Claims

1. An integratedairport ramp ground surface movement monitoring system that obtains airport ramp surface operations information of the entire ramp area from multiple locations, meshes real time data produced by multiple sources at the multiple locations, and transmits artificial intelligence-processed meshed real time data to aircraft pilots and ramp control operations personneldesigned to ensureimprove safety, efficiency, and security of airport ramp and airside operations, comprising:

a. a ramp area at an airportadjacent to an airport terminal with a plurality of parking locations for aircraft, passenger loading bridges, a plurality of aircraft moving within said ramp area into and out of said parking locations, at least some of said plurality of said aircraft driven by electric taxi drive systems, and a plurality of ground vehicles, equipment, and personnelground service vehicles, ground support vehicles, and ground equipment;

b. at least one electric taxi drive system-driven aircraft moved during ground travel within said ramp area by the electric taxi drive system;

bc. multiplea plurality of monitoring units positioned in multiple exterior locations on one or more of said plurality of passenger loading bridges, aircraft, and ground vehicles, equipment, and personnelmounted in one or more locations comprising on an exterior of said at least one electric taxi drive system-driven aircraft, on said ground service vehicles, on said ground support vehicles, on said ground equipment, on said airport terminal, and on said passenger loading bridges operative to produce securea composite streamsstream of meshed real time data ofrepresenting views of said entire ramp area from said multiple monitoring unitsone or more locations;

cd. an artificial intelligence-based processing system comprising intelligent algorithms operative to receive said composite stream of meshed real time data representing said views from said one or more locations in a secure encrypted form, to process and mesh said secure composite streams of real time data and to communicate said processed meshed data in the form of secure visual displays of said entire ramp area and signals in real time to pilots of said plurality of aircraft and to ramp control operations personnel or to store said processed meshed datameshed data to produce at least one visual display of said views from said one or more locations, and to communicate said at least one visual display in a secure encrypted form; and

de. a three-dimensional airside map of said entire ramp area in data transmission communication with said artificial intelligence-based processing systemdisplay devices to

~~receive said communicated at least one visual display located in at least a cockpit of said aircraft~~.

2. The ~~monitoring~~ system of claim 1, wherein each of said multiple~~plurality of~~ monitoring units comprises~~comprise at least~~ a scanning LiDAR device, a camera, or proximity sensors or combinations of~~a~~ scanning LiDAR devices, cameras, and proximity sensors positioned to produce views of said entire ramp area~~device and a camera, and at least one of said plurality of said monitoring units is mounted in said one or more locations comprising on an exterior of said at least one electric taxi system-driven aircraft~~.

~~3. The monitoring system of claim 2, wherein said plurality of said monitoring units are mounted in one location on each one of a plurality of said electric taxi drive system-driven aircraft in said ramp area.~~

~~4. The monitoring system of claim 2, wherein multiple ones of said plurality of said monitoring units are mounted in said one or more locations comprising only on exteriors of a plurality of said electric taxi system-driven aircraft.~~

~~5. The monitoring system of claim 1, wherein multiple ones of said plurality of said monitoring units are mounted in said one or more locations comprising only on said ground service vehicles, on said ground support vehicles, and on said ground equipment in said ramp area.~~

~~6. The monitoring system of claim 1, wherein said plurality of said monitoring units are mounted on exterior surfaces of aircraft in said ramp area not driven by electric taxi drive systems.~~

~~7. The monitoring system of claim 1, wherein multiple ones of said plurality of said monitoring units are mounted in said one or more locations comprising only on said airport terminal, and said passenger loading bridges.~~

~~8. The monitoring system of claim 1, further comprising display devices located in a ground control location and in an air traffic control tower location to receive said communicated visual display from said artificial intelligence-based processing system.~~

3~~9~~. The ~~monitoring~~ system of claim 1, ~~further comprising~~wherein said one or more of said plurality of ground personnel comprise ground personnel or ~~a~~ controllable robotic ramp ground surface roving unit functioning as ground personnel equipped with ~~one of~~ said ~~plurality of~~multiple monitoring units positioned exteriorly on said ground personnel or on said roving robotic units to produce a ~~provide an optimal~~ view of ~~a defined blind area in~~ said identified ramp area blind spots.

