of the ride vehicle to maintain the predetermined geometric relationship.

8. The system of claim 1, comprising an effect device positioned along the track and in communication with the control system, and wherein the processing circuitry of the control system is configured to determine, based on the tracked location and movement of the ride vehicle and a stored location of the effect device, a location of the ride vehicle relative to the effect device, and wherein the processing circuitry of the control system is configured to trigger the effect device when the location of the ride vehicle is within a predetermined distance to the effect device.

9. The system of claim 1, wherein:

the plurality of retro-reflective markers comprises a set of retro-reflective markers positioned on the path in a predetermined relationship relative to a direction of intended travel of the ride vehicle, the direction of intended travel being oriented toward a predetermined location along the path;

the ride vehicle comprises communication circuitry configured to communicate with the control system and a drive system configured to enable steering and velocity control of the ride vehicle; and

the processing circuitry of the control system is configured to maintain the ride vehicle generally along the direction of intended travel, over time, based on monitored retro-reflection from the retro-reflective markers on the path.

10. The system of claim 9, wherein the plurality of retro-reflective markers comprises a first set of retro-reflective markers positioned on a first side of the path and a second set of retro-reflective markers positioned on a second side of the path, the first and second sides of the path being at opposite lateral extents of the path relative to the direction of intended travel of the ride vehicle, and wherein the processing circuitry is configured to:

identify occlusion of retro-reflective markers of the first set of retro-reflective markers or second set of retro-reflective markers, or both, based on a change from a first pattern of retro-reflected electromagnetic radiation to a second pattern of retro-reflected electromagnetic radiation in which a portion of the first pattern is no longer present;

correlate the occlusion of the retro-reflective markers with the presence of the ride vehicle; and

adjust a movement vector of the ride vehicle to return the ride vehicle to a region of the path between the first and second sets of retro-reflective markers using the drive system of the ride vehicle.

11. The system of claim 10, wherein the first and second sets of retro-reflective markers converge toward one another such that the region of the path between the first and second sets of retro-reflective markers tapers toward the predetermined location.

12. The system of claim 9, wherein the plurality of retro-reflective markers comprises a set of retro-reflective markers positioned along the direction of intended travel of the ride vehicle and in a tapered geometry, and wherein the tapered geometry of the set of retro-reflective markers tapers toward the predetermined location.

13. The system of claim 1, wherein the processing circuitry is configured to:

identify occlusion of retro-reflective markers of the set of retro-reflective markers based on a change from a first pattern of retro-reflected electromagnetic radiation to a second pattern of retro-reflected electromagnetic radiation in which a portion of the first pattern is no longer present;

correlate the occlusion of the retro-reflective markers with the presence of the ride vehicle; and

maintain occlusion of at least a portion of the set of retro-reflective markers by the ride vehicle using the drive system of the ride vehicle to maintain a vector orientation of the movement of the ride vehicle generally along the direction of intended travel.

14. The system of claim 1, wherein the plurality of retro-reflective markers comprises at least three retro-reflective markers positioned on different sides of the ride vehicle, and wherein the detection subsystem comprises at least two detector cameras configured to

detect retro-reflected electromagnetic radiation from the at least three retro-reflective markers while filtering out electromagnetic radiation that is not retro-reflected, and wherein the processing circuitry of the control system is configured to track the ride vehicle in space and time in three spatial dimensions based on the retro-reflected electromagnetic radiation from the at least three retro-reflective markers.

15. The system of claim 14, wherein the processing circuitry of the control system is configured to track the ride vehicle in space and time in the three spatial dimensions relative to the path.

16. A method of tracking and controlling an amusement park ride vehicle, comprising:

flooding a ride vehicle path of an amusement park attraction with electromagnetic radiation using an emission subsystem comprising one or more emitters;

detecting wavelengths of electromagnetic radiation retro-reflected from within the ride vehicle path while filtering wavelengths of electromagnetic radiation not retro-reflected from within the guest attraction area using a detection subsystem having one or more optical filters; and

tracking, in space and time, a movement and a location of a ride vehicle on the ride vehicle path based on changes in the retro-reflected electromagnetic radiation with a control system communicatively coupled to the detection subsystem.

17. The method of claim 16, comprising controlling at least one operating parameter of the ride vehicle based on the tracked movement and location of the ride vehicle on the ride vehicle path using the control system, wherein tracking, in space and time, the movement and the location of the ride vehicle on the ride vehicle path comprises:

tracking patterns of retro-reflected electromagnetic radiation produced from retro-reflection by the retro-reflective markers positioned on the ride vehicle path;

identifying changes in the patterns of retro-reflected electromagnetic radiation in which a first pattern of retro-reflected electromagnetic radiation changes to a second pattern of retro-reflected electromagnetic radiation in which portions of the first pattern of retro-reflected electromagnetic radiation are no longer present; and

correlating the portions of the first pattern of retro-reflected electromagnetic radiation no longer present in the second pattern with occlusion of retro-reflective markers positioned on the ride vehicle path by the ride vehicle; and

wherein controlling at least one operating parameter of the ride vehicle based on the tracked movement and location of the ride vehicle on the ride vehicle path using the control system comprises controlling the at least one operating parameter to maintain a predetermined degree of occlusion of the retro-reflective markers on the path by the ride vehicle.

