Fraunhofer
IKS

FRAUNHOFER INSTITUTE FOR COGNITIVE SYSTEMS IKS

SAFE INTELLIGENCE MAGAZINE

2019 / 2020

We develop intelligent software technologies that make our lives not only easier, but safer and more dependable, both today and in the future. Simplicity through dependability.In all dimensions.

Living in a dependable world.

SAFE INTELLIGENCE

Fraunhofer Institute for Cognitive Systems IKS

Through our applied research activities in the field of software engineering, we ensure cognitive systems are used to serve the interests and well-being of people. Systems that we can trust, and which support us and allow us to think about and shape the future hand-in-hand.
OUR MISSION

We strive to create intelligent solutions that that make our lives functionally easier. And we strive to create solutions that make our lives emotionally easier. We strive for a world that provides a sense of safety and well-being. With safe intelligence.
OUR VISION

Read our blog! Experiencing SAFE INTELLIGENCE:

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DIALOGUE

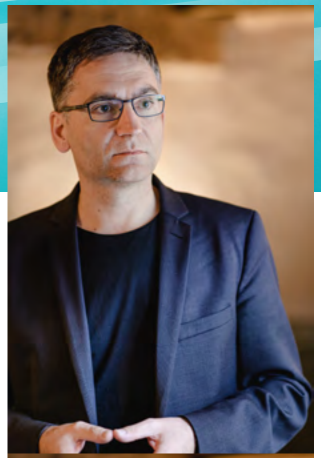
»We have to maintain a view of the overall safety concept« – Interview with apl. Prof. Dr. Mario Trapp

Mr. Trapp, as its name suggests, your institute is focused on cognitive systems. This term is not really established outside of the research world. What does it actually mean?
Prof. Dr. Mario Trapp: *When we talk about cognitive systems, we mean technical devices and machines that use artificial intelligence (AI) to open up a whole new world of opportunities. This happens for example when we analyze sensor data and utilize information from the network in order to represent the functionality of these machines and devices with learning methods. This leads to totally new options such as autonomous driving and autonomous flying, robots that literally cooperate hand-in-hand with people, and even new medical devices that feature unprecedented diagnosis and therapy capabilities.*

And where does Fraunhofer IKS actually focus its research activities in this area?
The key term here is safe intelligence. To date, safety and intelligence have been viewed as two separate entities. In other words, a cognitive system can be either safe or intelligent. The biggest challenge, and what represents for the most the part the decisive competitive edge in many industries, is actually bringing intelligence and safety together. This is exactly what safe intelligence and the research activities of Fraunhofer IKS represent. Artificial intelligence is very good in a lot of industries and most of the time it functions fairly well. But when human lives are involved, "most of the time" is not sufficient. Just think about autonomous driving. That means we need safety guarantees - an assurance that the software does not present a danger for the user. The mission of Fraunhofer IKS is to answer the question: How can I exploit the potential of the intelligence in the software without risking safety and dependability?

What role does dependability play in this context?
When we talk about safe intelligence, we're talking about safety of course. But by itself, safety is not sufficient. An automobile parked in a garage tends to be safe, but it's not available, and it's not dependable. What that means is that we always have to view safety in conjunction with dependability, because only then can I actually deliver a benefit. The bottom line is, it's not enough to simply make a cognitive system safe, including the AI technology. We have to make it safe and dependable.

Can you briefly explain the approaches that you follow?
To make AI safe, it's important to initially focus on the system. In other words, we have to make the system safe, not just the AI. For this reason it's important to maintain a view of the overall safety concept. Fraunhofer IKS works across four levels here. Of course I have to ensure that the AI itself is safe, explainable and robust, and that I can comprehend it. AI will always be more susceptible to errors than conventional software. So at the second level, I have to monitor the AI using conventional principles and allow access to the control mechanisms only when the validation leads to a positive assessment. But since safety always assumes the worst case scenario, I won't be able to manufacture a cost-effective product if I utilize AI. In turn, that means that at the third level, we have to build dynamics into the system by directly monitoring the situation at runtime, carrying out dynamic risk assessments and dynamically adapting the safety concept, and thus the system. At the fourth level we establish a concept that we call »continuous safety management«, which we use to give organizations the capability to quickly install the system in the field, learn from the field data step-by-step and expand the scope of the system with short update cycles and to react quickly to errors.




What core expertise from Fraunhofer ESK will Fraunhofer IKS develop further?
Cognitive systems are not only about AI, but about the systems. In this case, the term »systems« is still synonymous with complex software systems. The intelligence stems from more than just the pure AI. We're familiar with lots of processes, such as those from smartphones, which you can use to download apps. We're familiar with the service-oriented world of cloud technologies. Transferring these to technical systems and machines is a major challenge. And this is exactly where Fraunhofer ESK's experience lies. How can I build flexible and highly-dependable architectures – or highly-connected systems? This is all experience that we can utilize on the path to cognitive systems. When we expand this existing expertise with AI, then we come to cognitive systems. And it's only through this combination that we can actually develop them.

What industries are directly relevant to the institute's research activities?
Our work is ultimately relevant to all industries that truly need dependable information for AI or intelligent software. It's industries in which human lives are tied to this dependability. Autonomous driving is one example. But we're also talking about industries that have to deal with serious business risks for example. If a production system goes idle because of a misjudgment on the part of the AI, the company could face immense costs. As a result, we are active in any industry in which the success of the AI depends on quality guarantees.