~~10. The monitoring system of claim 4, wherein a single one of said plurality of said monitoring units comprising scanning LiDAR device and a camera is mounted in a single location on said exteriors of each of said plurality of said electric taxi system-driven aircraft.~~

~~4~~11. ~~A~~An integrated monitoring method that obtains airport ramp surface operations information of the entire ramp area from multiple locations, meshes real time data produced by multiple sources at the multiple locations, and transmits artificial intelligence-processed meshed real time data to aircraft pilots and ramp control operations personnel~~for monitoring ground surface movement in an airport ramp area~~ to ensure~~improve~~ safety, efficiency, and security of airport ramp operations, comprising:

a. providing a plurality of ~~monitoring units, each comprising at least a camera, at least a scanning LiDAR device, or at least a camera and a scanning LiDAR device, in a ramp area adjacent to an airport terminal with a plurality of~~ parking locations at an airport ramp area for aircraft,~~and~~ passenger loading bridges at the plurality of parking locations, a plurality of aircraft moving within the ramp area into and out of the parking locations, at least some of the plurality of aircraft being driven~~, at least one aircraft moved during ground travel within the ramp area~~ by electric taxi drive systems, and a plurality of ground ~~service~~ vehicles, equipment, and personnel~~ground support vehicles, and ground equipment~~;

b. positioning multiple monitoring units in multiple exterior locations on one or more of the plurality of passenger loading bridges, aircraft, and ground vehicles, equipment, and personnel, the monitoring units operating to produce secure composite streams of real time data of the entire ramp area from the multiple locations as the ground vehicles and personnel move within the ramp area and the aircraft are driven within the ramp area into and out of the parking locations~~mounting one or more of the plurality of monitoring units in exterior locations on the electric taxi drive system-driven aircraft to obtain optimal views of spaces adjacent to the aircraft exterior and the ramp area ground surface and producing a composite stream of meshed real time data representing said optimal views produced by the one or more monitoring units~~;

c. providing an artificial intelligence-based processing system comprising intelligent algorithms, and receiving, processing, and meshing the secure composite streams of real time data of the entire ramp area from the multiple monitoring units, and then communicating the processed meshed data in the form of secure visual displays of the entire ramp area and

signals in real time to pilots of the plurality of aircraft and to ramp control operations personnel or storing said processed meshed data~~transmitting the composite stream of meshed real-time data representing the optimal views in a secure encrypted form to the processing system, and processing the composite stream of meshed real time data to produce at least one visual display of the optimal views as the electric taxi drive system-driven aircraft is driven through the ramp area~~; and

d. in response to the communicated secure visual displays of the entire ramp area, continuing to move the aircraft within the ramp area into and out of the parking locations or stopping movement of the aircraft, or continuing to move or stopping movement of the ground vehicles and personnel~~communicating the at least one visual display from the artificial intelligence-based processing system in a secure encrypted form to a display device located in a cockpit of said aircraft~~.

~~12. The method of claim 11, further comprising mounting the others of the plurality of monitoring units in locations on exteriors of the plurality of ground~~

~~service vehicles and ground support vehicles, obtaining a composite stream of real time data representing optimal views of spaces adjacent to the plurality of ground service vehicles and ground support vehicles and the ramp area ground surface, meshing the real time data from the plurality of ground service vehicles and ground support vehicles, transmitting the composite stream of meshed real time data representing the optimal views in a secure encrypted form to the artificial intelligence-based processing system, processing the composite stream of meshed real time data to produce at least one visual display of the optimal views of the spaces adjacent to the plurality of ground service vehicles and ground support vehicles and the ramp area ground surface, and communicating the optimal views from the plurality of ground service vehicles and ground support vehicles to display devices located in aircraft cockpits, ground control locations, and air traffic control tower locations.~~