18. The method of claim 16, comprising:

retro-reflecting the electromagnetic radiation using at least three retro-reflective markers positioned on different sides of the ride vehicle;

detecting, from different perspectives, retro-reflected electromagnetic radiation from the at least three retro-reflective markers while filtering out electromagnetic radiation that is not retro-reflected using at least two detector cameras of the detection subsystem; and

tracking the ride vehicle in space and time in three spatial dimensions based on the retro-reflected electromagnetic radiation from the at least three retro-reflective markers using the control system.

19. The method of claim 16, comprising triggering an effect device when the tracked location and movement of the ride vehicle indicates that the ride vehicle is within a predetermined distance of the effect device.

20. An amusement park system, comprising:

a control system comprising processing circuitry configured to receive data indicative of retro-reflection of electromagnetic radiation by a plurality of retro-reflective markers, wherein the control system is configured to monitor the retro-reflected electromagnetic radiation to track a location and movement of a ride vehicle relative to a ride vehicle path based solely on changes in the retro-reflected electromagnetic radiation.

CLAIMS

The invention claimed is:

1. An amusement park ride system, comprising:

a ride vehicle positioned on a ride path and configured to move along the ride path;

a plurality of retro-reflective markers positioned on the ride vehicle, along the ride path, or both;

an emission subsystem configured to emit electromagnetic radiation toward the plurality of retro-reflective markers;

a detection subsystem configured to detect a pattern of retro-reflection of the electromagnetic radiation from the plurality of retro-reflective markers while filtering electromagnetic radiation that is not retro-reflected; and

a control system communicatively coupled to the detection subsystem and comprising processing circuitry configured to: monitor the pattern of retro-reflection of the electromagnetic radiation from the plurality of retro-reflective markers for changes; and track movement of the ride vehicle in space and time based on changes in the pattern of retro-reflected electromagnetic radiation detected by the detection subsystem.

2. The system of claim 1, wherein the detection subsystem comprises at least one detection camera having at least one optical filter and an overhead view of the ride path, wherein the at least one optical filter is configured to filter electromagnetic radiation that is not retro-reflected while not filtering electromagnetic radiation that is retro-reflected by the plurality of retro-reflective markers.

3. The system of claim 1, wherein the ride path comprises a rail system, and the plurality of retro-reflective markers comprises retro-reflective markers positioned on the rail system wherein the processing circuitry of the control system is configured to monitor retro-reflected electromagnetic radiation from the retro-reflective markers on the track for a change from a first pattern of retro-reflected electromagnetic radiation to a second pattern of retro-reflected electromagnetic radiation.

4. The system of claim 3, wherein the processing circuitry of the control system is configured to: correlate portions of the first pattern no longer present in the second pattern

with a pattern of retro-reflective markers on the track occluded by the ride vehicle over time; and determine a vector orientation of the movement of the ride vehicle on the track based on the pattern of retro-reflective markers on the track occluded by the ride vehicle.

5. The system of claim 4, wherein the processing circuitry is configured to maintain a predetermined relationship between the vector orientation and the track.

6. The system of claim 3, wherein the processing circuitry of the control system is configured to: correlate portions of the first pattern no longer present in the second pattern with a pattern of retro-reflective markers on the track occluded by the ride vehicle; compare the pattern of retro-reflective markers on the track occluded by the ride vehicle with a stored geometry of the ride vehicle; and identify whether the stored geometry of the ride vehicle and the pattern of retro-reflective markers on the track occluded by the ride vehicle have a predetermined geometric relationship.

7. The system of claim 6, wherein the processing circuitry of the control system is configured to control at least one operating parameter of the ride vehicle to maintain the predetermined geometric relationship.

8. The system of claim 1, comprising an effect device positioned along the track and in communication with the control system, and wherein the processing circuitry of the control system is configured to determine, based on the tracked location and movement of the ride vehicle and a stored location of the effect device, a location of the ride vehicle relative to the effect device, and wherein the processing circuitry of the control system is configured to trigger the effect device when the location of the ride vehicle is within a predetermined distance to the effect device.

9. The system of claim 1, wherein: the plurality of retro-reflective markers comprises a set of retro-reflective markers positioned on the path in a predetermined relationship relative to a direction of intended travel of the ride vehicle, the direction of intended travel being oriented toward a predetermined location along the path; the ride vehicle comprises communication circuitry configured to communicate with the control system and a drive system configured to enable steering and velocity control of the ride vehicle; and the processing circuitry of the control system is configured to maintain the ride vehicle generally along the direction of intended travel, over time, based on monitored retro-reflection from the retro-reflective markers on the path.