DIALOGUE

»Agile leadership attracts agile employees« – Interview with Dr. Sabine Sickinger

There has been a lot of talk about agile project management over the past few years. It sounds like a buzzword from an American business school…
Dr. Sabine Sickinger: *It's a lot more than that of course. Agile project management, which you frequently hear about in this context, is simply an element of agility. In particular, agility and agile work environments also encompass agile leadership, plus the organizational culture and structure. It always includes the employees as well. People are always at the heart of agile work.*

And that was different until now?
Absolutely. Agility offers a clear contrast to the conventional hierarchical work structures that we have been familiar with to date. It no longer has to do with authority or an authoritarian leadership style, but represents a totally new approach to leading and developing a company and its employees. The concept specifically targets companies.

The question is, how can a research institute profit from an agile approach?
Agility and agile work environments require the establishment of goals with the employees, but guardrails are set up within these objectives within which the employees can carry out their activities independently and with relatively wide latitude, plus they can assume responsibility and strengthen their decision-making skills. This helps them identify more strongly with the goals of the company or institute, and encourages them to address issues and problems with courage and curiosity and find solutions. At the end of the day, the entire institute benefits. Processes become leaner and more efficient and you sense a much higher degree of dynamics, which allows the institute to react to changes from the outside more rapidly.

Can you cite specific examples?
Among other things, agility relates to how work processes are designed and it describes the possibility to create a flexible work environment, both spatially and temporally. If we take a look at the opportunities that virtual meeting rooms offer, then it becomes very clear how an agile work environment can function within a research institute as well. We make it possible for young parents to reconcile their professional and family lives as an example. That means they can work whenever and wherever it best suits their private life at the moment.

What does agility mean with respect to Fraunhofer IKS specifically?
First and foremost, agility affects the management culture. If we look at employees with and without management responsibility, then in both instances we need completely new skills that are currently not required to this extent in companies with conventional, hierarchical structures.

Which skills?
We're talking about skills such as the ability to work independently and structure one's own work, the courage to make decisions on one's own and to assume responsibility. It's also about a completely new learning culture that we want to usher in at Fraunhofer IKS. That means moving away from inflexible, rigid training and education plans, and shifting to flexible, situation-dependent learning formats that are aligned with the requirements of the projects and the needs of the employees. That means we need employees whose skills are decidedly different from those needed in traditional company or institute environments.

That certainly has an impact on future recruiting.
Of course. Fraunhofer ISK should also grow significantly from the standpoint of its personnel strengths. That means we have to already begin the recruiting process. It's really important that we find employees who are well-suited to and are willing to accept an agile work environment and enjoy working within one. In other words, we want people whose mindset fits within the agile structures that we are building. I'm convinced that agile leadership attracts agile employees.

What is Fraunhofer IKS focusing on with respect to the issue of agility?
At the heart is the organization structure – how we organize Fraunhofer IKS in order to carry out our projects, our research activities and deal with the customers, all with the goal of solving their problems. We will go down completely new paths, away from conventional, hierarchical-based departments. Instead, we will create an agile foundation that allows the institute to operate at the program and project level. That means program or department managers don't necessarily have to have disciplinary responsibility as well.

This approach will also be reflected in our new facility in Garching. We will move away from long hallways that branch off to single offices, which is really not conducive to good communications, and create a lot of open spaces. We will think about coworking spaces, or offering environments in which everyone can find whatever they need to carry out their activities at any time: more peace and quiet, more communication and information sharing, or even space for virtual collaboration.

RESEARCH

Guaranteed quality for safety-critical systems

Cognitive systems require enormous processing power and capacity for tasks such as the execution of AI algorithms in real-time. They also have to be highly-flexible, in order to enable innovative business models. To date, both of these characteristics have been possible only through the use of platforms and middleware that are currently unable to satisfy the level of quality required for safety-critical or highly-dependable systems. Engineers are thus faced with the major challenge of figuring out how undependable hardware and middleware can be implemented when developing safety-critical systems.

Within the research world, resilient architectures have become a central approach for solving these issues. These architectures are designed such that they can guarantee the necessary quality characteristics even in unforeseen, critical situations. A key starting point for such architectures is self-adaptivity, which means the software systems can adapt on their own to specific contexts at runtime in order to achieve the best possible performance without violating their quality objectives.

The following articles outline two specific applications for implementing safety-critical service-oriented architectures, and for developing so-called end-to-end architectures that make it possible to offload critical system functions to the cloud.

RESILIENT ARCHITECTURES

RESILIENT ARCHITECTURES

Flexible and adaptive systems through the dynamic allocation of functions

Connected, embedded system architectures, such as those found in vehicles, industrial machines or intelligent medical products, must increasingly ensure new functions. They also have to adaptively react to changes and be updatable. This relates not only to updating existing functions, but to adding completely new ones. This affects enhancements in the form of software components, such as apps, as well as plug'n'play hardware.

What this calls for is the dynamic allocation of functions in the above-mentioned systems. That means an electronic control unit or computing platform no longer executes the same functions only during its own life cycle – it can also dynamically distribute them. One example of Fraunhofer IKS' activities in this area is collaboration with a partner in the automotive industry to enable the safe, dynamic distribution of software functions in future E/E vehicle architectures.

