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Mueller et al.

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(45) **Date of Patent: Mar. 1, 2011**

(54) **RUNWAY IDENTIFICATION SYSTEM VIA RADAR RECEIVER**

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G01S 13/93	(2006.01)
G01S 13/95	(2006.01)
G01S 13/00	(2006.01)

(52) **U.S. Cl.** ..... **342/33**; 342/26 R; 342/26 B; 342/26 D; 342/27; 342/175; 342/195; 340/945; 340/947; 701/1; 701/3; 701/300; 701/301

(58) **Field of Classification Search** ..... 342/5–11, 342/26 R–26 D, 29–60, 82, 89, 165, 173–175, 342/195, 27, 28, 350, 385, 386, 407, 410, 342/411, 412, 176, 179; 701/300, 301, 1, 701/3, 14–18; 324/600, 649, 658, 663, 664, 324/667; 702/1–5; 340/500, 540, 541, 552–557, 340/945–957, 971–983

See application file for complete search history.

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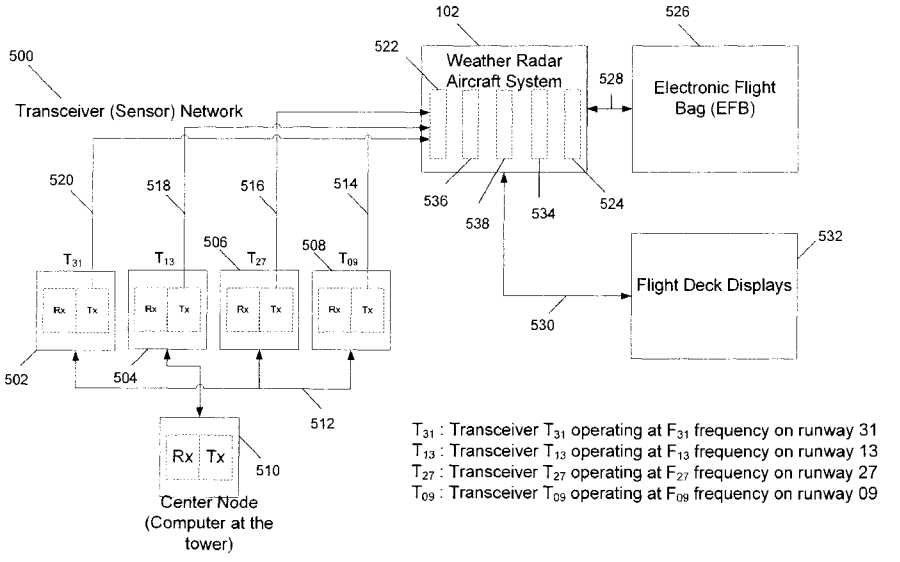
(57) **ABSTRACT**

A runway identification system including a weather radar system. The weather radar system includes a receiver. The receiver is configured to receive a runway characteristic signal from a transponder associated with a runway. The runway identification system determines a runway identification based on the runway characteristic signal.

22 Claims, 10 Drawing Sheets



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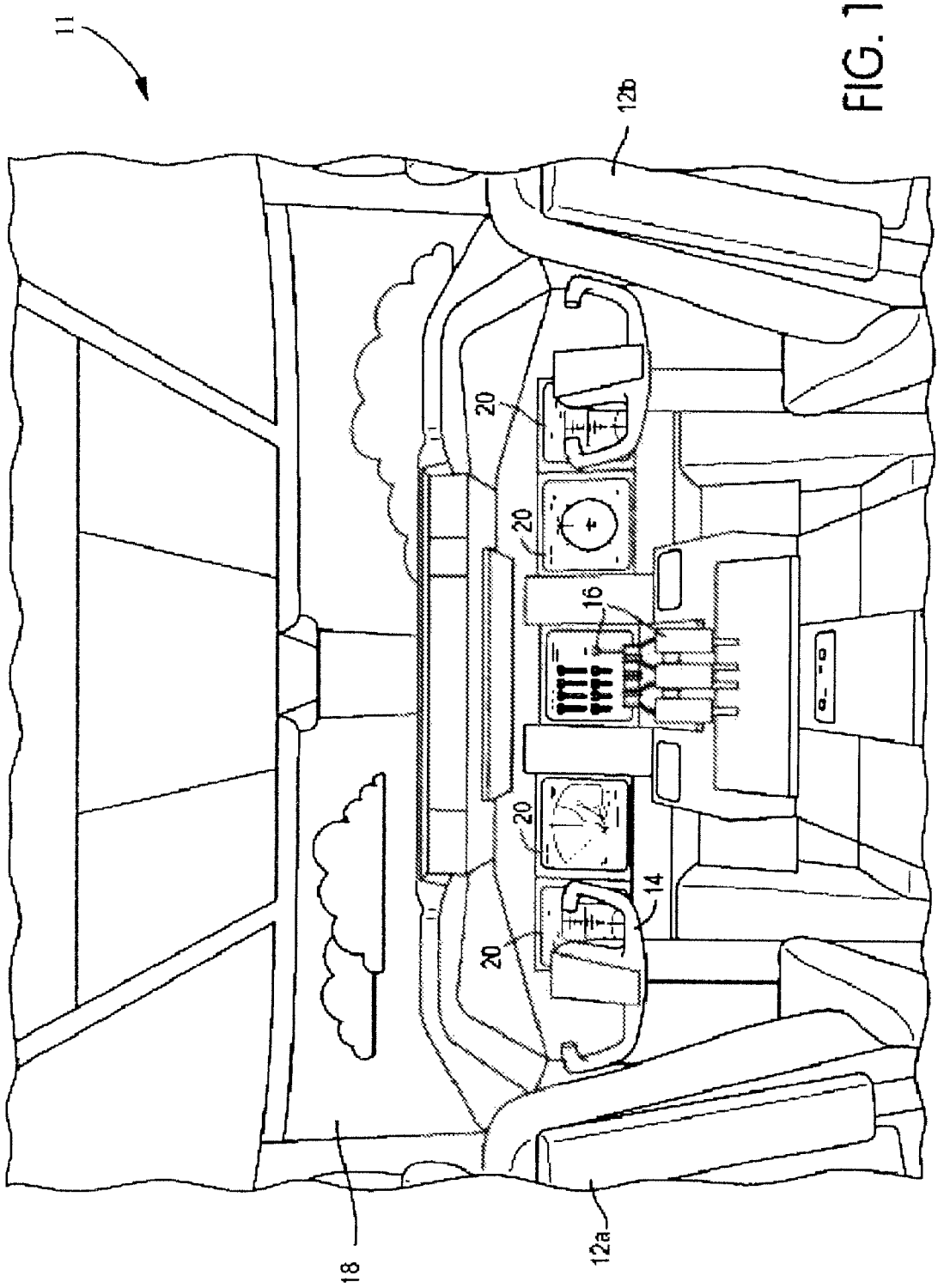


