SUMMARY

In one illustrative embodiment, a portable augmentation system comprises a group of reference receivers, each provided at one of a group of locations, and a navigation information generator. The group of reference receivers receives satellite signals and identifies raw pseudo-range data and satellite data parameters from the satellite signals. The raw pseudo-range data and the satellite data parameters form satellite data comprising location information and level of accuracy of the location. The navigation information generator receives the satellite data from the group of reference receivers, generates pseudo-range correction data using the satellite data, and identifies the level of accuracy of the location of the group of reference receivers based on the satellite data. Further, the navigation information generator identifies a level of accuracy for the generated pseudo-range correction data based on the identified level of accuracy of the locations of the group of reference receivers and indicates when the group of locations of the group of reference receivers does not meet a desired level of accuracy for the pseudo-range correction data. Still further, the navigation information generator generates messages using navigation information from the satellite data when the group of reference receivers has the desired level of accuracy for the pseudo-range correction data.

In another illustrative embodiment, a method of generating navigation information for an aircraft is presented. Satellite signals are received and identifying raw pseudo-range data and a group of satellite data parameters at a group of reference receivers, each provided at one of a group of locations. Satellite data comprising location information and level of accuracy of the location is formed. A level of accuracy is identified for the group of locations of the group of reference receivers based on satellite data formed from the satellite

signals. Pseudo-range correction data is generated using the satellite data. A level of accuracy for the generated pseudo-range correction data is identified based on the identified level of accuracy of the locations of the group of reference receivers It is indicated when the group of locations of the group of reference receivers, based on the satellite data does not meet a desired level of accuracy for the pseudo-range correction data. Messages are generated using the navigation information from the satellite data when the group of reference receivers has the desired level of accuracy for the pseudo-range correction data.

In yet another illustrative embodiment, an apparatus comprises a group of reference receivers, each provided at one of a group of locations, a transmitter system, and a navigation information generator. The group of reference receivers receives satellite signals and identifies raw pseudo-range data and a group of satellite data parameters in the satellite signals comprising location information and level of accuracy of the location. The raw pseudo-range data and the group of satellite data parameters form satellite data. The transmitter system transmits messages to an aircraft. The navigation information generator has a satellite data processor that receives the satellite data from the group of reference receivers. The navigation information generator generates pseudo-range correction data using the satellite data; identifies the level of accuracy of the locations of the group of reference receivers based on the satellite data; identifies a level of accuracy for the generated pseudo-range correction data based on the identified level of accuracy of the locations of the group of reference receivers; indicates when the group of locations of the group of reference receivers does not meet a desired level of accuracy for the pseudo-range correction data. The navigation information generator also generates the messages with navigation information from the satellite data and

configuration data when the group of reference receivers has the desired level of accuracy for the pseudo-range correction data. The navigation information generator sends the messages to the aircraft over the transmitter system. Further, the navigation information generator includes an operation application that controls operation of the group of reference receivers, the transmitter system, and the navigation information generator. Still further, the navigation information generator includes a configuration application that receives user input to access configuration data used by the satellite data processor to generate the messages. Even further, the navigation information generator includes a configuration database for the configuration data.

The features and functions can be achieved independently in various embodiments of the present disclosure or may be combined in yet other embodiments in which further details can be seen with reference to the following description and drawings.

CLAIMS:

What is claimed is:

1. A portable augmentation system comprising:

a group of reference receivers, each provided at one of a group of locations, that receives satellite signals and identifies raw pseudo-range data and a group of satellite data parameters from the satellite signals, wherein the raw pseudo-range data and the group of satellite data parameters form satellite data comprising location information and level of accuracy of the location; and

a navigation information generator that receives the satellite data from the group of reference receivers; generates pseudo-range correction data using the satellite data; identifies the level of accuracy of the locations of the group of reference receivers based on the satellite data; identifies a level of accuracy for the generated pseudo-range correction data based on the identified level of accuracy of the locations of the group of reference receivers; indicates when the group of locations of the group of reference receivers does not meet a desired level of accuracy for the pseudo-range correction data; and generates messages using navigation information from the satellite data when the group of reference receivers has the desired level of accuracy for the pseudo-range correction data.

2. The portable augmentation system of claim 1 further comprising:

a transmitter system that transmits the messages to an aircraft, wherein the navigation information generator sends the messages to the aircraft over the transmitter system.