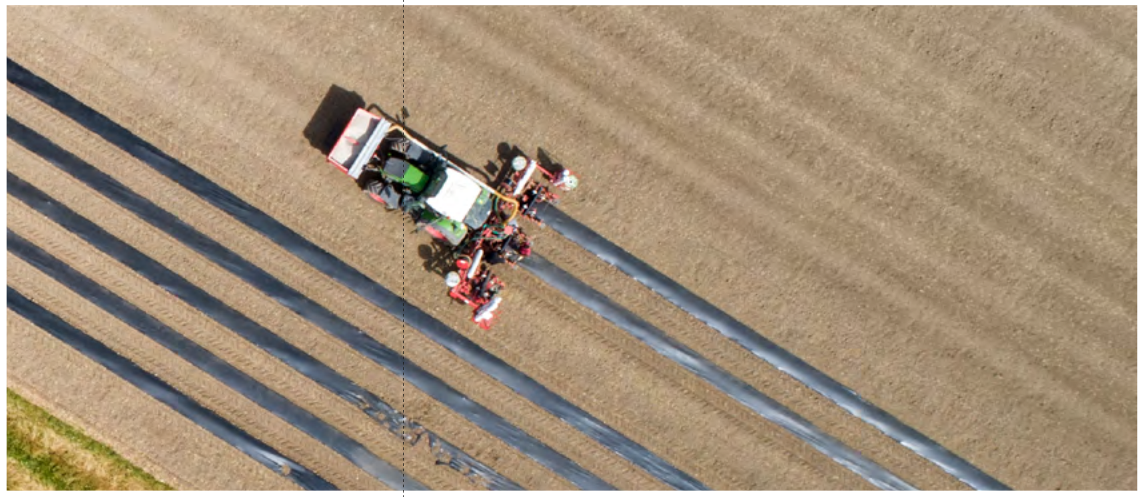
STRINGENT SAFETY REQUIREMENTS

To make this happen, service-oriented architectures (SOA) that have been popular in the web and cloud are now making their way into embedded systems. Because these place completely different demands on safety and availability however, this SOA approach cannot be ported over on a one-to-one basis. Instead, new mechanisms have to be developed for resilient architectures within the framework of this paradigm change. And that means a shift from functions to services.
If a service for a production control system needs to be real-time and sufficiently fault-tolerant for example, potential errors have to be identified in advance and then countermeasures developed and implemented into the system.

Updating safety-relevant functions involves a range of other different aspects. One important factor is ensuring that this type of function is correctly executed in all safety-critical states. That means the function cannot be stopped and replaced without verification. Instead, there has to be an assurance that this function is not required during the current update period and that all of its dependencies are being fulfilled, such as the availability of other functions.

This calls for planning and implementing the dynamic distribution so that the safety of the system is not impacted, despite the additional flexibility. Numerous factors and variants have to be taken into account, which means there is no longer just one system configuration that can be tested, validated and distributed in advance. The embedded system must independently ensure that the current service-oriented functions architecture can satisfy all of the safety requirements and rule out any errors.

The system can be optimized accordingly, as long as this safety foundation is guaranteed. This type of performance optimization allows the implementation of optimization goals such as reduced energy consumption or high capacity.
In one example, scientists at Fraunhofer IKS collaborated with an industry partner to conduct research into and validate a solution for the safety of autonomous transport systems, which optimizes the performance of the transport times.
The example showed that incorporating this type of functional allocation enables the creation of flexible and adaptive systems that satisfy the requirements of the market when it comes to the capability to update and adapt.



LEARN MORE ABOUT THE TOPIC OF DYNAMIC SAFETY MANAGEMENT

RESILIENT ARCHITECTURES

Industrial control access from the cloud

With their latest system architectures, manufacturers of industrial controls are pursuing the goal of opening the cloud step-by-step. This includes:

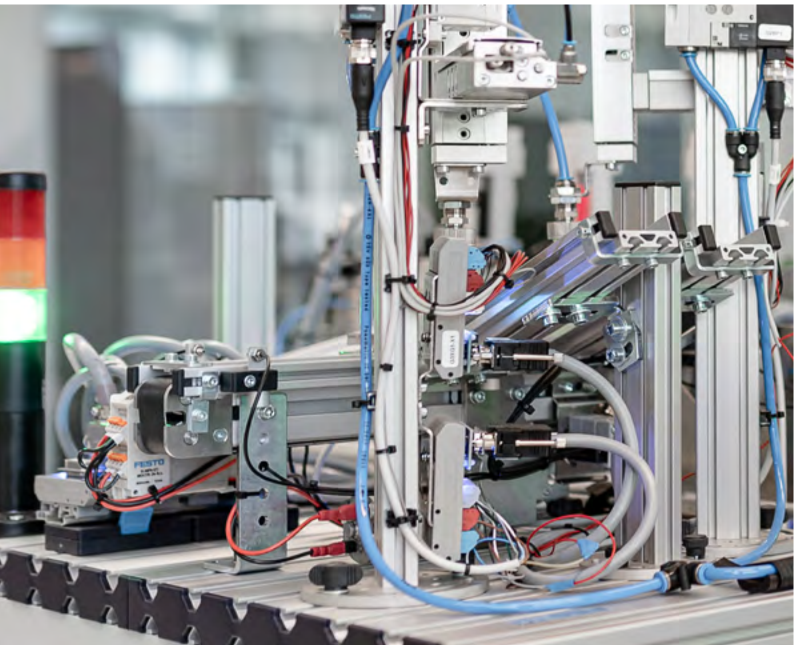
— Hosting and managing versions of IEC 61131-3 application code

— App store concepts for reloading individual functions or complete alternative runtime environments

— Asset management of the automation components

— Analysis of machine-acquired data with cloud-based intelligent analysis tools

Efforts are also underway to virtually operate software-based control instances on servers to save numerous small controls that are under-utilized. Manufacturers are also increasingly turning away from IEC 61131 and moving to high level languages employed in nearly all conventional control systems. Industrial control systems are furthermore increasingly relying on the integration of solutions that to date have been separate from a hardware standpoint, such as drive or robot controls, image detection or machine learning algorithms for optimization tasks.



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THE SICS PLATFORM MAKES IT POSSIBLE TO OPERATE AN INDUSTRIAL CONTROL AT THE PUSH OF A BUTTON ON ANY DEVICE OR IN THE CLOUD.