FIG. 1

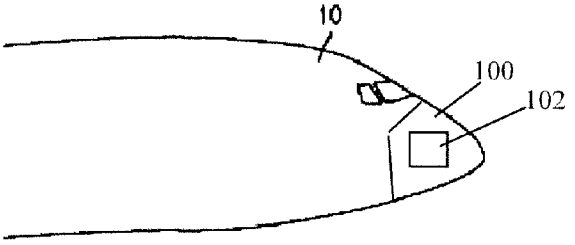


FIG. 2A

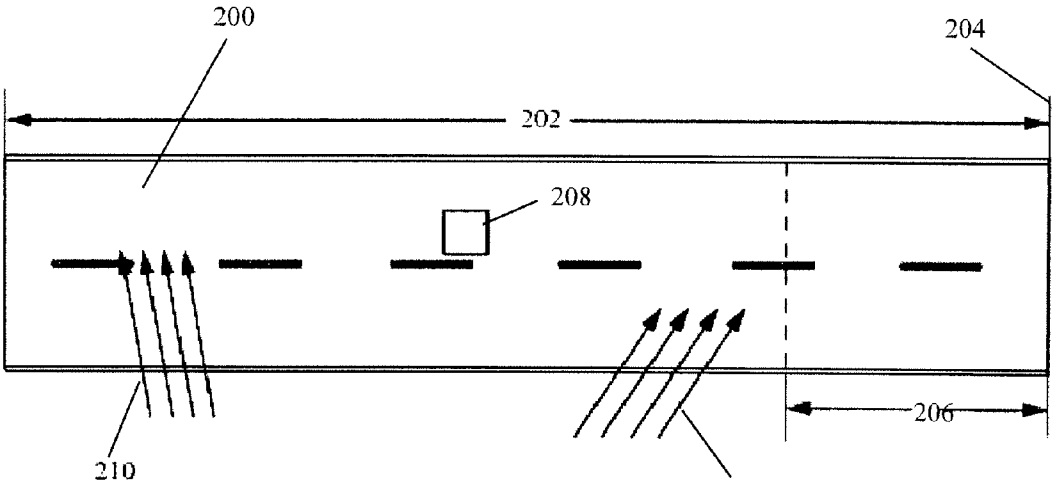
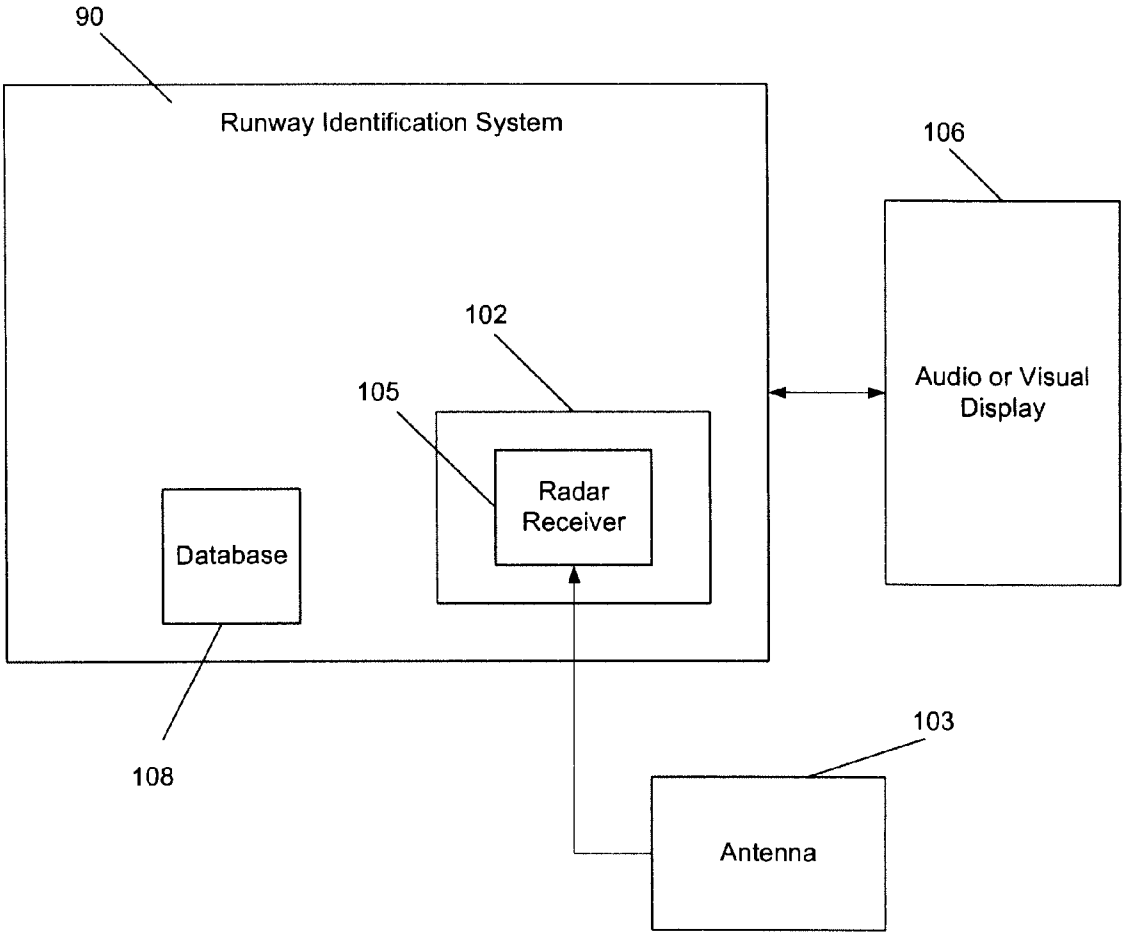


FIG. 3

FIG. 2B


90
Runway Identification System
106
Audio or Visual Display
102
105
Radar Receiver
Database
108
103
Antenna

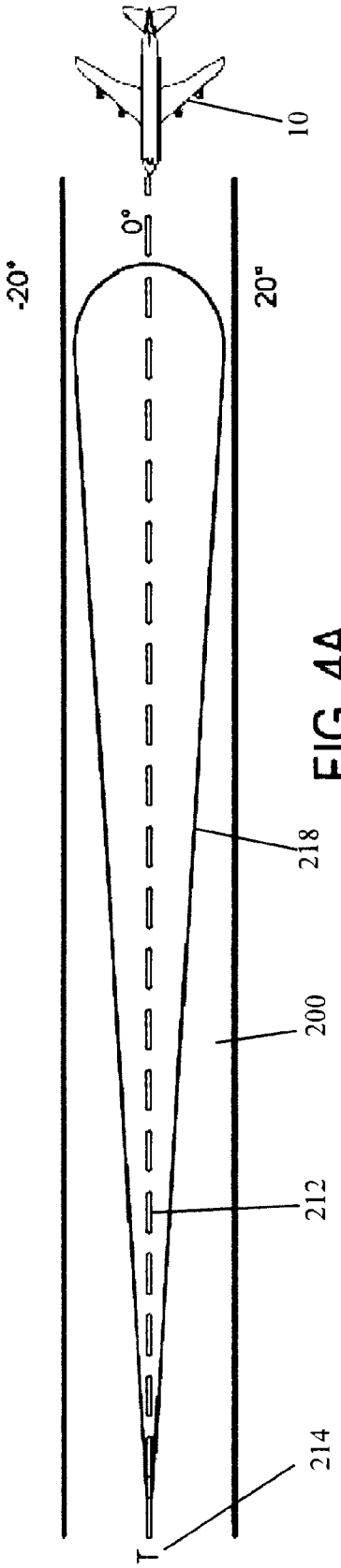


FIG. 4A

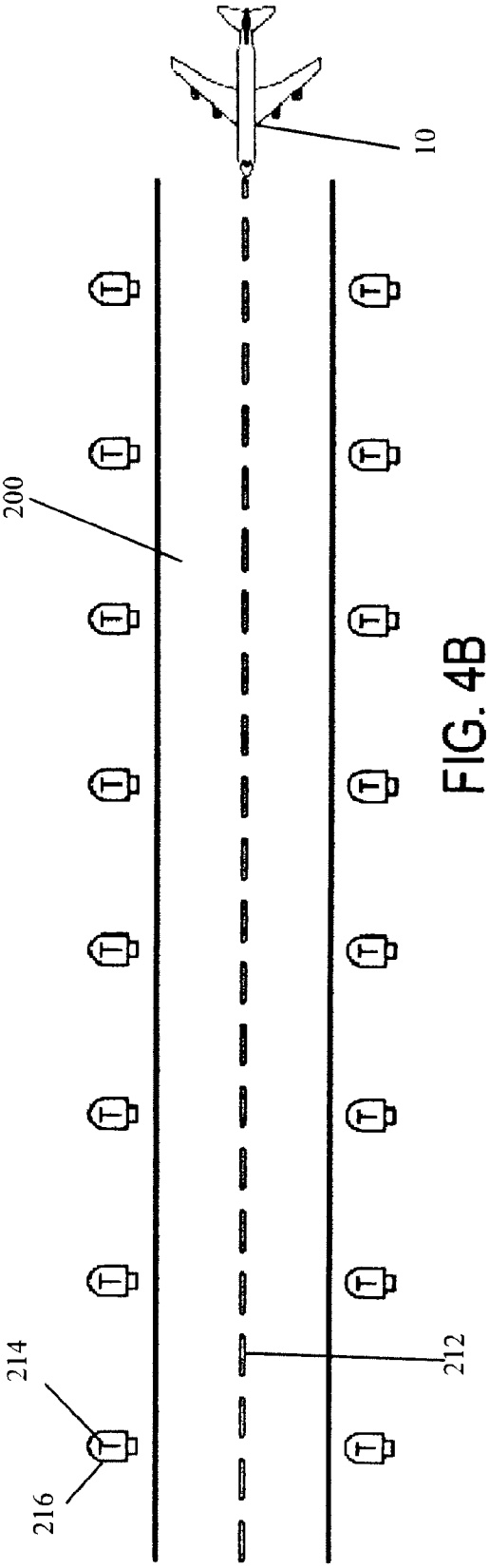
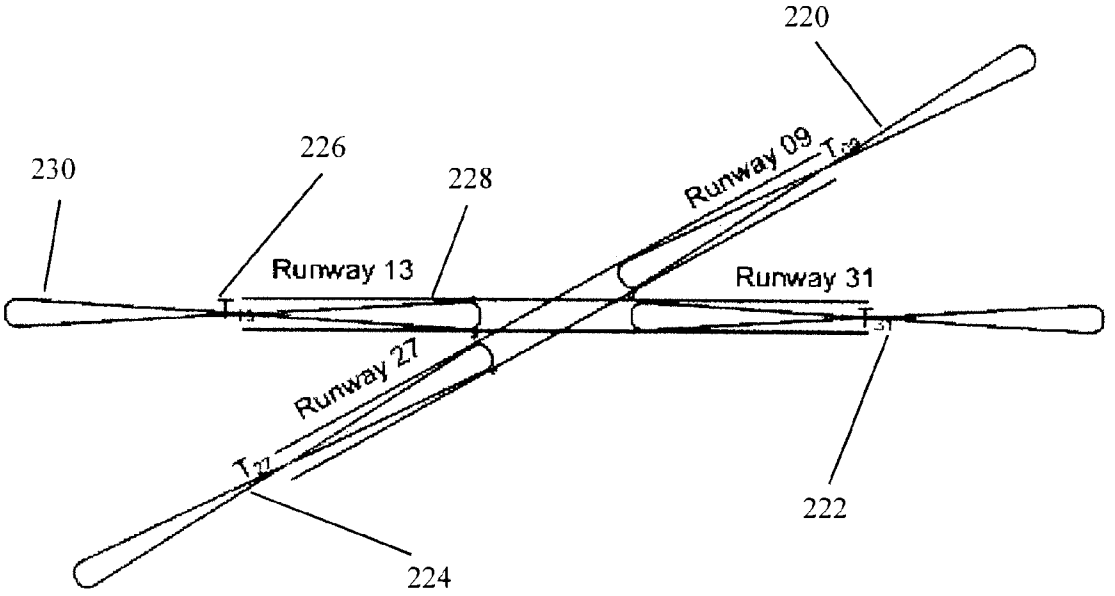


