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# United States Patent [19] Erskine

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## [54] NOISE PAIR VELOCITY AND RANGE ECHO LOCATION SYSTEM

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[\*] Notice: The term of this patent shall not extend beyond the expiration date of Pat. No. 5,642,194.

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[51] Int. Cl.<sup>6</sup> ..... **G01B 9/02**

[52] U.S. Cl. .... **356/345; 356/28.5; 356/349; 356/4.09**

[58] Field of Search ..... **356/4.09, 28.5, 356/349, 345**

## [56] References Cited

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## [57] ABSTRACT

An echo-location method for microwaves, sound and light capable of using incoherent and arbitrary waveforms of wide bandwidth to measure velocity and range (and target size) simultaneously to high resolution. Two interferometers having very long and nearly equal delays are used in series with the target interposed. The delays can be longer than the target range of interest. The first interferometer imprints a partial coherence on an initially incoherent source which allows autocorrelation to be performed on the reflected signal to determine velocity. A coherent cross-correlation subsequent to the second interferometer with the source determines a velocity discriminated range. Dithering the second interferometer identifies portions of the cross-correlation belonging to a target apart from clutter moving at a different velocity. The velocity discrimination is insensitive to all slowly varying distortions in the signal path. Speckle in the image of target and antenna lobing due to parasitic reflections is minimal for an incoherent source. An arbitrary source which varies its spectrum dramatically and randomly from pulse to pulse creates a radar elusive to jamming. Monochromatic sources which jitter in frequency from pulse to pulse or combinations of monochromatic sources can simulate some benefits of incoherent broadband sources. Clutter which has a symmetrical velocity spectrum will self-cancel for short wavelengths, such as the apparent motion of ground surrounding target from a sidelooking airborne antenna.

26 Claims, 20 Drawing Sheets

