Shelton, U.S. Patent No. 11,703,602

US 11,703,602 B2 Traffic Radar System with Patrol Vehicle Speed Detection Claims

[1.0] A traffic radar system comprising:
[1.1] a radar transceiver configured to transmit and receive radar beams in a front zone corresponding to an area in front of a patrol vehicle or in a rear zone corresponding to an area behind the patrol vehicle and to generate an electronic signal corresponding to the received radar beam;
[1.2] a speed determining element configured to determine and output a speed of the patrol vehicle and not receive signals or data from the patrol vehicle; and
[1.3] a processing element configured to
[1.4] receive a plurality of digital data samples derived from the electronic signal,
[1.5] receive the speed of the patrol vehicle from the speed determining element,
[1.6] perform a time domain to frequency domain conversion on the digital data samples creating a plurality of frequency bins, each frequency bin associated with a frequency bin number, having a relative magnitude value, and corresponding to a speed of a vehicle,
[1.7] convert the speed of the patrol vehicle to a frequency bin number,
[1.8] form a patrol vehicle speed window that includes a range of frequency bin numbers having the frequency bin number of the converted patrol vehicle speed as a center of the range,
[1.9] determine at least one group of successive frequency bin numbers outside of the patrol vehicle speed window whose relative magnitude is greater than a spike threshold value,
[1.10] convert one frequency bin number in each group to the relative speed of one target vehicle, and
[1.11] convert the relative speed of the target vehicle to an absolute speed using the speed of the patrol vehicle.

[2.0] The traffic radar system of claim 1, wherein the processing element is further configured to perform one of the following depending the directions of travel of the patrol vehicle and the target vehicle:
[2.1] add the relative speed of the target vehicle to the speed of the patrol vehicle to determine the absolute speed of the target vehicle,

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[2.2] subtract the relative speed of the target vehicle from the speed of the patrol vehicle to determine the absolute speed of the target vehicle, and

[2.3] subtract the speed of the patrol vehicle from the relative speed of the target vehicle to determine the absolute speed of the target vehicle.

[3.0] The traffic radar system of claim 1, wherein the processing element is further configured to determine whether the patrol vehicle is moving or stationary and convert the relative speed of the target vehicle to the absolute speed using the speed of the patrol vehicle only when the patrol vehicle is moving.

[4.0] The traffic radar system of claim 1, wherein the speed determining element outputs the patrol vehicle speed in a stream of messages and the processing element is further configured to determine that the patrol vehicle is moving when the patrol vehicle speed is greater than a first threshold value for a predetermined number of successive messages.

[5.0] The traffic radar system of claim 1, wherein the speed determining element outputs the patrol vehicle speed in a stream of messages and the processing element is further configured to determine that the patrol vehicle is stationary when the patrol vehicle speed is less than a second threshold value for a predetermined number of successive messages.

[6.0] The traffic radar system of claim 1, wherein the speed determining element is further configured to receive and process radio frequency signals from a global navigation satellite system.

[7.0] The traffic radar system of claim 1, further comprising a display configured to display a plurality of speeds, and the processing element is further configured to control the display to display the speed of the patrol vehicle and the absolute speed of the target vehicle.

[8.0] The traffic radar system of claim 1, further comprising an analog to digital converter configured to receive the electronic signal and output the digital data samples.

[9.0] A traffic radar system comprising:

[9.1] a radar transceiver configured to transmit and receive radar beams in a front zone corresponding to an area in front of a patrol vehicle or in a rear zone corresponding to an area behind the patrol vehicle and to generate an electronic signal corresponding to the received radar beam;

[9.2] a speed determining element configured to receive and process radio frequency signals from a global navigation satellite system to determine and output a speed of the patrol vehicle; and

[9.3] a processing element configured to

[9.4] receive a plurality of digital data samples derived from the electronic signal,

[9.5] receive the speed of the patrol vehicle from the speed determining element,

[9.6] perform a time domain to frequency domain conversion on the digital data samples creating a plurality of frequency bins, each frequency bin associated with a frequency bin number, having a relative magnitude value, and corresponding to a speed of a vehicle,

[9.7] convert the speed of the patrol vehicle to a frequency bin number,

[9.8] form a patrol vehicle speed window that includes a range of frequency bin numbers having the frequency bin number of the converted patrol vehicle speed as a center of the range,

[9.9] determine at least one group of successive frequency bin numbers outside of the patrol vehicle speed window whose relative magnitude is greater than a spike threshold value,

[9.10] convert one frequency bin number in each group to the relative speed of one target vehicle, and

[9.11] convert the relative speed of the target vehicle to an absolute speed using the speed of the patrol vehicle.

[10.0] The traffic radar system of claim 9, wherein the processing element is further configured to perform one of the following depending the directions of travel of the patrol vehicle and the target vehicle:

[10.1] add the relative speed of the target vehicle to the speed of the patrol vehicle to determine the absolute speed of the target vehicle,

[10.2] subtract the relative speed of the target vehicle from the speed of the patrol vehicle to determine the absolute speed of the target vehicle, and

[10.3] subtract the speed of the patrol vehicle from the relative speed of the target vehicle to determine the absolute speed of the target vehicle.

[11.0] The traffic radar system of claim 9, wherein the processing element is further configured to determine whether the patrol vehicle is moving or stationary and convert the relative speed of the target vehicle to the absolute speed using the speed of the patrol vehicle only when the patrol vehicle is moving.

[12.0] The traffic radar system of claim 9, wherein the speed determining element outputs the patrol vehicle speed in a stream of messages and the processing element is further configured to

[12.1] determine that the patrol vehicle is moving when the patrol vehicle speed is greater than a first threshold value for a predetermined number of successive messages, and

[12.2] determine that the patrol vehicle is stationary when the patrol vehicle speed is less than a second threshold value for a predetermined number of successive messages.

[13.0] The traffic radar system of claim 12, wherein the processing element is further configured to set a mode of speed detection to moving when the processing element determines that the patrol vehicle is moving or to stationary when the processing element determines that the patrol vehicle is stationary.

[14.0] The traffic radar system of claim 9, further comprising a display configured to display a plurality of speeds, and the processing element is further configured to control the display to display the speed of the patrol vehicle and the absolute speed of the target vehicle.

[15.0] The traffic radar system of claim 9, further comprising an analog to digital converter configured to receive the electronic signal and output the digital data samples.