FIG. 4B

FIG. 4C


220
226
230
228
Runway 09
Runway 13
Runway 31
Runway 27
222
224

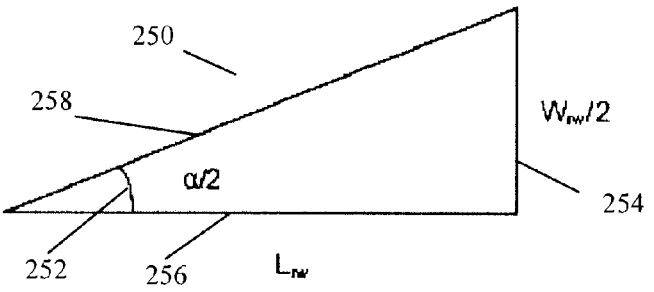


FIG. 5

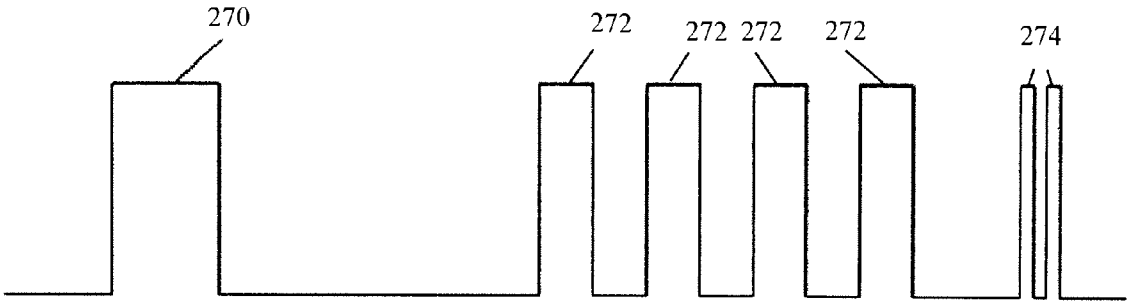


FIG. 8

FIG. 6

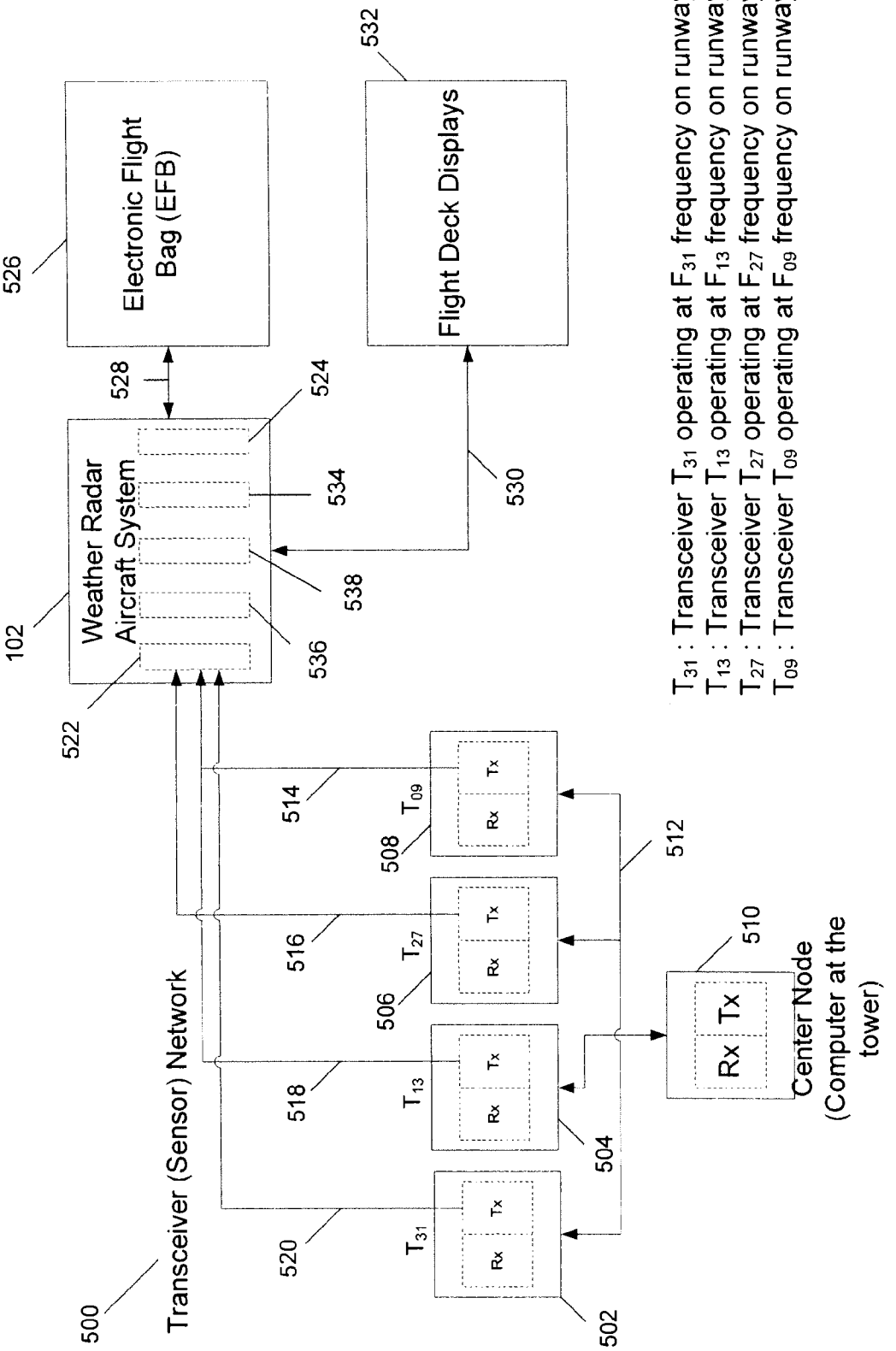

Electronic Flight Bag (EFB)
526
Flight Deck Displays
532
528
524
534
530
538
536
Weather Radar Aircraft System
102
522
514
508
T_{09}
Tx
Rx
512
516
506
T_{27}
510
518
T_{13}
504
520
T_{31}
500
Transceiver (Sensor) Network
502
Center Node (Computer at the tower)
T_{31} : Transceiver T_{31} operating at F_{31} frequency on runway 31
T_{13} : Transceiver T_{13} operating at F_{13} frequency on runway 13
T_{27} : Transceiver T_{27} operating at F_{27} frequency on runway 27
T_{09} : Transceiver T_{09} operating at F_{09} frequency on runway 09