« **Dipl.-Ing. Michael Stiller,** research associate at Fraunhofer IKS

SERVICE-ORIENTED CONTROL SYSTEMS

Fraunhofer IKS is moving toward the next step in the evolution of industrial controls with an approach that involves the use of cloud-based, service-oriented controls as part of an end-to-end architecture. In collaboration with the University of Düsseldorf, the institute developed the SICS (smart industrial control service) platform, which permits operation of an industrial control at the push of a button on any type of device (smartphone/tablet, laptop/PC, server) or within the cloud. The only prerequisite is a JavaScript interpreter available in all browsers or as a JS node on the server side. This allows almost any device to be transformed into an industrial control.

The segmentation of control runtime and I/O router into separate services enables highly-flexible implementation, such as decoupling and reconfiguring of the connection between sensors/actuators and the controls while the system is running. This unique concept can thus significantly reduce the engineering effort due to

— seamless change between virtual and real commissioning

— reduced costs through a leaner infrastructure

— ability to reconfigure while the system is running, thus reducing software-based downtime

— simple connectivity of the services in local and global networks

— support for heterogeneous automation components

One of the key advantages is the requirements-dependent distribution of control services in hybrid cloud structures (private/public). The service-based architecture thus offers the opportunity to install individual control services in a more flexible and scalable fashion within the operational technology (OT) level, to implement cost-effective, redundant and more dependable software concepts or to segregate control applications into safety, standard or coordination services depending on the requirements.

With the service-oriented platform implemented in SICS, we are moving closer to the vision of autonomous machines and equipment capable of independently rectifying errors or learning fault tolerance in order to develop a certain degree of resilience and self-optimization.

LEARN MORE ABOUT THE TOPIC OF CLOUD CONTROLS

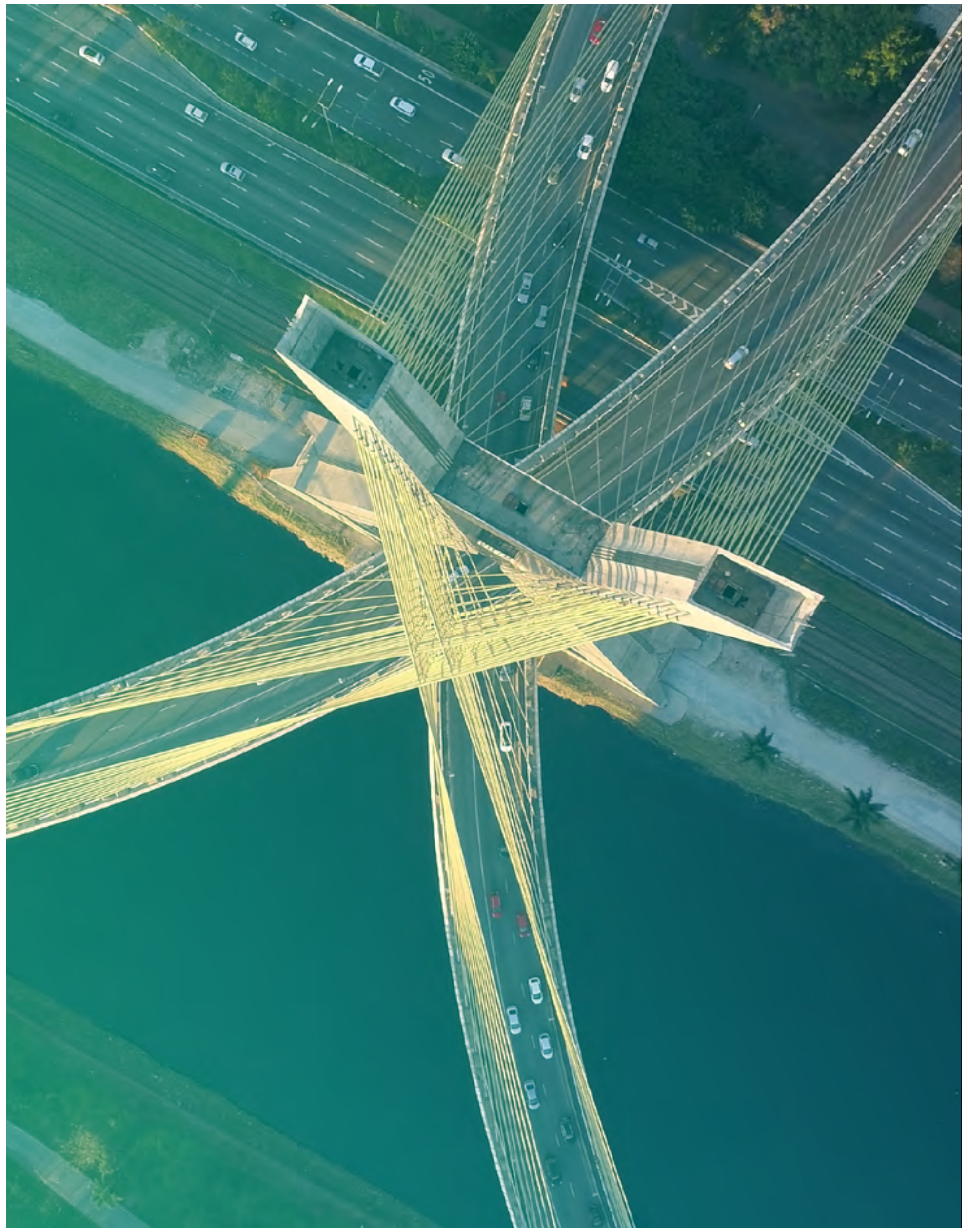
RESILIENT ARCHITECTURES

CONTINUOUS IMPROVEMENTS THROUGH CONTINUOUS INTEGRATION AND CONTINUOUS DELIVERY

The SICS service-oriented architecture offers the ideal conditions for following the DevOp paradigm at the OT level of the manufacturing company in the future. That means software can be continuously improved and expanded for a machine through continuous integration of the code and continuous delivery of software.

