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(54) **COHERENT TWO-DIMENSIONAL IMAGE FORMATION BY PASSIVE SYNTHETIC APERTURE COLLECTION AND PROCESSING OF MULTI-FREQUENCY RADIO SIGNALS SCATTERED BY CULTURAL FEATURES OF TERRESTRIAL REGION**

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(58) **Field of Search** 455/423–425, 455/63, 62, 12.1, 13.1, 427, 226.1; 342/172–178, 25, 191, 192, 199

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,659,318 A	*	8/1997	Madsen	342/25
5,767,802 A	*	6/1998	Kosowsky	342/45
5,805,098 A	*	9/1998	McCorkle	342/25
5,940,737 A	*	8/1999	Eastman	455/3.2
6,232,922 B1	*	5/2001	McIntosh	342/453
6,384,766 B1	*	5/2002	Ulander	342/25
6,400,306 B1	*	6/2002	Nohara	342/25
6,424,290 B1	*	7/2002	O'Neil	342/55
6,466,156 B1	*	10/2002	Ulander	342/25
6,518,914 B1	*	2/2003	Peterson et al.	342/25

* cited by examiner

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(57) **ABSTRACT**

An imaging system uses wideband 'RF daylight' created by plural narrowband RF illumination sources, to passively generate spectrally different sets of RF scattering coefficients for multiple points within a prescribed three-dimensional volume being illuminated by the narrowband RF transmitters. To correct for the lack of mutual coherence among different RF illumination sources, the respective sets of scattering coefficient data are applied to a cultural feature extraction operator, to locate one or more strong cultural features spatially common to multiple images. For spatial points along the extracted cultural feature theoretical scattering coefficients are calculated. Differences between phase values of these calculated scattering coefficients and those of the collected and processed scattering energy are used to modify the measured scattering coefficient values for all spatial points in the illuminated region. This allows the scattering coefficients of that narrowband frequency set to be coherently combined with those of another spectrally different narrowband set of scattering coefficients whose phase components have been similarly corrected, based upon the same extracted cultural feature.

24 Claims, 5 Drawing Sheets