FIG. 7

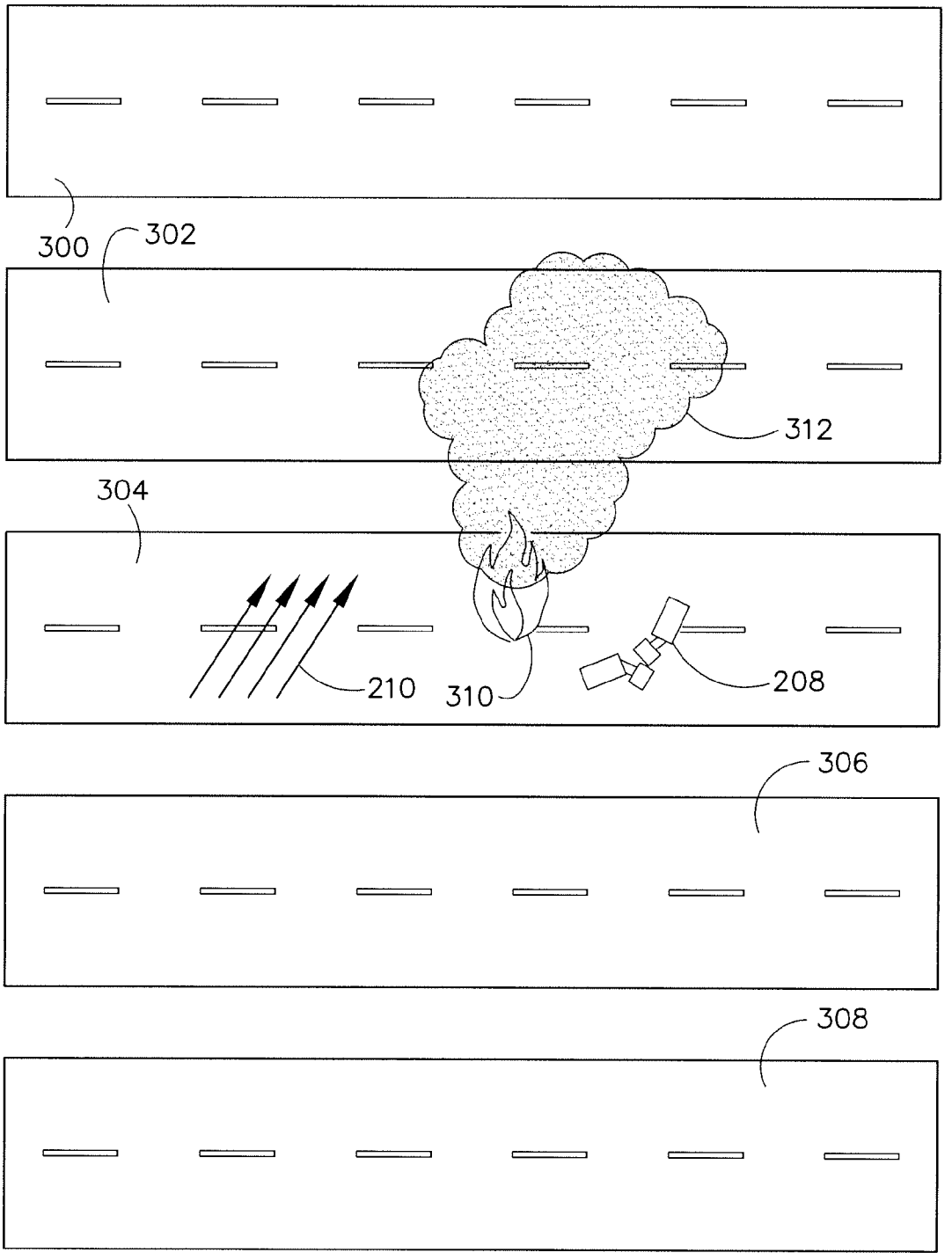


FIG. 9

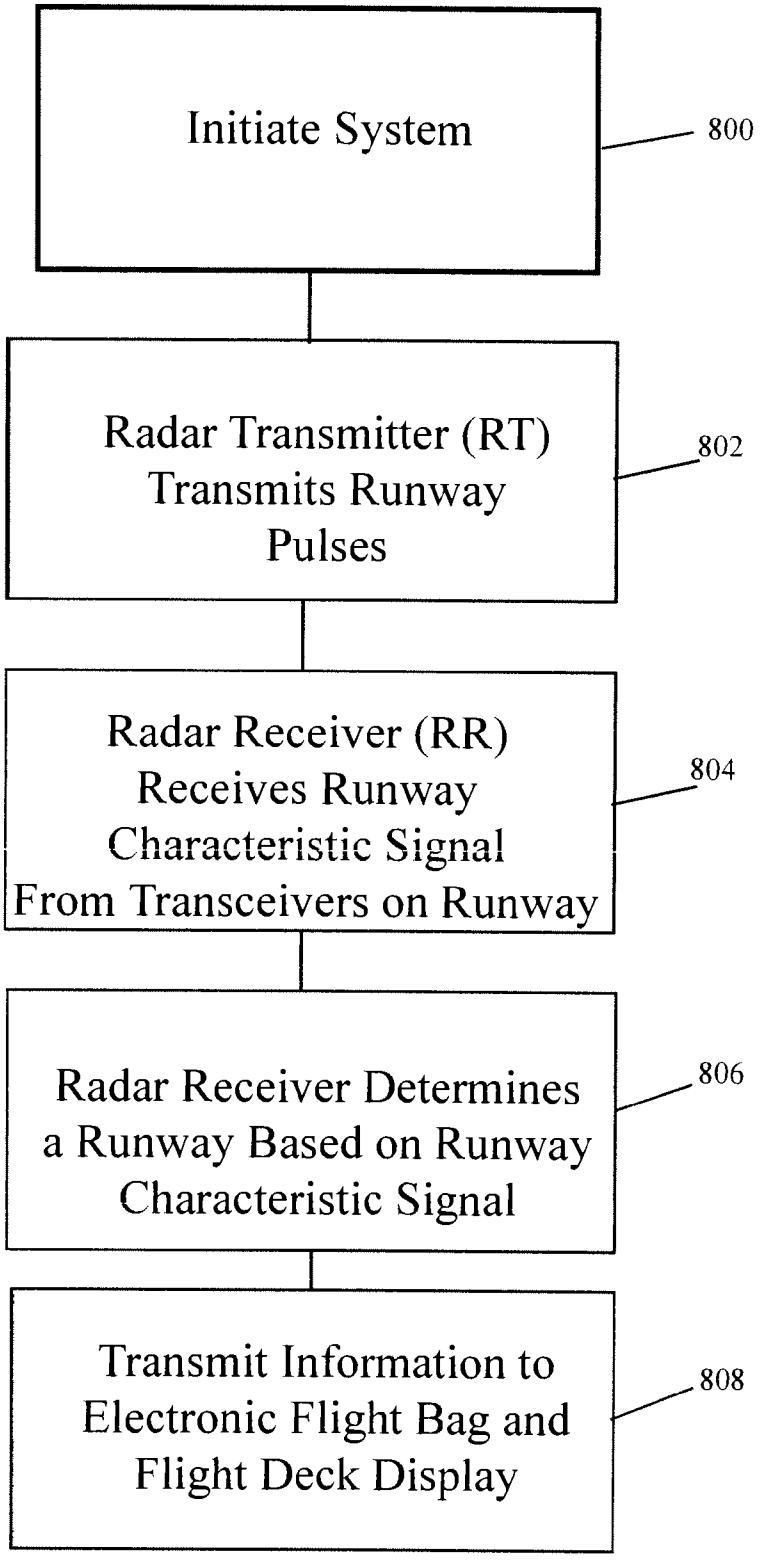

Initiate System
800
Radar Transmitter (RT) Transmits Runway Pulses
802
Radar Receiver (RR) Receives Runway Characteristic Signal From Transceivers on Runway
804
Radar Receiver Determines a Runway Based on Runway Characteristic Signal
806
Transmit Information to Electronic Flight Bag and Flight Deck Display
808