~~13. The method of claim 11, further comprising mounting others of the plurality of monitoring devices on exteriors of the plurality of the passenger loading bridges and exteriors of airport terminal structures, obtaining meshed real time data representing optimal views of ramp area spaces adjacent to the plurality of passenger loading bridges and the airport terminal, transmitting the meshed real time data representing the optimal views of the ramp area spaces in a secure encrypted form to the artificial intelligence-based processing system, processing the meshed real time data to produce at least one visual display of the optimal views of the spaces, and communicating the optimal views from the plurality of passenger loading bridges and the airport terminal to display devices located in aircraft cockpits, ground control locations, and air traffic control tower locations.~~

5~~14~~. The method of claim 4~~11~~, further comprising ~~providing others of the plurality of monitoring devices for ground personnel~~positioning the monitoring units exteriorly on ground personnel~~ and for~~ or on roving robotic units functioning as ground personnel~~, mounting the monitoring units on the ground personnel and on the roving robotic units, obtaining meshed real time data representing optimal views of spaces adjacent to the ground personnel and the roving robotic units~~ to produce secure composite streams of data as the ground personnel or~~and the~~ roving robotic units move

on the ramp area ground surface, receiving, processing, and meshing the secure composite streams of real time data of views of ramp area locations~~transmitting the meshed real time data representing the optimal views in a secure encrypted form to the artificial intelligence-based processing system~~, and communicating the processed meshed data in the form of real time secure visual displays~~optimal views from the ground personnel and the roving robotic units~~ to display devices located in aircraft cockpits, ground control locations, and air traffic control tower locations.

~~15. The method of claim 11, further comprising mounting multiple ones of the plurality of monitoring units in exterior locations on the electric taxi drive system-driven aircraft to obtain panoramic views of ramp area spaces and surfaces adjacent to the aircraft exterior, producing a composite stream of meshed real time data representing said panoramic views, transmitting the composite stream of meshed real time data to the artificial intelligence-based processing system in a secure encrypted form, processing the composite stream of meshed real time data to produce a visual display of said panoramic views, and communicating the visual display to the aircraft cockpit display device and to display devices in aircraft cockpits, ground control locations, and air traffic control tower locations in a secure encrypted form.~~

6~~16~~. The method of claim 4~~11~~, further comprising wherein multiple ones of the plurality of aircraft are driven in the ramp area by the electric taxi drive systems, transmitting the composite streams of real time data from the monitoring units on each of the multiple aircraft ~~in the form of encrypted meshed data representing the optimal views from each of the multiple aircraft~~ to the artificial intelligence-based processing system, processing, and meshing the secure composite streams of real time data from the multiple ones of the electric taxi drive system-driven aircraft, and then communicating the processed meshed data in the form of secure visual displays and signals in real time to pilots of said plurality of aircraft and to ramp control operations personnel or storing said processed meshed data for further analysis and use at a later time if the processed ~~analyzing the encrypted meshed data, and storing the analyzed data for further analysis and use at a later time if the analyzed~~ data does not identify a safety or collision hazard.

~~17. The method of claim 11, further comprising providing others of the plurality of monitoring devices for aircraft not driven by electric taxi drive systems and mounting the~~

~~others of the plurality of monitoring units in locations on exteriors of the aircraft not driven by electric taxi drive systems, obtaining meshed real~~

~~time data representing optimal views of ramp area spaces adjacent to the exteriors of the aircraft not driven by electric taxi drive systems, transmitting the meshed real time data representing the optimal views to the artificial intelligence based processing system, and communicating the optimal views from the aircraft not driven by electric taxi drive systems to display devices located in aircraft cockpits, ground control locations, and air traffic control tower locations.~~

~~18. The method of claim 11, further comprising mounting monitoring devices only on fixed locations comprising the airport terminal and immobile structures in the ramp area, producing meshed real time data representing views of the entire ramp area, transmitting the real time meshed data in a secure encrypted form to the artificial intelligence based processing system, and communicating a visual representation of the entire ramp area from the meshed real time data to display devices in aircraft cockpits, ground control locations, and air traffic control tower locations.~~