What today is possible only with maintenance and retrofit activities, will one day be possible while the system is running with the Fraunhofer IKS approach: swapping out individual software functions without impacting operation of the system. To do this, so-called deployment pipelines, known within IT and adapted especially for the OT level, will be needed in order to detect potential errors or conflicts with the help of virtual commissioning. Apart from ensuring the quality of the new software components, the interaction with the existing components has to be validated as well. In this area, the Fraunhofer Institute for Cognitive Systems IKS offers concepts and tools adapted to the specific needs of the manufacture for end-to-end engineering in line with DevOp principles.

This approach also requires runtime mechanisms in the platform architecture, which enable validated deployment by combining a production and staging environment, while guaranteeing the seamless transformation from old to new software components within the cycle time of the control. All of the key prerequisites were created in SICS in order to provide these mechanisms. Fraunhofer IKS serves as an expert partner for machine and equipment manufacturers, providing support when designing and implementing concrete applications.



RESEARCH

SAFE AUTONOMOUS SYSTEMS

Validating the safety of AI-based systems

The enormous potential of artificial intelligence (AI), which is indisputable, opens up completely new opportunities across a wide range of applications. If safety-critical applications such as autonomous driving are involved however, concrete products will evolve from the wealth of ideas only if the safety of the AI systems can be validated. Research, as well as industry, are still in the very early stages in many instances. Even fundamental questions, such as when an autonomous system can be viewed as safe, remain unanswered so far.

That means the capability to validate the safety of cognitive systems will play a central role in the race to develop the first market-ready, fully autonomous vehicle. The following articles introduce three approaches that make a significant contribution to resolving this issue. Using a high-level safety architecture as a starting point, one of the key questions related to safety analyses is when is a system safe enough. It’s also important to validate the AI itself by among other things evaluating the quality of AI-based classifications using corresponding metrics.

The four plus one safety architecture

Errors in autonomous vehicles, to cite just one of many examples, endanger people and can quickly lead to accidents involving serious injuries and even traffic fatalities. This calls for incorporating stringent safety validation mechanisms into cognitive systems and the artificial intelligence (AI) technologies they rely on.

Dependable quality guarantees are still a major challenge for both industry and the field of research. These challenges are often reduced down to just one of a wide range of solution approaches, such as new test methods, conventional monitoring architectures or quality metrics. As with every safety or dependability concept however, what also matters is finding the right combination of suitable building blocks.

ADAPTIVE SAFETY MANAGEMENT

The Fraunhofer Institute for Cognitive Systems IKS utilizes the four plus one safety architecture concept. At the first level, the AI itself has to be adapted in order to transition from blackbox to at least greybox approaches, which make it possible to evaluate the quality of the AI technology. The focus here is on new architectures and metrics that deliver a verifiable contribution to the safety validation mechanism.

The second level monitors the AI at a functional level as a blackbox. The foundation of these tests is special error analyses, from which custom monitors can be derived. This monitoring would be too conservative by itself. It would also be either too unsafe, or it would lessen the dependability through too many false positives. For this reason it's important to combine the blackbox testing with the results of the first level to enable efficient monitoring.

At the third level, the approach extends beyond the conventional scope of safety architectures. Instead of merely detecting errors and then reacting, the systems are enhanced under the framework of adaptive safety management with the capability to independently evaluate the current safety risks and adapt so that optimal performance is achieved without violating the safety risks. Instead of conservative worst-case scenarios during the development phase, this approach can be used to not only develop significantly more cost-efficient systems, but systems that are in a position to work around unforeseen situations. After all, increasingly smarter functions require more intelligent safety architectures.

SYSTEMATICALLY LEARNING FROM FIELD EXPERIENCE

Despite all of these measures, we have to expect a higher error rate. Especially with the step-by-step introduction of cognitive systems with a constantly expanding scope of functions, the opportunity nevertheless exists to learn from experience in the field without putting safety at risk. For this reason it's essential to have a fourth level that makes continuous safety management and continuous engineering possible at the same time. This allows you to systematically learn from errors in the field in order to quickly improve the product in the sense of safe DevOps, as well as to systematically develop the knowledge required for validating cognitive systems and thus improve the safety processes.

These levels are flanked by an orthogonal level that revolves around the methods for safety validation and quality assurance. Although it's been possible to frequently work with general safety architectures up to this point, this approach is too costly for cognitive systems. For this reason the safety architectures have to be optimally adapted to the system, which in turn can be only be accomplished with extremely efficient and effective analysis methods, the absence of which would make it difficult to bring cost-effective, yet safe cognitive systems to the market.

SAFE AUTONOMOUS SYSTEMS

The challenge of dependable environment models

A key building block for the implementation of highly-automated systems is having a dependable way to perceive the environment. As the degree of automation in cognitive systems grows, so does the level of complexity, which in turn calls for more dependable and robust monitoring of the environment. In highly-automated vehicles for instance, real-world models form the basis for safety-critical driving maneuvers and decisions. However, in order to precisely detect all traffic participants in the vehicle's surroundings in a timely manner, a wide range of sensors such as cameras, short- and long-distance radars, laser radars and ultrasound sensors must be deployed so that every side of the vehicle can be monitored with multiple sensors. These sensors, which deliver various information about the vehicle's environment, have inherent weaknesses and strengths with respect to robustness, range and precision. This raises the question of how to ensure this sensor data is dependable enough for the creation of reasonable environment models for use with safe autonomous functions. It also leaves the question of how to carry out safety analyses to determine to what extent the design of the perception chain and the fusion of the sensor information impacts the safety characteristics of an autonomous system.

