Data Descriptor

Vehicle Detection and Speed Estimation Using Millimetre Wave Radar

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Abstract

The dataset titled Data from 76- to 81-GHz mmWave Sensor located at S7 road contains data recorded employing an IWR1642 mmWave sensor from Texas Instruments. The data comes from two sessions lasting 24h each. The dataset provides the possibility to perform analyses related to car traffic intensity on one of the carriageways of the motorway heading to the Gdańsk metropolitan area. Based on the gathered data, it is possible to calculate the number of vehicles in particular time intervals and to estimate their speed.

Keywords: radar sensor; road; vehicle detection; vehicle speed

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Specification table (data records)

Subject area	Traffic Study, Electronics, Sensors
More specific subject area	Vehicle Speed Estimation, Vehicle Detection
Type of data	Text
How the data was acquired	The data was collected at the Gdańsk University of Technology using an IWR1642 mmWave sensor from Texas Instruments installed on the S7 motorway.
Data format	The tables are in .csv format
Experimental factors	The data contained in the dataset were decoded from binary format recordings
Experimental features	Detection of vehicles and estimation of their speed in real-life conditions

Data source location	MOST Wiedzy Open Research Catalog Gdańsk University of Technology, Gdańsk, Poland
Data accessibility	The dataset is accessible and is publicly and freely available for any research or educational purposes.

Background

The millimetre wave radar was one of the components of the intelligent road sign prototype developed as a part of the project "INZNAK: Intelligent Road Signs with V2X Interface for Adaptive Traffic Controlling". The radar sensor was installed in a measuring station, which also contained the following sensors:

- temperature, pressure and humidity,
- light intensity,
- precipitation,
- interior temperature,
- Bluetooth device scanner,
- 22GHz Doppler radar,
- video camera,
- sound intensity probe,
- accelerometer,
- lidar.

A Raspberry Pi microcomputer was used to collect information from the sensors, a Kontron microcomputer supervised the operation of the components, and connectivity was provided by using a router with an LTE modem.

Tests on the S7 road were aimed at verifying the operation of the sensors in real measurement conditions. The measuring station was mounted on a gantry pillar (Fig. 30.1) at a height of approx. 250 cm from the ground (the sensor was installed 40 cm from the bottom edge of the station). The distance from the edge of the right lane was about 420 cm.

Fig. 30.1. Measuring station (marked with a red rectangle) mounted on the gantry pillar

The tests proved that the Data from 76- to 81-GHz mmWave Sensor located at S7 road dataset can be applied for traffic analysis. Using relatively simple algorithms (based e.g. on distance analysis) should enable the process of automatic detection of vehicles and their speed.

Example data overlaid on an image from a camera mounted under the measurement station shows the functionality of the dataset: https://youtu.be/bKmTF2NT5Oc.

Methods

The evaluation board from Texas Instruments, based on an IWR1642 (rev. B) single-chip 76-GHz to 81-GHz mmWave sensor (Fig. 30.2), was used to collect the data (IWR1642 EVM (IWR1642BOOST) Single-Chip mmWave Sensing Solution User's Guide, 2018). The board is equipped with antennas and communicates with a computer using a UART<->USB interface.

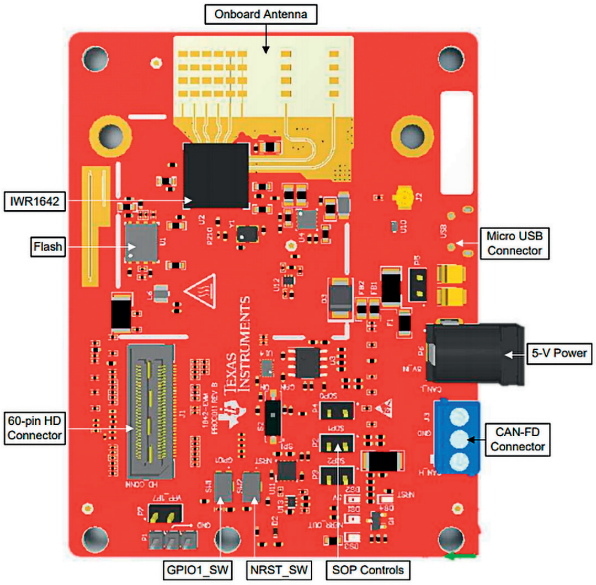

Fig. 30.2. IWR1642 evaluation board (IWR1642 EVM (IWR1642BOOST) Single-Chip mmWave Sensing Solution User's Guide, 2018)

Based on the supplied software, it is possible to adjust the parameters of the device (e.g. detection range, maximum object speed) to specific needs with the use of configuration files (MMWAVE SDK User Guide, 2019). The data in the dataset was gathered employing the following parameters:

1. November 26/27, 2019 – the maximum velocity was set to 152 km/h, the maximum distance was set to 147 meters, the accuracy of speed reading was about 1.2 km/h, and the accuracy of distance reading – about 2.2 m;

2. December 16/17, 2019 – the maximum velocity was set to 158 km/h, the maximum distance was set to 147 meters, the accuracy of speed reading was about 1.2 km/h, and the accuracy of distance reading – about 2.2 m.

The detection of vehicles driving on the adjacent roadway was disabled – only objects approaching the sensor were subject to detection.

The sensor data was stored in binary .dat format. Based on the documentation installed with mmWave SDK package (Millimeter Wave (mmw) Demo for XWR16XX, 2019), a python script was developed to decode the data into CSV format.

Data quality and availability

The data comes from two sessions lasting 24h each. Unfortunately, there are some gaps in the recorded data. These are caused by: errors in capturing data, applying corrections to radar settings (modifying the configuration files).

The gaps occur mainly between 9 and 11 pm.

Dataset DOI
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References

IWR1642 EVM (IWR1642BOOST) 'Single-Chip mmWave Sensing Solution User's Guide', May 2017, revised July 2018.

'Millimeter Wave (mmw) Demo for XWR16XX, mmWave SDK' (2019).

'MMWAVE SDK User Guide' (2019).