FIG. 10A

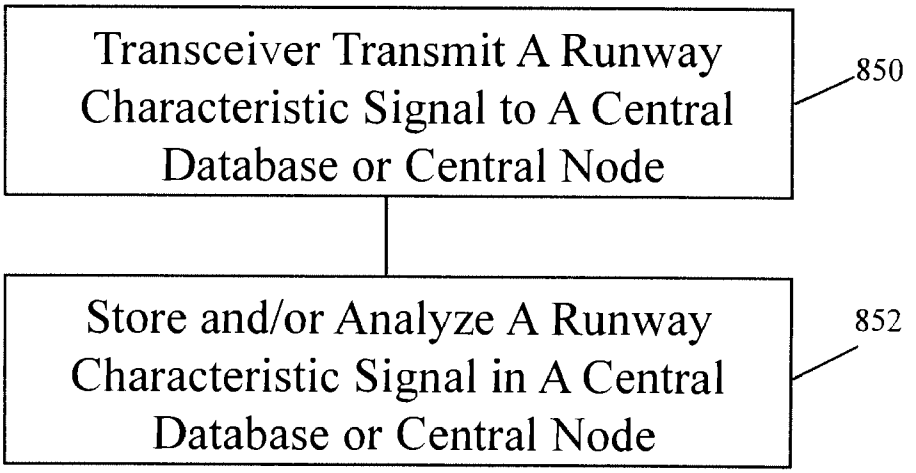
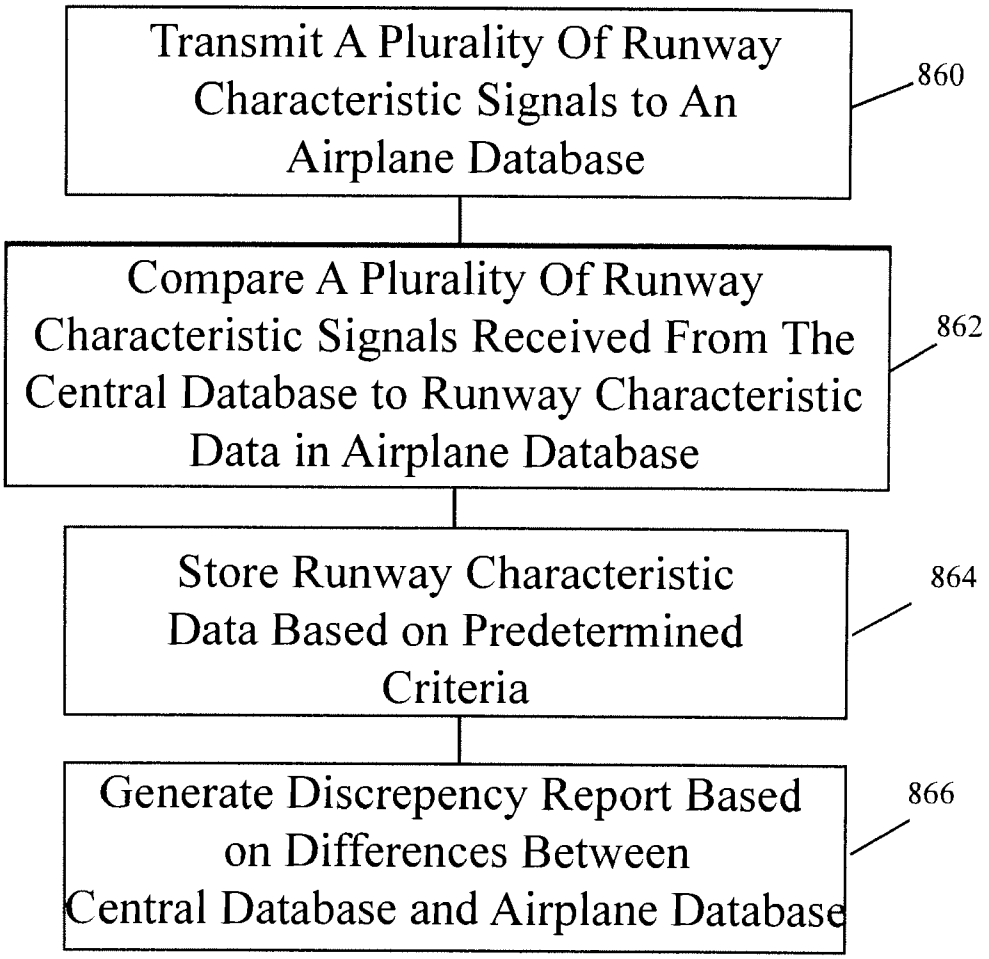


FIG. 10B



RUNWAY IDENTIFICATION SYSTEM VIA RADAR RECEIVER

BACKGROUND

The present disclosure relates generally to the field of aviation. Specifically, the present disclosure relates to a system and method for runway identification via a radar receiver.

Airplanes sometimes land short, land long, enter the wrong runway, enter an active runway, and/or enter a runway with hazardous conditions. A runway has certain characteristics that are unique to a particular runway. These characteristics may be runway length, width, starting position, ending position and runway-end-warning distance. An airplane may enter a runway short because the airplane landed before the runway-starting position. An airplane may enter a runway long because the airplane landed too far from the runway-starting position. An airplane may enter the wrong runway because of a miscommunication between the aircrew and the tower.

A runway identification system may be used to improve situational awareness which may reduce pilot workload to allow the aircrews to avoid mistakes, such as landing short, landing long, entering an active runway, entering the wrong runway, and/or entering a runway with hazardous conditions. A system that is configured to provide runway identification details, which could be utilized to provide warning signals based on the airplane potentially landing short, landing long, entering the wrong runway, entering an active runway, and/or entering a runway with hazardous conditions would be advantageous. The system is configured to provide warning signals, which could reduce the likelihood of any of these situations from occurring.

What is needed is a runway identification system configured to provide sufficient runway identification details to allow the aircrew to more effectively determine the appropriate course of action in an aircraft landing situation.

It would be desirable to provide a system and/or method that provides one or more of these or other advantageous features. Other features and advantages will be made apparent from the present specification. The teachings disclosed extend to those embodiments which fall within the scope of the appended claims, regardless of whether they accomplish one or more of the aforementioned needs.

SUMMARY

One embodiment of the disclosure relates to a runway identification system. The runway identification system includes a weather radar system. The weather radar system includes a receiver. The receiver is configured to receive a runway characteristic signal from a transponder associated with a runway. The runway identification system is configured to determine a runway identification utilizing the runway characteristic signal.

Another embodiment of the disclosure relates to a method for runway identification utilizing a runway transponder located in proximity to the runway. The method includes receiving a runway characteristic signal from the runway transponder and determining a runway from the runway characteristic signal. The method further includes transmitting a runway identification signal and determining at least one of an advisory state, a caution state, and a warning state based on the runway characteristic signal. The method also includes storing the runway characteristic signal in a database.

Another embodiment of the disclosure relates to a runway identification system. The runway identification system includes a means for providing weather radar and a means for receiving a runway characteristic signal from a transponder associated with a runway. The runway identification system further includes a means for determining a runway identification utilizing the runway characteristic signal and a means for transmitting at least one of an advisory signal, a caution signal, and a warning signal based on the runway characteristic signal.

Another embodiment of the disclosure relates to a runway identification system for an airport including a first runway, a second runway, a first runway transponder, a second runway transponder, and a communication network. The communication network is in communication with first runway transponder and second runway transponder. The first runway transponder being configured to transmit a first runway characteristic signal corresponding to the first runway and a second runway transponder being configured to transmit a second runway characteristic signal corresponding to the second runway.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosure will become more fully understood from the following detailed description, taken in conjunction with the accompanying drawings.

FIG. **1** is an illustration of an aircraft control center, according to one exemplary embodiment;

FIG. **2**A is an illustration of an aircraft cone section, which includes the radar receiver, according to one exemplary embodiment;

FIG. **2**B is a block diagram of the runway identification system shown in FIG. **2**A, according to an exemplary embodiment;

FIG. **3** is an illustration of a runway, according to an exemplary embodiment;

FIGS. **4**A-**4**C are illustrations of runway system configurations, according to exemplary embodiments;

FIG. **5** is an illustration of a method of determining system parameters for the runway system of FIGS. **4**A and **4**C, according to an exemplary embodiment;

FIG. **6** is a block diagram of the system, according to an exemplary embodiment;

FIG. **7** is an illustration of a neighboring runway alert system, according to an exemplary embodiment;

FIG. **8** is an illustration of the pulse width measurements in a weather mode, a windshear mode and a runway mode, according to an exemplary embodiment;

FIG. **9** is flowchart of a system operating procedure, according to an exemplary embodiment; and

FIGS. **10**A-**10**B are flowcharts of other system operating procedures, according to an exemplary embodiment.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

Although the description below contains many specificities, these specificities are utilized to illustrate some of the exemplary embodiments of this disclosure and should not be construed as limiting the scope of the disclosure. The scope of this disclosure should be determined by the claims, their legal equivalents and the fact that it fully encompasses other embodiments which may become apparent to those skilled in the art. A method or device does not have to address each and every problem to be encompassed by the present disclosure. All structural, chemical and functional equivalents to the elements of the below-described disclosure that are known to those of ordinary skill in the art are expressly incorporated

herein by reference and are intended to be encompassed by the present claims. A reference to an element in the singular is not intended to mean one and only one, unless explicitly so stated, but rather it should be construed to mean at least one. No claim element herein is to be construed under the provisions of 35 U.S.C. §112, sixth paragraph, unless the element is expressly recited using the phrase "means for." Furthermore, no element, component or method step in the present disclosure is intended to be dedicated to the public, regardless of whether the element, component or method step is explicitly recited in the claims.