CRITICAL FACTOR: SITUATIONAL AWARENESS

One of the biggest challenges in autonomous driving systems is correctly identifying high-risk situations and scenarios that could arise from undependable perception processes.
Using statistical risk analyses and evaluation methods from conventional safety management approaches, Fraunhofer IKS develops new perception metrics and performance indicators to correctly analyze the degree of safety in dynamic driving situations and derive corresponding countermeasures.
Situational awareness is extremely important here. That means information such as the geographic situation, infrastructure and weather conditions in real autonomous systems must be used as evaluation criteria for determining the dependability of the environment model.

A thorough assessment of the impact of the perception architecture on the safety of the autonomous function is important as well. To do that, Fraunhofer IKS develops new ways to incorporate the fusion of the sensor data within the different feature extraction and fusion steps and designs additional measures and algorithms for determining their dependability and robustness.

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HIGHLY-AUTOMATED SYSTEMS REQUIRE DEPENDABLE PERCEPTION OF THE ENVIRONMENT.

« **Maximilian Henne,**
research associate at Fraunhofer IKS

SAFE AUTONOMOUS SYSTEMS

Uncertainties you can depend on

In order to validate AI systems in safety-critical applications such as self-driving automobiles or automated medical diagnoses, the predictions require a way to identify any uncertainties impacted by these models. For instance, after detecting an object on the road, an autonomous vehicle has to categorize it as a person or other type of object. The uncertainties provide information related to the dependability of the decision model's current prediction in this situation. These uncertainties, which are in the form of a false result probability, are used by other components of the overall safety system as metrics for evaluating the current level of safety in the system.

LOOK BEYOND TRAINING

The identification of such uncertainties is a challenging task. While many AI models provide a confidence value between 0 and 1 for each prediction – essentially a measure of its dependability – this value cannot be merely interpreted as a probability. Powerful neural networks thus tend toward high confidence values even with false predictions. This has much to do with the fact that these models were trained with datasets that do not fully describe the real situation, including all of the possible states. It should then come as no surprise when a model trained only with images of dogs and cats, classifies a jaguar as a pet cat with a very high degree of confidence. After all, the cat has a much higher resemblance to a jaguar than a dog, plus the model is unfamiliar with the concept of a jaguar.
This situation can have life-threatening consequences for autonomous automobiles as well. It's possible that an autonomous system could fail to correctly identify an object as a person in disguise, or in an unusual pose, thus leading to an accident. To prevent such mistakes, we develop models that are capable of verifying situations with higher uncertainty values, which differ greatly from the concepts learned from the training datasets. This allows the model to quantify a situation if there are any prediction uncertainties.

LEARN MORE ABOUT THE TOPIC OF MANAGING UNCERTAINTIES

SAFE INTELLIGENCE

FRAUNHOFER INSTITUTE FOR COGNITIVE SYSTEMS IKS – PROFILE

Fraunhofer IKS conducts research into software engineering for cognitive systems, with a special focus on safety-critical applications in the automobile industry and Industry 4.0. Our underlying goal is to harmonize artificial intelligence and safety in the truest sense. And this is exactly what safe intelligence and the research activities of Fraunhofer IKS stand for.