3. The portable augmentation system of claim 1 or 2, wherein the group of locations is a first group of locations, the level of accuracy for the pseudo-range correction data based on the

identified level of accuracy of the group of reference receivers based on the satellite data is a first level of accuracy for the pseudo-range correction data based on the identified level of accuracy of the first group of locations for the group of reference receivers, the satellite data is first satellite data, and further comprising:

subsequent to a portion of the group of reference receivers being moved to a second group of locations that is different than the first group of locations, the navigation information generator identifies a second level of accuracy for the pseudo-range correction data based on the identified level of accuracy of the group of reference receivers based on second satellite data identified from the satellite signals by the group of reference receivers.

4. The portable augmentation system of any one of claims 1 to 3, wherein the level of accuracy for the pseudo-range correction data based on the identified level of accuracy of the group of reference receivers based on the satellite data is a first level of accuracy for the pseudo-range correction data based on the identified level of accuracy of the group of reference receivers, the satellite data is first satellite data, and further comprising:

subsequent to a portion of the group of reference receivers being one or more of re-powered and re-configured, the navigation information generator identifies a second level of accuracy for the pseudo-range correction data based on the identified level of accuracy of the group of reference receivers based on second satellite data formed from the satellite signals from the group of reference receivers.

5. A method of generating navigation information for an aircraft, the method comprising:

receiving satellite signals and identifying raw pseudo-range data and a group of satellite data parameters at a group

of reference receivers, each provided at one of a group of locations;

forming satellite data comprising location information and level of accuracy of the location;

identifying a level of accuracy for the group of locations of the group of reference receivers based on satellite data formed from the satellite signals;

generating pseudo-range correction data using the satellite data;

identifying a level of accuracy for the generated pseudo-range correction data based on the identified level of accuracy of the locations of the group of reference receivers;

indicating when the group of locations of the group of reference receivers, based on the satellite data does not meet a desired level of accuracy for the pseudo-range correction data; and

generating messages using the navigation information from the satellite data when the group of reference receivers has the desired level of accuracy for the pseudo-range correction data.

6. The method of claim 5 further comprising:

sending the messages generated using the navigation information to the aircraft over a transmitter system.

7. The method of claim 5 or 6, wherein the group of locations is a first group of locations, the level of accuracy for the pseudo-range correction data based on the identified level of accuracy of the group of reference receivers based on the satellite data is a first level of accuracy for the pseudo-range correction data based on the identified level of accuracy of the first group of locations for the group of reference receivers, the satellite data is first satellite data formed from the satellite signals, and further comprising:

identifying a second level of accuracy for the pseudo-range correction data based on the identified level of accuracy of the group of reference receivers based on second satellite data

formed from the satellite signals from the group of reference receivers when a portion of the group of reference receivers are one or more of re-powered, re-configured, and moved to a second group of locations that is different than the first group of locations.

8. An apparatus comprising:

a group of reference receivers, each provided at one of a group of locations, that receives satellite signals and identifies raw pseudo-range data and a group of satellite data parameters in the satellite signals, wherein the raw pseudo-range data and the group of satellite data parameters form satellite data comprising location information and level of accuracy of the location;

a transmitter system that transmits messages to an aircraft; and

a navigation information generator having a satellite data processor that receives the satellite data from the group of reference receivers, generates pseudo-range correction data using the satellite data; identifies the level of accuracy of the locations of the group of reference receivers based on the satellite data; identifies a level of accuracy for the generated pseudo-range correction data based on the identified level of accuracy of the locations of the group of reference receivers; indicates when the group of locations of the group of reference receivers does not meet a desired level of accuracy for the pseudo-range correction data; generates the messages with navigation information from the satellite data and configuration data when the group of reference receivers has the desired level of accuracy for the pseudo-range correction data, and sends the messages to the aircraft over the transmitter system; an operation application that controls operation of the group of reference receivers, the transmitter system, and the navigation information generator; and a configuration application that receives user input to access.

9. The apparatus of claim 8, wherein the navigation information generator further comprises:

a self-surveyor that performs a self-survey.

10. The apparatus of claim 9, wherein the self-survey identifies a group of locations where the group of reference receivers were placed and indicates whether the group of reference receivers provide a desired level of accuracy at the group of locations.

11. The apparatus of any one of claims 8 to 10, wherein the configuration data includes values for the messages; and

wherein the group of reference receivers receive more than one frequency per satellite.

12. The apparatus of any one of claims 8 to 11, wherein the group of reference receivers is configured to receive the satellite signals from a plurality of constellations of satellites.

13. The apparatus of any one of claims 8 to 12, wherein the navigation information includes at least one of take off information, landing information, approach information, or missed approach information.