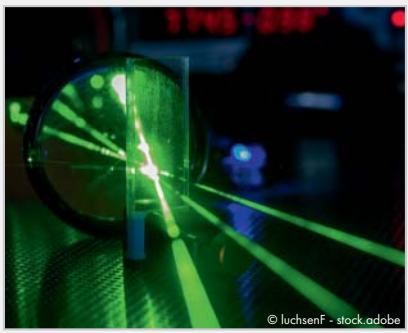
ims chips
Institut für Mikroelektronik Stuttgart
IMS Newsletter 2/22

DoRiE - AI for sensor-related applications in industrial use

Companies from Baden-Württemberg as well as the IMS CHIPS, FZI and Hahn-Schickard research facilities are jointly developing reference applications that demonstrate the sensor-related use of artificial intelligence. The Ministry of Economics in Baden-Württemberg is supporting DoRiE with 2 million euros.

DoRiE page 2

QSens: An outlook on the 3 joint projects in the Future Cluster



Within the framework of the "Future Cluster Qsens", IMS CHIPS is involved in the QVOL, QSCALE and QIND projects. These projects will be carrying out application-driven work on the market introduction of quantum sensor technology in the areas of (bio)medical technology, industrial sensor technology and sensors for research as well as demonstrate scalable manufacturing possibilities.

QSens projects page 3

New i-Line Stepper Canon FPA3030i5a operational

With the commissioning of the new i-Line Stepper Canon FPA3030i5a for optical lithography, a further milestone in the expansion of the IMS line for 200 mm wafers was reached in June. This means that a state-of-the-art production facility is now available, which opens up numerous new opportunities for the IMS to develop new processes for the future.

New i-Line stepper page 3

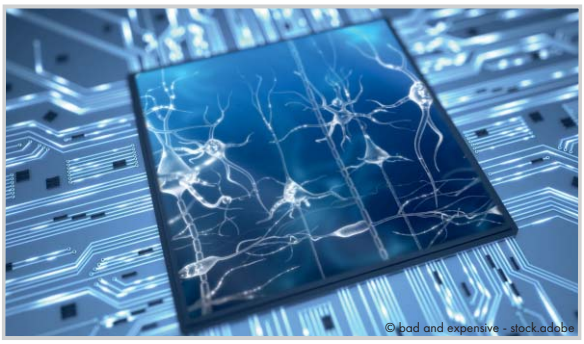
Qoool Camp '22 - The startup generator for quantum computing and quantum sensor technology

The "Future Cluster Qsens" and the first quantum computer in Europe offer outstanding opportunities for research and infrastructures. The question arises as to how these can be transferred into concrete applications and business models? The answer to this was addressed at Qoool Camp '22 and the following camp week at the AI xpress incubator in Böblingen.

Qoool Camp page 4

DoRiE - AI for sensor-related applications

Proprietary AI chip makes sensors “smart”



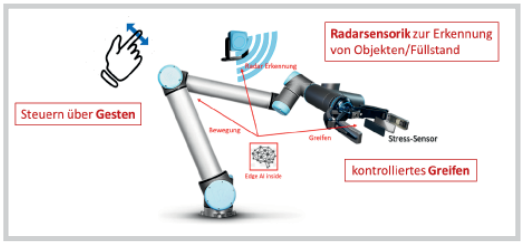
Nowadays, sensors are used in all areas of technical equipment. They constantly provide data on temperatures, pressure, current and voltage curves, etc., which must be reliably and continuously transmitted to central control units in order to determine operating conditions based on sensor data. Today, modern machines are equipped with a large number of sensors, which entail a corresponding amount of effort in terms of cabling and data transmission. A central control unit then provides a picture of the current operating status. A classic sensor only determines the measured value of a physical variable, but does not draw any conclusions from it. Using artificial intelligence (AI) methods, it is in principle possible to evaluate and classify sensor data. Ideally, this evaluation is carried out at the sensor and not in a control unit the sensor transmits the raw data to. An intelligent sensor can, on the one hand, check itself and, on the other hand, evaluate the data it measures. This way, instead of continuously transmitting temperature values, the AI sensor can transmit individually evaluated data: “Temperature is within the permissible range” and the amount of data to be transmitted can be drastically reduced, which greatly reduces the necessary bandwidth in communication and simplifies the evaluation, especially in applications with many sensors.