~~19. The method of claim 11, wherein each of the plurality of monitoring units comprises a scanning LiDAR device and a camera.~~

7~~20~~. The method of claim 4~~14~~, further comprising positioning at least one of the roving robotic units in a ramp area location with an identified blind spot, monitoring the identified blind spot as an aircraft is driven with the electric taxi drive system to maneuver near or into the blind spot, ~~obtaining meshed real time data representing optimal views of the blind spot spaces~~ producing the secure composite streams of data, receiving, processing, and meshing the secure composite streams of real time data of views of the identified blind spot as the one of the roving robotic units moves in the ramp area near the identified blind spot, transmitting the meshed real time data representing the optimal views of the blind spot to the artificial intelligence-based processing system, and communicating the ~~optimal views of the blind spot~~ processed meshed data in the form of real time secure visual displays from the one of the roving robotic units to at least a display device located in a cockpit of the aircraft.

8. The system of claim 1, wherein said three-dimensional airside map identifies at least ramp area blind spots and structures that present obstacles to safe aircraft ramp movement of at least said plurality of aircraft within said entire ramp area.

9. The system of claim 3, wherein said one or more of said plurality of ground personnel comprise roving robotic units and said multiple monitoring units are positioned in exterior locations on said roving robotic units.

10. The system of claim 9, wherein said multiple monitoring units are positioned only in said exterior locations on said roving robotic units.

11. The method of claim 4, further comprising positioning monitoring units comprising single or multiple scanning LiDAR devices, cameras, and proximity sensors or combinations of said single or multiple scanning LiDAR devices, cameras, and proximity sensors in the multiple locations, producing secure composite streams of real time data comprising views of the entire ramp area, processing the real time data and producing meshed secure composite streams of real time data, communicating the secure processed meshed data in the form of real time views of the entire ramp area to the aircraft pilots and to the ramp control operations personnel, and continuing to move or stopping movement of the aircraft.

12. The method of claim 11, wherein one of the plurality of aircraft is driven by electric taxi drive systems and the monitoring units are positioned exteriorly on the roving robotic units, further comprising positioning one or more of the roving robotic units in a ramp area location with identified blind spots or corners, monitoring a ramp area space adjacent to an identified blind spot or an identified corner with the roving robotic unit as the aircraft is driven and maneuvered with the electric taxi drive systems near or into the blind spots or corners, producing secure composite streams of data, receiving, processing, and meshing the secure composite streams of real time data of views of the identified blind spot or corner, and communicating the processed meshed data in the form of real time secure visual displays to at least a display devices located in the aircraft cockpit.

13. The method of claim 12, further comprising receiving, processing, and meshing the secure composite streams of real time data from the multiple monitoring units on the passenger loading bridges, and then communicating the processed meshed data in the form of

secure visual displays and signals in real time to display devices located in aircraft cockpits, ground control locations, and air traffic control tower locations.

14. The method of claim 12, further comprising receiving, processing, and meshing the secure composite streams of real time data from the multiple monitoring units on the ground vehicles and equipment, and then communicating the processed meshed data in the form of secure visual displays and signals in real time to display devices located in aircraft cockpits, ground control locations, and air traffic control tower locations.

15. The method of claim 12, further comprising receiving, processing, and meshing the secure composite streams of real time data from the multiple monitoring units on the aircraft driven with electric taxi drive systems, and then communicating the processed meshed data in the form of secure visual displays and signals in real time to display devices located in aircraft cockpits, ground control locations, and air traffic control tower locations.

16. The method of claim 4, further comprising, wherein others of the plurality of aircraft are driven without the electric taxi drive systems, transmitting the composite streams of real time data from the monitoring units on each of the aircraft driven without electric taxi drive systems to the artificial intelligence-based processing system, processing, and meshing the secure composite streams of real time data from each of the aircraft driven without the electric taxi drive systems, and then communicating the processed meshed data in the form of secure visual displays and signals in real time to display devices located in aircraft cockpits, ground control locations, and air traffic control tower locations.