



US008362948B2

(12) **United States Patent**
Kolinko et al.

(10) **Patent No.:** **US 8,362,948 B2**
(45) **Date of Patent:** **Jan. 29, 2013**

(54) **LONG RANGE MILLIMETER WAVE SURFACE IMAGING RADAR SYSTEM**

(56) **References Cited**

(75) Inventors: **Vladimir Kolinko**, San Diego, CA (US);
Chris Sexton, San Diego, CA (US);
Grant Bishop, Carlsbad, CA (US); **John Lovberg**, San Diego, CA (US)

U.S. PATENT DOCUMENTS

5,592,170	A *	1/1997	Price et al.	342/22
7,724,180	B2 *	5/2010	Yonak et al.	342/70
7,782,251	B2 *	8/2010	Bishop et al.	342/179
2005/0134440	A1 *	6/2005	Breed	340/435
2008/0272955	A1 *	11/2008	Yonak et al.	342/54
2009/0135051	A1 *	5/2009	Bishop et al.	342/175
2011/0199254	A1 *	8/2011	Bishop et al.	342/179

(73) Assignee: **Trex Enterprises Corp**, San Diego, CA (US)

* cited by examiner

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

Primary Examiner — John B Sotomayor

(74) Attorney, Agent, or Firm — John R. Ross

(21) Appl. No.: **13/374,362**

(22) Filed: **Dec. 22, 2011**

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2012/0249363 A1 Oct. 4, 2012

A long range millimeter wave imaging radar system. Preferred embodiments are positioned to detect foreign object debris objects on surface of the runway, taxiways and other areas of interest. The system includes electronics adapted to produce millimeter wave radiation scanned over a frequency range of a few gigahertz. The scanned millimeter wave radiation is broadcast through a frequency scanned antenna to produce a narrow scanned transmit beam in a first scanned direction (such as the vertical direction) defining a narrow, approximately one dimensional, electronically scanned field of view corresponding to the scanned millimeter wave frequencies. The antenna is mechanically pivoted or scanned in a second scanned direction perpendicular to the first scanned direction so as to define a two-dimensional field of view.

Related U.S. Application Data

(63) Continuation-in-part of application No. 12/806,488, filed on Aug. 13, 2010.

(60) Provisional application No. 61/626,660, filed on Oct. 1, 2011.

(51) **Int. Cl.**
G01S 13/89 (2006.01)

(52) **U.S. Cl.** **342/179; 342/27; 342/58; 342/180**

(58) **Field of Classification Search** **342/27, 342/57-58, 74-75, 81, 90, 100, 103, 179-180**

See application file for complete search history.

24 Claims, 15 Drawing Sheets