VISION

LIVING IN
A DEPENDABLE
WORLD

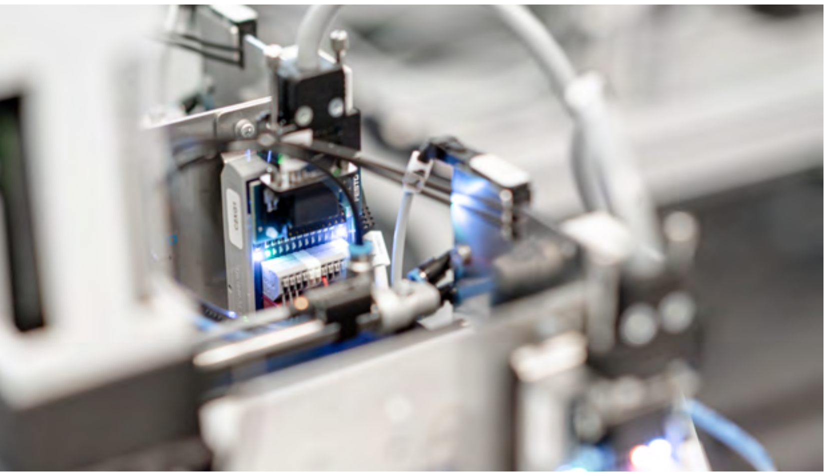
MISSION

DEPENDABLE
SOFTWARE TECHNOLOGIES
FOR PEOPLE

LIVING LAB

Collaborative testing and optimization with customers

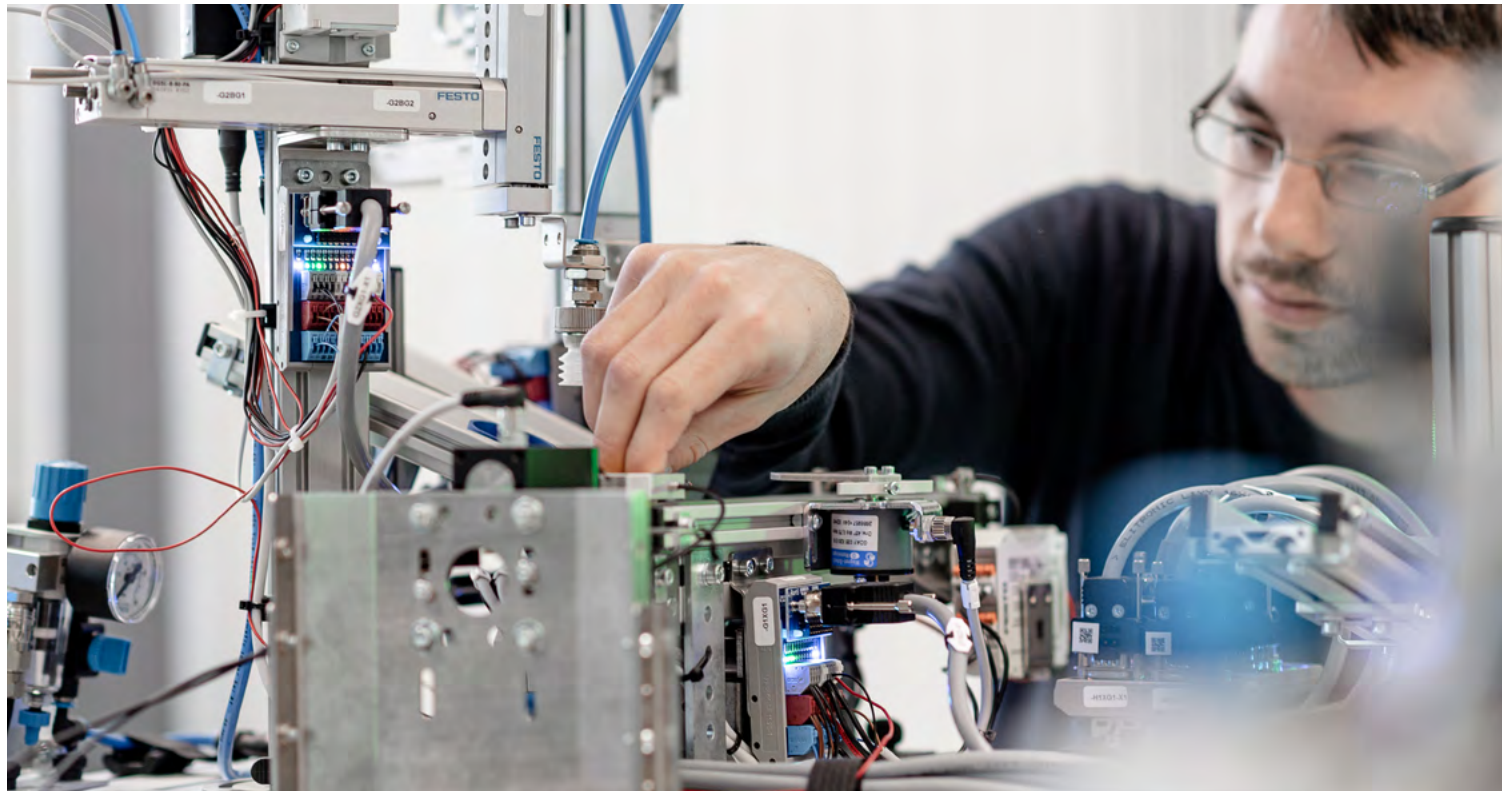
THE LIVING LAB



The Living Lab plays a special role at the Fraunhofer Institute for Cognitive Systems IKS. This facility allows the institute to independently carry out application-oriented, dynamic development activities. And not only that: customers and scientists at the institute jointly develop models that serve as the foundation for further development activities.

Prototypes of concrete software solutions for automotive and industrial automation applications are developed at several stations in the Living Lab. Specific customer applications are quickly and flexibly replicated within the permanently-installed test environment. Flexible prototypes can be adapted to the customers' individual applications at various stations.

Read our SAFE INTELLIGENCE blog:



THE MODEL FACTORY

The Model Factory, part of the Living Lab, offers a flexible assembly platform with five stations and three industrial robots. Software component tests run in the background of the assembly chain across distributed architectures in order to analyze the behavior of the software. The communication behavior is visualized with publish/subscribe mechanisms and displayed on monitors. The model also illustrates the functional scope of the DANA analysis tool, which analyzes the overall system behavior at runtime and serves as the basis for optimizing the software under test.
The Model Factory relies on the open source robot operating system (ROS), the most popular operating system for robots in use today. Given that this system is not yet safety-compliant, researchers at Fraunhofer IKS have the opportunity to develop safety conditions under ROS and apply them directly in the model.

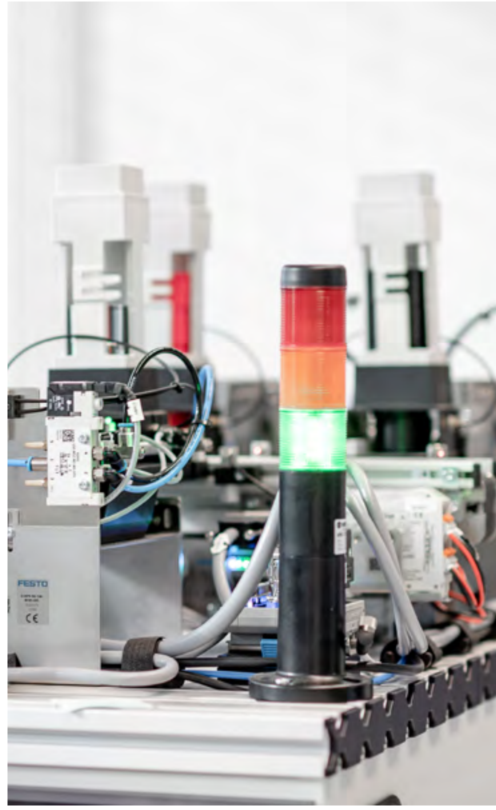
LIVING LAB

AMPLE ROOM FOR COLLABORATION

Fraunhofer IKS researchers work together with industry partners in the Living Lab. Customer components are integrated into the model via special interfaces in order to test the behavior of new constellations. This allows the teams to quickly and realistically replicate ideas and innovations and demonstrate potential development paths. This approach fosters agile innovation and the rapid transfer of solutions to actual industry applications.