The research partners involved in the DoRiE project have laid the foundations for their own AI chips over the past two years in the successfully completed Baden-Württemberg-funded NeMoH project and are now implementing them in industrial reference applications.

An exciting application is the ongoing self-diagnosis of solenoid valves, in which the AI sensor simply observes the current curve of the valve during the switching process. Based on the typical course of the current curve, the condition of the valve can be determined with a high hit rate. This determines whether the valve is operating within normal boundaries, whether the medium is too hot, or whether the pressure of the medium is either too high or too low. Also, malfunctions, such as foreign bodies in the valve (grain of sand, incrustations) can be detected: “valve does not fully open” or “valve does not fully close”. Even the valve component temperature can be ascertained from the current curve. Equipped with the AI sensor, a component, such as a solenoid valve, can determine, its own operating status, and signal it to the outside.

In order to use this capability, numerous system data must be collected and classified in advance. To do this, extensive measurements with artificially induced fault conditions must be carried out on reference components in advance. In order to collect this data on the condition, the research partners have developed appropriate test rigs to automatically generate thousands of data sets. These data are used to train an artificial neuronal network. Which is then fed with actual measured values in the AI sensor application. The neural network now classifies the measured values into predefined condition categories.

For another demonstration of AI sensors, the research partners are currently developing a robotics application in which a robotic arm uses radar sensors (like those used to measure distance in distance cruise control systems) to orient itself in its environment and can be controlled by a human using hand gestures. The radar sensors generate very large amounts of data during operation, illustrating distances to and movements of objects. Again, neural networks are trained on different condition categories to be evaluated by an AI system close to the sensor in the application.



Robotic arm with sensor-based AI enables gesture control, object recognition and grabbing objects by sensing them

The project is accompanied by an industry advisory board consisting of the Balluff, NEXT.robotics, Pilz, Schunk, Staiger and Swoboda companies, which helps define system requirements and monitors the implementation of the applications. In addition, the project offers a free opportunity for companies from Baden-Württemberg to check their own applications or ideas for possible AI sensor potential at any time. For this purpose, interested parties can apply for a QuickCheck for a feasibility study or an Exploring Project for a more in-depth investigation: ki.ims-chips.de

Contact: Thomas Deuble • phone+49 711 21855-244 • deuble@ims-chips.de

QSens: 3 joint projects in the Future Cluster

Within the framework of the "Qsens Future Cluster", IMS CHIPS is participating in the QVOL, QSCALE and QIND projects

The objective of the "Qsens Future Cluster" is to transfer the outstanding basic research findings in quantum sensor technology from physics labs into everyday industrial applications, see front page. IMS CHIPS is participating in three joint projects within the framework of QSens. The first three years will see application-driven work on the market introduction of quantum sensor technology in the areas of (bio)medical technology, industrial sensor technology and sensors for research and demonstrate scalable manufacturing possibilities.

The QVOL project is specifically focusing on essential enabling technologies for sensors based on solid-state defects in silicon carbide, which will play a central role in industrial use and the increase of the scalability of this sensor type towards the targeted high-volume production. In addition to microelectronic and photonic integration to miniaturize and increase the energy efficiency of these sensors, the project will focus on sensitivity enhancement issues for three different characteristics of SiC-based quantum sensors.

The microelectronic and photonic integration of NV-center-based sensors pursued in the QSCALE project focuses on one of the central tools to increase the scalability of a sensor technology, because the integration offers immense potential to reduce the size and power consumption of the sensor. In combination with the scalable fabrication of the sensor output material as well as particular investigations regarding the reliability of microhybrid packaging for quantum sensors, the QSCALE project lays the scientific and technical foundations for a future use of NV-center-based sensors in markets with moderate to high volumes and moderate to low unit costs.

Finally, QIND focuses on the further development of sensors for industrial applications in process technology. These are required in industrial manufacturing (e. g. the food or pharmaceutical sectors) for the production of everyday products in large quantities. The challenges here are high accuracy and great robustness of the sensors. New quantum sensors can significantly increase application range and accuracy. NV-based quantum sensors for industrial use in extreme conditions, in particular with regard to pressure and temperature, are being researched and developed using the example of pressure and level sensors. In addition to the sensor concept, the further development of the assembly and connection technology (AVT) as well as a suitable integration strategy play a central role.