Referring to FIG. **1**, an illustration of a cockpit or an aircraft control center **11** is shown, according to one exemplary embodiment. Aircraft control center **11** may include a pilot seat **12***a*, a co-pilot seat **12***b*, an aircraft control stick or yoke **14**, a plurality of flight controls **16** and a number of flight displays **20**. The pilot sitting in pilot seat **12***a* may utilize aircraft control stick **14** as well as other flight controls to maneuver an airplane **10**. The pilot may initiate airplane **10** maneuvers including moving airplane **10** in an upwardly motion, downwardly motion, banking to the left, banking to the right or any combination thereof. The pilot can visually monitor the flight path thorough windshield **18**. However, when the pilot utilizes windshield **18**, his visual range is limited.

The crew utilizes flight displays **20** to increase their visual range and to enhance their decision-making abilities. In an exemplary embodiment, flight displays **20** may be configured to show weather, terrain, fixed obstacles, variable obstacles (i.e., other airplanes), flight characteristics (i.e., altitude or speed), or any combination thereof.

Referring to FIG. **2**A, an illustration of an aircraft cone section **100** is shown. Airplane **10** includes aircraft cone section **100**. In an exemplary embodiment, aircraft cone section **100** may include equipment that is utilized to identify a runway. For example, the equipment may include the weather radar platform and can employ radio frequency ("RF") technology. In an exemplary embodiment, aircraft cone section **100** includes a weather radar **102**. Weather radar **102** is configured to be able to receive signals from ground stations and transceivers/transponders placed on the runway. Weather radar **102** is configured to include all the functionality of a WRT-2100 model. The WRT-2100 may be purchased from Rockwell Collins, Cedar Rapids, Iowa 52498. In an exemplary embodiment, aircraft cone section **100** may also include equipment associated with a TAWS, GPWS, GCAS, WRT or any combination thereof.

Referring to FIG. **2**B, a block diagram of a runway identification system **90** is shown, according to an exemplary embodiment. In an exemplary embodiment, runway identification system **90** includes weather radar **102** and a database **108**. Weather radar **102** has a radar receiver **105**, which is in communication with an antenna **103**. In an exemplary embodiment, runway identification system **90** is in communication with a display **106**. In an exemplary embodiment, display **106** can be an audio display, a visual display or both.

In an exemplary embodiment, runway identification system **90** may be utilized in combination with a Terrain Awareness and Warning System ("TAWS") to communicate with aircrew that the aircraft's flight path may be on an imminent collision course with an obstacle. TAWS may include a Ground Proximity Warning System (GPWS), a Ground Collision Avoidance Systems (GCAS), a Terrain Awareness and Warning System or any combination thereof.

In an exemplary embodiment, runway identification system **90** is based on the ability of weather radar **102** to identify and detect different frequency signals. In an exemplary embodiment, each runway **200** (see FIG. **3**) in an airport may have transceiver/transponder **214** (see FIGS. **4**A-**4**C). Transponder **214** transmits a particular frequency or channel for each runway **200**. In an exemplary embodiment, an airport with 32 runways may be configured to have 32 transmitting channels each transmitting different unique frequencies. The table below is an exemplary embodiment of runway frequencies.

Runway ID No./Transmitting Channel	Transmitting Frequency (Hz)
1	9,000,000,000
2	9,000,000,001
3	9,000,000,002
4	9,000,000,003
5	9,000,000,004
6	9,000,000,005
7	9,000,000,006
8	9,000,000,007
9	9,000,000,008
...	...
...	...
...	...
31	9,000,003,000
32	9,000,003,100

In an exemplary embodiment, radar receivers **105** are able to detect each individual frequency and determine the specific runway associated with that particular frequency. In another exemplary embodiment, weather radar **102** may be configured to radiate a passive transponder with a transmission and determine the specific runway associated with that particular passive transponder.

In FIG. **3**, an illustration of a runway **200** is shown, according to an exemplary embodiment. Runway **200** includes a runway length **202** and a runway end **204**. In an exemplary embodiment, runway identification system **90** can be configured to utilize a runway-end-warning distance **206** to signal to the flight crew that runway end **204** is approaching. In another exemplary embodiment, runway identification system **90** can be configured to utilize runway length **202**, runway end **204** and/or runway-end-warning distance **206** to initiate an advisory signal, a caution signal or a warning signal. In an exemplary embodiment, runway identification system **90** can be configured to identify and prioritize the level of notification. An advisory signal is the lowest level of notification and indicates that the aircraft crew should be aware of the condition. A caution signal is the second highest level of notification and indicates that the aircraft crew should be aware of the condition at a higher level than an advisory signal. A warning signal is the highest level of notification and indicates that the aircraft crew should be aware of the conditions and take affirmative action to avoid the condition.

In another exemplary embodiment, runway identification system **90** can be configured to utilize runway data including information regarding an obstacle **208** and characteristic information related to wind **210**. In an exemplary embodiment, obstacle **208** may be debris, material handling equipment, other aircraft, emergency vehicles or personnel. In an exemplary embodiment, obstacle **208** may be tagged with a radio frequency transceiver that allows the system to be actively aware of the position of obstacle **208**. In an exemplary embodiment, an emergency vehicle may enter runway **200** while airplane **10** is five hundred miles from runway **200**. In this situation, runway identification system **90** can be configured to initiate an advisory signal. If the emergency vehicle exits runway **200**, the advisory signal is discontinued. In an exemplary embodiment, the emergency vehicle remains on

runway **200** when airplane **10** is one hundred miles from runway **200**. In this situation, runway identification system **90** can be configured to initiate a caution signal. If the emergency vehicle exits runway **200**, the caution signal is discontinued. In an exemplary embodiment, the emergency vehicle remains on runway **200** when airplane **10** is twenty-five miles from runway **200**. In this situation, runway identification system **90** can be configured to initiate a warning signal. In another exemplary embodiment, runway identification system **90** can be configured to alert obstacle **208** that airplane **10** is approaching. In an exemplary embodiment, the alert could include airplane characteristics (i.e., size, weigh, speed, or fuel level) and/or data concerning arrival time. In an exemplary embodiment, the system could also be a passive system. It should be noted that the advisory, caution and warning signals could be initiated at any distance desired.

In an exemplary embodiment, wind **210** characteristics may be transmitted to the aircraft crew. Wind **210** characteristics may include speed, strength, direction, and/or cross currents. In an exemplary embodiment, runway identification system **90** can be configured to receive other weather information, such as rain, snow or hail.

In FIGS. **4**A-**4**C, illustrations of runway system configurations are shown, according to exemplary embodiments. In FIG. **4**A, airplane **10** is approaching runway **200**. In an exemplary embodiment, a transponder **214** is located at a runway centerline **212** on runway **200**. Transponder **214** has a signal envelope **218**. In an exemplary embodiment, signal envelope **218** maintains a −20° to +20° coverage region around runway centerline **212**. In this exemplary embodiment, runway centerline **212** has an angle of 0°. Signal envelope **218** is configured to minimize overflow and/or interference between signal envelope **218** on runway **200** and signal envelope (not shown) on a different runway (not shown). In an exemplary embodiment, transponder **214** may be connected (i.e., wirelessly or wired) to a central node. The central node may be a computer at the tower. The central node can actively manage every transponder **214** on multiple runways **200**. In an exemplary embodiment, transponder **214** is configured to communicate to other transponders, the central node and/or act as a stand alone unit.

In FIG. **4**B, airplane **10** is approaching runway **200**. In an exemplary embodiment, runway lights **216** are positioned on both sides of runway **200**. In this exemplary embodiment, transponder **214** is located inside and/or adjacent to runway lights **216**. The signal strength of each transponder **214** can be reduced with the use of multiple transponders **214**. In an exemplary embodiment, the overflow and/or interference may be minimized by utilizing multiple transponders **214**. It should be noted that transponder **214** may transmit data, receive data or both.

In FIG. **4**C, another illustration of a runway system is shown, according to an exemplary embodiment. In this exemplary embodiment, spillage of radio frequency activity to neighboring runways is controlled by filtering algorithms. In an exemplary embodiment, an airport includes $runway_{31}$ **222**, $runway_{13}$ **226**, $runway_{27}$ **224**, and $runway_{09}$ **220**. These runways have a transponder signal that includes a first signal envelope **228** and a second signal envelope **230**. First signal envelope **228** and second signal envelope **230** are configured to minimize interference with other first signal envelopes and second signal envelopes.

