Fraunhofer IZM

Fraunhofer Institute for Reliability and Microintegration IZM

Hardware Platform for Integrated Radar Sensors

360° Radar Sensors for Autonomous Vehicles

Research project KameRad

Together with several partners from industry and research, Fraunhofer IZM has developed a hardware platform for a camera-radar-sensor system to detect the surroundings of autonomous vehicles.

With image sensors, LiDAR, ultrasound, and radar, various sensor principles are available for detecting a vehicle's surroundings. Each of these principles has specific advantages but also disadvantages. A camera system only works if the visibility conditions are sufficient, for example, while radar or LiDAR sensors cannot recognize traffic signs. Various manufacturers have tried several times to focus on one sensor principle. In the end, however, it was always the case that the sensor was unable to detect trucks or people in exceptional circumstances. For this reason, the integration of redundant systems is becoming increasingly popular.

Together with partners from industry and research, Fraunhofer IZM has developed an integration concept in which two cameras and a radar sensor can be combined into one sensor module. This has further functional advantages: The camera and radar capture the surroundings from the same angle, making data correlation easier and more efficient. The recorded data is fused directly in the sensor module; long transmission paths are avoided by integrating all functionally important components on the glass interposer.

Fraunhofer IZM's work focused on the development of the hardware architecture, the interposer design, and the manufacture and qualification of the assembly. Based on this work, the institute now offers the radar-camera platform to interested customers. At the same time, a unique qualification environment was created in which radar, communication, and camera modules can be evaluated in one defined low-reflection environment.

Project partners

- InnoSenT GmbH
- Silicon Radar GmbH
- John Deere GmbH & Co. KG
- AVL Software and Functions GmbH
- Jabil Optics GmbH
- Fraunhofer FOKUS
- Technische Universität Berlin

Volume

- €5.52 Million
- Funding share of 58% by the Federal Ministry of Education and Research (BMBF)

Runtime

- 02/2017 - 01/2020

Funding reference

- BMBF 16ES0572

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Federal Ministry of Education and Research

KameRad

Hardware architecture

The hardware platform developed consists of two image sensors, a 79 GHz radar system, and the Drive PX2 AI platform from NVIDEA, which was specially designed for processing camera and radar sensor data.

By using the Drive PX2 platform, part of the sensor data fusion and evaluation can be carried out decentrally in the sensor module with the aid of artificial intelligence methods. The sensor module also has an IMU and interfaces for a GPS receiver and car-to-x communication. Other computing platforms can also be evaluated on the multi-sensor system.

Interposer design

The hardware platform is realized using 2.5 integration technologies. Using materials and technologies from semiconductor production, a high-quality glass interposer is effectively manufactured as a system carrier with high wiring densities (10 µm line/space). The system has two routing layers and was designed using 3D full-wave simulation. The interposers were manufactured on Fraunhofer IZM-ASSID's 300 mm wafer line.

Radar antenna design

Fraunhofer IZM has over 20 years of experience in the field of antenna design. Building on this expertise, the focus over the last ten years has been on the development of innovative integrated radar sensors with application-specific antennas. The basic antenna shape has already been selected so that it can fulfill part of the specification. By connecting the antennas in an array (fully occupied, thinned out), the antennas can meet the requirements of the application for the radar system. These application-specific antennas and the technology selection for radar antennas can only be found at Fraunhofer IZM and are a distinguishing feature of the Berlin institute.

Qualification environment

Fraunhofer IZM has developed a qualification environment for modules based on an antenna measurement system. For the first time in Europe, a measuring system has been implemented that calibrates and evaluates radar modules with the help of several linear motors and a robot. The radar sensor can be integrated on a robot that can move the sensor horizontally and vertically in a defined manner. Several targets (radar targets) are moved on the linear motors. These moving targets can be used to calibrate and qualify a wide variety of radar sensors. The qualification environment is indispensable for the development of innovative radar sensors. Further development of radar hardware thanks to the application of 3D packaging and PCB embedding technology as well as AI radar signal processing methods .

Use case scenario

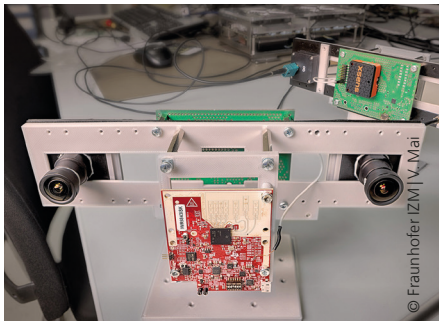
The existing module can be used for various applications. It can therefore be integrated into automated guided vehicles (AGVs) as well as into cars.

Advantages of the development

- Short-range radar together with stereo camera systems
- The radar sensor has a field of view of more than 180° based on the 3D antennas
- Resolution in the mm range
- Highly compact and simplified calibration of the system for various applications
- Innovative sensor platform with a wide field of view and robust integration
- Qualification environment available for the evaluation of radar sensors

Application of the development

- Autonomous vehicles
- Driverless transportation systems
- Drones



Multi sensor platform for sensor fusion with stereo camera and 79 GHz radar-sensor system

More information

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