10. The system of claim 9, wherein the plurality of retro-reflective markers comprises a first set of retro-reflective markers positioned on a first side of the path and a second set of retro-reflective markers positioned on a second side of the path, the first and second sides of the path being at opposite lateral extents of the path relative to the direction of intended travel of the ride vehicle, and wherein the processing circuitry is configured to: identify occlusion of retro-reflective markers of the first set of retro-reflective markers or second set of retro-reflective markers, or both, based on a change from a first pattern of retro-reflected electromagnetic radiation to a second pattern of retro-reflected electromagnetic radiation in which a portion of the first pattern is no longer present; correlate the occlusion of the retro-reflective markers with the presence of the ride vehicle; and adjust a movement vector of the ride vehicle to return the ride vehicle to a region of the path between the first and second sets of retro-reflective markers using the drive system of the ride vehicle.

11. The system of claim 10, wherein the first and second sets of retro-reflective markers converge toward one another such that the region of the path between the first and second sets of retro-reflective markers tapers toward the predetermined location.

12. The system of claim 9, wherein the plurality of retro-reflective markers comprises a set of retro-reflective markers positioned along the direction of intended travel of the ride vehicle and in a tapered geometry, and wherein the tapered geometry of the set of retro-reflective markers tapers toward the predetermined location.

13. The system of claim 1, wherein the processing circuitry is configured to: identify occlusion of retro-reflective markers of the set of retro-reflective markers based on a change from a first pattern of retro-reflected electromagnetic radiation to a second pattern of retro-reflected electromagnetic radiation in which a portion of the first pattern is no longer present; correlate the occlusion of the retro-reflective markers with the presence of the ride vehicle; and maintain occlusion of at least a portion of the set of retro-reflective markers by the ride vehicle using the drive system of the ride vehicle to maintain a vector orientation of the movement of the ride vehicle generally along the direction of intended travel.

14. The system of claim 1, wherein the plurality of retro-reflective markers comprises at least three retro-reflective markers positioned on different sides of the ride vehicle, and wherein the detection subsystem comprises at least two detector cameras configured to detect retro-reflected electromagnetic radiation from the at least three retro-reflective markers while filtering out electromagnetic radiation that is not retro-reflected, and wherein the processing circuitry of the control system is configured to track the ride vehicle in space

and time in three spatial dimensions based on the retro-reflected electromagnetic radiation from the at least three retro-reflective markers.

15. The system of claim 14, wherein the processing circuitry of the control system is configured to track the ride vehicle in space and time in the three spatial dimensions relative to the path.

16. A method of tracking and controlling an amusement park ride vehicle, comprising:

flooding a ride vehicle path of an amusement park attraction with electromagnetic radiation using an emission subsystem comprising one or more emitters;

detecting wavelengths of electromagnetic radiation retro-reflected from within the ride vehicle path while filtering wavelengths of electromagnetic radiation not retro-reflected from within the guest attraction area using a detection subsystem having one or more optical filters; and

tracking, in space and time, a movement and a location of a ride vehicle on the ride vehicle path based on changes in the retro-reflected electromagnetic radiation with a control system communicatively coupled to the detection subsystem.

17. The method of claim 16, comprising controlling at least one operating parameter of the ride vehicle based on the tracked movement and location of the ride vehicle on the ride vehicle path using the control system, wherein tracking, in space and time, the movement and the location of the ride vehicle on the ride vehicle path comprises:

tracking patterns of retro-reflected electromagnetic radiation produced from retro-reflection by the retro-reflective markers positioned on the ride vehicle path;

identifying changes in the patterns of retro-reflected electromagnetic radiation in which a first pattern of retro-reflected electromagnetic radiation changes to a second pattern of retro-reflected electromagnetic radiation in which portions of the first pattern of retro-reflected electromagnetic radiation are no longer present; and correlating the portions of the first pattern of retro-reflected electromagnetic radiation no longer present in the second pattern with occlusion of retro-reflective markers positioned on the ride vehicle path by the ride vehicle; and

wherein controlling at least one operating parameter of the ride vehicle based on the tracked movement and location of the ride vehicle on the ride vehicle path using the control

system comprises controlling the at least one operating parameter to maintain a predetermined degree of occlusion of the retro-reflective markers on the path by the ride vehicle.

18. The method of claim 16, comprising:

retro-reflecting the electromagnetic radiation using at least three retro-reflective markers positioned on different sides of the ride vehicle;

detecting, from different perspectives, retro-reflected electromagnetic radiation from the at least three retro-reflective markers while filtering out electromagnetic radiation that is not retro-reflected using at least two detector cameras of the detection subsystem; and

tracking the ride vehicle in space and time in three spatial dimensions based on the retro-reflected electromagnetic radiation from the at least three retro-reflective markers using the control system.

19. The method of claim 16, comprising triggering an effect device when the tracked location and movement of the ride vehicle indicates that the ride vehicle is within a predetermined distance of the effect device.