Referring to FIGS. **2**A, **2**B, **4**A, **4**B and **4**C, runway identification system **90** can function as a receiver and establishes communication with transponders **214** that are located on runway **200** at an airport. In an exemplary embodiment, this communication occurs when airplane **10** approaches within 1,000 feet proximity of runway **200**. Transponders **214** are assigned to a specific runway **200**. Transponders **214** contain unique and specific data regarding a specific runway **200**. This data may be static or dynamic depending on the system configuration. This data may include runway ID number, runway length **202**, runway end **204**, wind **210** direction or wind **210** speed. In an exemplary embodiment, the data may also include end-of-runway warning, and condition of runway (i.e., hazard alerts, diversion runway).

In an exemplary embodiment, runway identification system **90** can be configured to receive signals from transponder **214**. Runway identification system **90** can process and correct the signal utilizing filtering techniques. In an exemplary embodiment, transponders **214** are placed on runways **200** and are connected (i.e., wirelessly or wired) to a central node. Transponders **214** may be configured to communicate with each other via the central node. In an exemplary embodiment, runway identification system **90** can be configured to have full communication functionality with electronic flight bag **526** (see FIG. **6**) in order to convey messages received from runway identification system **90**. In an exemplary embodiment, notifications and alerts can be displayed at flight deck display **532** (see FIG. **6**).

Each runway **200** can have information that is specific to that particular runway **200**. In an exemplary embodiment, unidirectional transponders **214** can be used to ensure that transponders **214** on a particular runway **200** are not intercepting with transponders **214** on another runway **200**. In an exemplary embodiment, each transponder **214** has the capability to be programmed with the necessary information by the appropriate users. In an exemplary embodiment, the appropriate users may be the control tower personnel, runway crew, computer support staff and/or operational personnel.

In FIG. **5**, an illustration of a method of determining system parameters for the runway system of FIGS. **4**A and **4**C is shown, according to an exemplary embodiment. A right triangle **250** includes an $\alpha/2$ angle **252**, a $W_{rw}/2$ side **254**, a L_{rw} side **256** and a hypotenuse **258**. In an exemplary embodiment, the formula to determine the beam width of transponder **214** is:

$$\alpha = 2 \tan{-1} \left((W_{rw}/2)/L_{rw} \right) \text{ and } D_{max} < L_{rw}$$

Where runway length **202** is L_{rw} the width of runway **200** is W_{rw} the maximum distance of taxing for lift is $D_{max} < L_{rw}$, the beam width of transponder **214** is α.

In FIG. **6**, another block diagram of runway identification system **90** is shown, according to an exemplary embodiment. A transceiver network **500** includes a $transceiver_{31}$ **502**, a $transceiver_{13}$ **504**, a $transceiver_{27}$ **506**, a $transceiver_{09}$ **508**, and a center node **510**. Transceiver network **500** is configured to communicate with weather radar **102** via a first communication path **514**, a second communication path **516**, a third communication path **518** and a fourth communication path **520**. Weather radar **102** includes a receiver **522**, a transmitter **524**, a sensor **536**, a processor **538** and a memory **534**. In an exemplary embodiment, weather radar **102** communicates via a fifth communication path **528** to an electronic flight bag **526**. In an exemplary embodiment, weather radar **102** communicates via a six communication path **530** to at least one flight deck display **532**.

In an exemplary embodiment, $transceiver_{31}$ **502** operates at a F_{31} frequency on $runway_{31}$, $transceiver_{13}$ **504** operates at a F_{13} frequency on $runway_{13}$, $transceiver_{27}$ **506** operates at a F_{27} frequency on $runway_{27}$ and $transceiver_{09}$ **508** operates at a F_{09} frequency on $runway_{09}$. In an exemplary embodiment, airplane **10** is approaching $runway_{09}$ to potentially land on $runway_{09}$. In this exemplary embodiment, $transceiver_{09}$ **508**

communicates runway$_{09}$ data to weather radar **102** via first communication path **514**. In this exemplary embodiment, whether airplane **10** will land on runway$_{09}$ depends on the conditions present on runway$_{09}$. If transceiver$_{09}$ **508** does not issue a warning signal, airplane **10** may land on runway$_{09}$. If transceiver$_{09}$ **508** issues a caution and/or an advisory signal, airplane **10** may land on runway$_{09}$ depending on other communications with the control tower, other airplanes or aircraft crew experience.

In another exemplary embodiment, if transceiver$_{09}$ **508** issues a warning signal, the system may be configured to scan for the nearest runway **200** which is clear for landing and has the appropriate characteristics (i.e., length) for this particular airplane **10**.

In FIG. **7**, an illustration of a neighboring runway alert system is shown, according to an exemplary embodiment. In an exemplary embodiment, an airport includes a first runway **300**, a second runway **302**, a third runway **304**, a fourth runway **306**, and a fifth runway **308**. In this exemplary embodiment, third runway **304** may have various conditions that may be reported to any airplane **10** attempting to utilize third runway **304**. These conditions may also be transmitted to airplanes **10** attempting to utilize first runway **300**, second runway **302**, fourth runway **306**, and fifth runway **308**.

In an exemplary embodiment, a fire **310** may be located on third runway **304**. Fire **310** has produced a smoke cloud **312**. In this exemplary embodiment, second runway **302** transponders may transmit a caution signal based on fire **310** and a warning signal based on smoke cloud **312**. In an exemplary embodiment, runway identification system **90** can combine these signal into one warning signal. In this exemplary embodiment, first runway **300** transponders may transmit a caution signal based on smoke cloud **312**. The caution signal could also be a warning signal depending on system parameter tolerances related to distance of hazard versus movement of hazard and/or significance of hazard.

In this exemplary embodiment, fourth runway **306** and fifth runway **308** transponders may transmit an advisory signal based on fire **310**, smoke cloud **312** and wind **210** direction. This advisory signal may become a caution signal or a warning signal with a change in wind **210** direction.

In another exemplary embodiment, second runway **302** transponders may transmit an advisory signal, a caution signal or a warning signal based on wind **210** characteristics.

In another exemplary embodiment, fourth runway **306** transponders may transmit a caution signal and/or a warning signal based on the speed and/or distance of obstacle **208**.

In FIG. **8**, an illustration of the pulse width measurements in a weather mode, a windshear mode and a runway mode are shown, according to an exemplary embodiment. In an exemplary embodiment, transponder **214** transmits narrow and tall train pulses **274** in runway mode. Narrow and tall train pulses **274** provide the necessary information the aircrew needs regarding runway characteristics. In an exemplary embodiment, the pulse width may be 1 micro second. It should be noted that narrow and tall train pulse's **274** pulse width may vary from 10^{-9} micro second to 2 micro seconds. In an exemplary embodiment, pulse compression concepts are used to generate very high signal-to-noise ratio ("SNR") in order to ensure data quality. In an exemplary embodiment, pulse compression may be utilized to generate sharp and narrow pulses. In another exemplary embodiment, runway mode may use radio altitude to identify the height of airplane **10** from the ground, as opposed to the height of airplane **10** from sea level.

In an exemplary embodiment, wide and tall pulse pattern **270** may be used in weather mode. In an exemplary embodiment, wide and tall pulse pattern **270** may be 25 micro seconds. It should be noted that wide and tall pulse pattern **270** pulse width may vary from 5 micro seconds to 35 micro seconds. In another exemplary embodiment, medium and tall pulse pattern **272** may be used in windshear mode. In an exemplary embodiment, medium and tall pulse pattern **272** pulse width may vary from 0.5 micro second to 2.5 micro seconds.

In an exemplary embodiment, the weather mode may be initiated at or above 2,600 feet. The windshear mode may be initiated from 10 feet to 2,599 feet. Runway mode may be initiated below 2,600 feet.

In an exemplary embodiment, the receiver architecture of weather radar **102** is configured to allow weather radar receiver **522** to receive signal from transponder **214**. Weather radar receiver **522** identifies utilizing filter technology these signals from transponder **214**. In an exemplary embodiment, weather radar receiver **522** is a transceiver and a time delay is present between transmitting pulses. During this delay, weather radar receiver **522** is configured to listen to transponder **214**. In another exemplary embodiment, runway identification system **90** can be configured to allow weather radar receiver **522** to receive signal from transponder **214**.

In FIG. **9**, a process flowchart for the system is shown, according to an exemplary embodiment. Runway identification system **90** is initiated (step **800**). The radar transmitter transmits runway pulses (step **802**). Radar receiver receives runway characteristic signals from transceivers on runway **200** (step **804**). Radar receiver determines runway **200** based on runway characteristic signal (step **806**). Runway identification system **90** transmits information to electronic flight bag **526** and/or flight deck display **532** (step **808**). In an exemplary embodiment, runway identification system **90** can be configured to store the runway signal in a database.