Contact: Jens Aders • phone +49 711 21855-202 • anders@ims-chips.de

New i-Line Stepper Canon FPA3030i5a operational

Further milestone reached in the expansion of the line to 200 mm wafers

A new optical lithography system was commissioned in the IMS clean room in June with funding from the state of Baden-Württemberg. The new i-Line stepper Canon FPA3030i5a replaces the previous Canon FPA3000i5+, which was an important part of the CMOS chip production at the IMS for more than 20 years. This new acquisition makes a state-of-the-art system available again now. This also created additional possibilities with regard to current and future activities of the IMS.

For example, the new stepper can process wafer sizes of 150 mm diameter as well as 200 mm diameter fully automatically and with a high throughput while this changeover can be done in just a few steps. For the current MEMS and GaN projects processed at the IMS in particularly, this production system was designed to provide the greatest possible flexibility with regard to the substrates that can be processed, so that, for example, the thickness of the wafers to be exposed can range from 200 µm to 1200 µm.

The Canon FPA3030i5a stepper is additionally equipped with an infrared camera system for which silicon is transparent. With this so-called "Through Silicon Alignment" system, exposures can be adjusted and aligned with high accuracy to structures located on the back of the wafer. This is particularly important for applications in the field of MEMS.

In line with these new possibilities, a new resist track from the Osiris company was also procured with state funds, which can deposit and develop wafers with diameters of 150 mm, 200 mm and 300 mm fully automatically with photoresist. This system will also be installed before the end of the year. This was also done in order to create the greatest possible flexibility regarding the nature of the wafers to be processed.

Contact: Holger Sailer • phone +49 711 21855-457 • sailer@ims-chips.de

QSens and Qoool Camp

The startup generator for quantum computing and quantum sensor technology

Workshop at the AI xpress startup center

The "Qsens Future Cluster" and the first quantum computer in Europe offer outstanding opportunities for research and infrastructures. The question arises as to how these can be transferred into concrete applications and business models? The answer to this was addressed at Qoool Camp '22 and the following camp week at the AI xpress in Böblingen. In 24 rounds of talks and workshops over the course of two days, quantum sensors and quantum computing, as well as linking science and applications were discussed.

The more than 100 participants were introduced to the event with overview presentations by IBM and Bosch. In small groups, individual topics were then explored in more detail and possible business models and startup opportunities were developed. The heterogeneous field of participants consisting of students, engineers and users led to exciting discussions as well as created some interesting ideas.

The event closed with live music and rooftop barbecue.

The following Qoool camp week then took a closer look at quantum sensing. Guided tours at the University of Stuttgart, Hahn-Schickard and IMS CHIPS as well as discussions with specialists further explored the topic from a research and development perspective. Subsequently, new business models were developed and startup opportunities were looked at. The most promising models were awarded prizes at an awards ceremony.

Guided tour at IMS CHIPS

Contact: Mathias Kaschel • phone +49 711 21855-467 • kaschel@ims-chips.de

News Flash

„Beams & More" This title defines the 19th lithography workshop to be held at the IMS. The workshop will take place as webinar on November 17th, 2022. For further information and registration, please go to http://beams-and-more.ims-chips.de.

Projekt HyPerStripes launched The kick-off meeting in April marked the start of the European joint project HyPerStripes - "New packaging technology for reliable bendable electronics" in the European Penta program. 18 partners from four European countries will cooperate on the development of solutions for flexible interconnects and planar hybrid foil systems in the project initiated by the IMS. Additional information on the HyPerStripes project can be found at https://hyperstripes.ims-chips.de.

Springer Theses Prize – The „Ultra-Thin Sensors and Data Conversion Techniques for Hybrid System-in-Foil" dissertation written at the IMS by Dr. Mourad Elsobky has been awarded the Springer Theses Prize. For further information on the dissertation, please go to: https://link.springer.com/book/10.1007/978-3-030-97726-9.

Research Association
of the Institut für Mikroelektronik Stuttgart e.V.

The non-profit Research Association of the Institut für Mikroelektronik Stuttgart was established in 1983 and supports the contacts between industry and research. It is a contact point for talents from Germany as well as from abroad that will be supported by the IMS with a scholarship. It opens doors to member companies that sponsor them.

An annual member meeting takes place every year. Members receive a discount on trainings and events.

For further information, please refer to www.ims-forschungsverein.de.

Contac: Christina Ott • Pilz GmbH & Co. KG, Felix-Wankel-Straße 2, 73760 Ostfildern

Phone +49 711 3409-7949 • ims-forschungsverein@pilz.de