PRESS RELEASE

Safe roads thanks to artificial intelligence: "KI-FLEX" project comes to successful conclusion

Erlangen/Berlin: How can autonomous driving be made more reliable? Yesterday, the "KI-FLEX" project, which was funded by the German Federal Ministry of Education and Research (BMBF) and led by Fraunhofer IIS, presented its research results. The initiative was built around a high-performance, energy-efficient, and yet flexible hardware platform with the corresponding software framework, which uses AI technology to process and fuse data from various sensors. This allows vehicles to perceive and localize environmental stimuli in a manner that is fast, efficient, and reliable.

If autonomous vehicles are to make the correct decision in every conceivable situation, they must be able not only to locate their own position in traffic, but also to reliably capture their environment with precision. To do this, vehicles must have the ability to collect and fuse data from sources such as laser, camera, and radar sensors. For the algorithms that process such sensor data, artificial neural networks have become indispensable tools. However, these networks need fast, efficient, flexible hardware, which is precisely what the "KI-FLEX" project has been successfully researching over the past four years. "This is an important step toward the safe mobility of the future," says Michael Rothe, who heads the Embedded AI group at Fraunhofer IIS.

On top of every traffic situation

Systems must be able to unambiguously detect and identify objects and road users in traffic situations. As such, the importance and utility of the individual sensors vary accordingly. Both the traffic situation and the weather and light conditions have to be taken into account in order to ensure safe autonomous driving. Moreover, the systems must be able to respond flexibly to potential sensor failures or adversarial attacks in their data. To address this requirement, the project partners developed resource-optimized approaches for the early and late fusion of camera data, lidar data, and detected objects along with an AI-based monitoring system. These components allow vehicles to reliably respond to changed situations by adjusting the algorithms used.

Reconfigurable AI system

Artificial neural networks are currently developing at a rapid rate. The growing number of architectures is making increasing demands on the hardware and software. For this

reason, "KI-FLEX" employs a heterogeneous hardware architecture made up of FPGA and ASIC AI accelerators in order to implement the neural networks for object detection in camera and lidar data. This flexibly reconfigurable and programmable AI accelerator system anticipates the future to some extent, as the hardware will be able to support emerging neural network designs. Furthermore, the hardware platform's computing resources can be allocated dynamically according to load.

The AI chip developed in the project also offers considerable advantages with regard to power consumption, processing speed, and cost savings compared to conventional multi-purpose processors (CPUs) or graphics processing units (GPUs).

Germany-wide research initiative

The project "KI-FLEX – Reconfigurable hardware platform for AI-based sensor data processing for autonomous driving," which launched in September 2019, was funded by the German Federal Ministry of Education and Research (BMBF) within the guidelines on promoting research initiatives in the field of "AI-based electronic solutions for safe autonomous driving (AI element: autonomous driving)."

Led by Fraunhofer IIS, the project consortium comprises several German research and industry partners: Infineon Technologies AG, videantis GmbH, the Technical University of Munich (Chair of Robotics, Artificial Intelligence and Real-Time Systems), the Fraunhofer Institute for Open Communication Systems FOKUS, the Daimler Center for Automotive IT Innovations (DCAITI, Technical University of Berlin) and the Friedrich-Alexander-Universität Erlangen-Nürnberg (Chair of Computer Science 3: Computer Architecture).

The Fraunhofer-Gesellschaft, headquartered in Germany, is the world's leading applied research organization. Its research activities are conducted by 76 institutes and research units at locations throughout Germany. The Fraunhofer-Gesellschaft employs a staff of around 38,000, who work with an annual research budget of roughly €3.0 billion.

The **Fraunhofer Institute for Integrated Circuits IIS**, headquartered in Erlangen, Germany, conducts world-class research on microelectronic and IT system solutions and services. Today, it is the largest institute of the Fraunhofer-Gesellschaft. Research at Fraunhofer IIS revolves around two guiding topics:

In the area of **"Audio and Media Technologies"**, the institute has been shaping the digitalization of media for more than 30 years now. Fraunhofer IIS was instrumental in the development of mp3 and AAC and played a significant role in the digitalization of the cinema. Current developments are opening up whole new sound worlds and are being used in virtual reality, automotive sound systems, mobile telephony, streaming and broadcasting.

In the context of **"cognitive sensor technologies"**, the institute researches technologies for sensor technology, data transmission technology, data analysis methods and the exploitation of data as part of data-driven services and their accompanying business models. This adds a cognitive component to the function of the conventional "smart" sensor.

More than 1170 employees conduct contract research for industry, the service sector and public authorities. Founded in 1985 in Erlangen, Fraunhofer IIS now has locations in 11 cities: Erlangen (headquarters), Nuremberg, Fürth and Dresden, as well as Bamberg, Deggendorf, Ilmenau, Munich, Passau, Waischenfeld and Würzburg. 72 percent of the budget of 189.7 million euros a year is financed by contract research projects. Institutional funding from the Fraunhofer-Gesellschaft covers 28 percent of the budget.

Detailed information on: www.iis.fraunhofer.de/en