In FIG. **10**A, another process flowchart for runway identification system **90** is shown, according to an exemplary embodiment. Runway identification system **90** transmits a runway characteristics signal to a central database (step **850**). The central database stores the runway characteristics signal (step **852**).

In FIG. **10**B, another process flowchart for runway identification system **90** is shown, according to an exemplary embodiment. The central database transmits a plurality of runway characteristic signals to an airplane database (step **860**). An airplane processor compares the plurality of runway characteristic signals received from the central database to runway characteristic data already stored in the airplane's database (step **862**). The airplane processor stores the plurality of runway characteristic signals based on a predetermined set of criteria (step **864**). In an exemplary embodiment, runway identification system **90** can analyzes discrepancies between the plurality of runway characteristic signals and the runway characteristic signals already stored in the airplane's database to determine which value should be stored in the airplane's database. In an exemplary embodiment, runway identification system **90** can be configured to generate a report of the discrepancies between the plurality of runway characteristic signals and the runway characteristic signals already stored in the airplane's database (step **866**).

Although specific steps are shown and described in a specific order, it is understood that the method may include more, fewer, different, and/or a different ordering of the steps to perform the function described herein.

The exemplary embodiments illustrated in the figures and described herein are offered by way of example only. Accordingly, the present application is not limited to a particular embodiment, but extends to various modifications that nevertheless fall within the scope of the appended claims. The

order or sequence of any processes or method steps may be varied or re-sequenced according to alternative embodiments.

The present application contemplates methods, systems and program products on any machine-readable media for accomplishing its operations. The embodiments of the present application may be implemented using an existing computer processor, or by a special purpose computer processor for an appropriate system, incorporated for this or another purpose or by a hardwired system.

It is important to note that the construction and arrangement of the runway identification system **90** as shown in the various exemplary embodiments is illustrative only. Although only a few embodiments of the present application have been described in detail in this disclosure, those skilled in the art who review this disclosure will readily appreciate that many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors and orientations) without materially departing from the novel teachings and advantages of the subject matter recited in the claims. For example, elements shown as integrally formed may be constructed of multiple parts or elements, the position of elements may be reversed or otherwise varied, and the nature or number of discrete elements or positions may be altered or varied. Accordingly, all such modifications are intended to be included within the scope of the present application as defined in the appended claims. The order or sequence of any process or method steps may be varied or re-sequenced according to alternative embodiments. In the claims, any means-plus-function clause is intended to cover the structures described herein as performing the recited function and, not only structural equivalents, but also equivalent structures. Other substitutions, modifications, changes and omissions may be made in the design, operating conditions and arrangement of the exemplary embodiments without departing from the scope of the present application as expressed in the appended claims.

As noted above, embodiments within the scope of the present application include program products comprising machine-readable media for carrying or having machine-executable instructions or data structures stored thereon. Such machine-readable media can be any available media which can be accessed by a general purpose or special purpose computer or other machine with a processor. By way of example, such machine-readable media can comprise RAM, ROM, EPROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to carry or store a desired program code in the form of machine-executable instructions or data structures and which can be accessed by a general purpose or special purpose computer or other machine with a processor. When information is transferred or provided over a network or another communications connection (either hardwired, wireless, or a combination of hardwired or wireless) to a machine, the machine properly views the connection as a machine-readable medium. Thus, any such connection is properly termed a machine-readable medium. Combinations of the above are also included within the scope of machine-readable media. Machine-executable instructions comprise, for example, instructions and data which cause a general purpose computer, special purpose computer, or special purpose processing machine to perform a certain function or group of functions.

It should be noted that although the diagrams herein may show a specific order of method steps, it is understood that the order of these steps may differ from what is depicted. Also, two or more steps may be performed concurrently or with partial concurrence. Such variation will depend on the software and hardware systems chosen. It is understood that all such variations are within the scope of the application. Likewise, software implementations of the present application could be accomplished with standard programming techniques with rule-based logic and other logic to accomplish the various connection steps, processing steps, comparison steps and/or decision steps.

The foregoing description of embodiments of the application has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the application to the precise form disclosed, and modifications and variations are possible in light of the above teachings, or may be acquired from practice of the application. The embodiments were chosen and described in order to explain the principles of the application and its practical application to enable one skilled in the art to utilize the application in various embodiments and with various modifications as are suited to the particular use contemplated.

Although the description contains many specificities, these specificities are utilized to illustrate some of the preferred embodiments of this application and should not be construed as limiting the scope of the application. The scope of this application should be determined by the claims, their legal equivalents, and the fact that it fully encompasses other embodiments which may become apparent to those skilled in the art.

What is claimed is:

1. A runway identification system, comprising:

a weather radar system including a receiver, wherein the receiver is configured to receive a runway signal from a transponder associated with a runway, wherein the runway signal includes data, wherein the data is related to at least one of an atmospheric condition associated with the runway, an obstacle associated with the runway, a runway dimension, and an incident associated with the runway; and

wherein an indication of an advisory, a caution or a warning is determined utilizing the runway signal.

2. The runway identification system of claim **1**, wherein at least one of an advisory state, a caution state, and a warning state is determined based on the data associated with the runway signal.

3. The runway identification system of claim **1**, wherein at least one of the runway signal and a runway identification signal is transmitted to an electronic flight bag.

4. The runway identification system of claim **1**, wherein at least one of the runway signal and a runway identification signal is transmitted to a flight deck display.

5. The runway identification system of claim **1**, wherein the runway signal includes data related to at least one of an obstacle and an occurrence.

6. The runway identification system of claim **1**, wherein the runway signal is stored in a database.

7. The runway identification system of claim **6**, wherein stored runway data is transmitted to an off-board central database.

8. The runway identification system of claim **7**, wherein the off-board central database transmits a plurality of stored runway data to the database; and

wherein the plurality of stored runway data was obtained from other runway identification systems.

9. The runway identification system of claim **7**, wherein a processor compares the plurality of stored runway data to the received runway data and is configured to generate a discrepancy report.

10. A method for runway identification utilizing a runway transponder located in proximity to the runway, comprising:
receiving a runway signal from the runway transponder, the runway signal having a frequency or data identifying a specific runway;
determining a runway from the runway signal;
transmitting a runway identification signal;
determining at least one of an advisory state, a caution state, and a warning state in response to the runway signal; and
storing the runway signal in a database.

11. The method of claim 10, wherein at least one of the runway identification signal, an advisory signal, a caution signal and a warning signal is transmitted to an electronic flight bag.

12. The method of claim 10, wherein at least one of the runway identification signal, an advisory signal, a caution signal and a warning signal is transmitted to a flight deck display.

13. The method of claim 10, further comprising transmitting the runway signal to a central database.

14. The method of claim 13, further comprising receiving a plurality of runway signals from a central database.

15. The method of claim 14, further comprising comparing the plurality of runway signals from the central database to runway signals in the database.

16. A runway identification system, comprising:
a means for providing weather radar which includes a means for receiving a runway signal from a transponder associated with a runway, the runway signal having a frequency or data identifying a particular runway;
a means for determining a runway identification utilizing the runway signal; and
a means for transmitting at least one of an advisory signal, a caution signal, and a warning signal based on the runway signal.

17. The runway identification system of claim 16, wherein the means for providing weather radar transmits at least one of the runway signal, the advisory signal, the caution signal, and the warning signal to an electronic flight bag.

18. The runway identification system of claim 16, wherein the means for providing weather radar transmits at least one of the runway signal, the advisory signal, the caution signal, and the warning signal to a flight deck display.

19. The runway identification system of claim 16, wherein the runway signal includes data related to at least one of an obstacle and an occurrence.

20. A runway identification system for an airport, comprising:
a first runway;
a second runway;
a first runway transponder;
a second runway transponder;
a communication network in communication with first runway transponder and second runway transponder; and
wherein first runway transponder is configured to transmit a first runway characteristic signal corresponding to the first runway, the first runway signal having a frequency or data associated with the first runway; and
wherein second runway transponder is configured to transmit a second runway signal corresponding to the second runway, the second runway signal having a frequency or data associated with the second runway, wherein the data includes at least one of wind data, runway length data, end of runway data and fire data.

21. The runway identification system for an airport of claim 20, wherein an airplane weather radar receives one of the first runway signal or the second runway signal.

22. The runway identification system for an airport of claim 20, wherein an emergency vehicle receives one of the first runway signal or the second runway signal.

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