ADAPTIVE E/E SYSTEMS FOR VEHICLES

The Living Lab features its own research environment for adaptive E/E systems, where flexible safety architectures for the automobile industry are tested. Driving functions are distributed across the system in an intelligent manner with the goal of ensuring that safety-critical functions, such as braking, are always available. The model can be used to replicate different adaptive architecture scenarios. The software model can also be expanded in order to continuously test new scenarios and functions.



INDUSTRY LABS

Directly adjacent to the Living Lab is the Industry Lab. This facility features dedicated offices for our customers, giving them the space and quiet atmosphere they need to concentrate on project activities or collaborate on joint concepts. System designs that have been developed and tested in the Living Lab can be further enhanced here in the Industry Lab.

An additional benefit of the Industry Lab is that industry partners have the opportunity to utilize the platforms, simulation environments and software tools that Fraunhofer IKS researchers regularly work with, including access to both commercial tools and proprietary platforms developed by the institute. This makes collaboration considerably easier since it provides a simpler and faster way to transfer joint research results.

OUTLOOK

While the single research topics are currently tested at the individual stations, plans are in place to eventually link all of the areas so that the interaction behavior of the overall system can be replicated and analyzed. Researchers will then be able to model the behavior of complete end-to-end architectures. A cloud control model for distributed systems will be set up as a new test station for this purpose.

BUNDLING EXPERTISE – SHAPING THE FUTURE

Competence network for »Artificial Machine Intelligence «

Bavaria has set up a network for »Artificial Machine Intelligence«, with participation from universities in Munich, Erlangen, Wurzburg, Augsburg, Bayreuth, Ingolstadt and Amberg-Weiden. Playing a leading and coordinating role is the Fraunhofer-Gesellschaft. The Fraunhofer Institute for Cognitive Systems IKS, in close collaboration with the Technical University Munich (TUM) and Ludwig-Maximilians University Munich (LMU), will be established as a key area of the network

The new institute will be tasked with finding new solutions to pressing questions about artificial intelligence (AI), machine learning and cyber security. The three organizations will pool their expertise in these cutting-edge fields to build the bridge needed to cross the divide between basic and applied research. Joining forces with other players, this Munich-based alliance aims to develop the outlines of a concept to be implemented as a key component of the German government's AI strategy. Research and development efforts will focus on AI in combination with resilient cognitive systems and specific AI solutions for autonomous systems.

Photo above right (from left to right): Minister of State Bernd Sibler, Minister of State Hubert Aiwanger, President of the Ludwig-Maximilians-Universität München Prof. Bernd Huber, President of the Fraunhofer-Gesellschaft Prof. Reimund Neugebauer, Germany's Federal Minister of Education and Research Anja Karliczek, Bavaria's Minister President Dr. Markus Söder and former President of the Technical University of Munich Prof. Wolfgang A. Herrmann

Celebratory signing

As part of the celebration marking the 70 year anniversary of the Fraunhofer-Gesellschaft, TUM, LMU and the Fraunhofer-Gesellschaft signed a joint statement of intent to establish the Fraunhofer Institute for Cognitive Systems IKS. Fraunhofer views its role in the competence network as the central partner for the transfer of research results originating from the Munich and Bavaria regions to industry.

Apart from the development of ties with TUM through the appointment of four joint professors (including the Executive Director of Fraunhofer IKS), in addition to the establishment of Fraunhofer IKS on the Garching campus, the statement of intent calls for the appointment of two joint professors and the creation of joint research projects at LMU. The aim is for the institute to serve as a conduit to help pave the way for the transfer of research results from the Munich universities to industrial applications.

Quelle: www.fraunhofer.de/presse

From left to right: State Secretary Roland Weigert (Bavarian Minister for Economics, Development and Energy), Dr. Hans-Otto Feldhütter (Fraunhofer-Gesellschaft), Dr. Sabine Trupp (Fraunhofer EMFT), Prof. Andrea Büttner (Fraunhofer IVV), Prof. Georg Sigl (Fraunhofer AISEC), Dr.-Ing. Steffen Klan (Fraunhofer IGCV), Prof. Gunnar Grün (Fraunhofer IBP), apl. Prof. Dr. habil. Mario Trapp (Fraunhofer IKS)

High Performance Center »Secure Intelligent Systems«

The Fraunhofer Institute for Cognitive Systems IKS is part of the High Performance Center »Secure Intelligent Systems« (LZSiS). Other participating organizations include the Fraunhofer institutes AISEC, EMFT, IVV, IGCV and IBP from the Munich metropolitan area, as well as Technical University Munich and the German Bundeswehr University in Munich.

To address the challenges of advances in digitalization, LZSiS bundles its interdisciplinary expertise to offer comprehensive support in the design and implementation of secure system solutions tailored to the specific needs of the customer. Working with neutral and manufacturer-independent partners, LZSiS helps companies – start-ups, SMEs or large firms - identify the potential of digitalization and implement it with a secure design.

Under the motto, “Secure from sensor to cloud”, the participating partners opened a showroom on the premises of Fraunhofer EMFT in July 2019. During his address at the opening, Roland Weigert, State Secretary of the Bavarian Ministry for Economics, Development and Energy, described the innovation strength of the Fraunhofer network of institutes as one of the keys to success of the Bavarian economy.

THE NEW BLOG

safe-intelligence.fraunhofer.de

EXPERT ADVICE

The Advisory Board of the Fraunhofer Institute for Cognitive Systems IKS

The members of advisory board support the Fraunhofer Institute for Cognitive Systems IKS in the professional orientation of the institute. The advisory board currently consists of seven experts from industry, science, and civil service.

MINDIR DR. MICHAEL FREHSE

— Chairman of the Advisory Board
— Head of Directorate Z II (Community), German Federal Ministry of the Interior, Building and Community

The goal of the BMI is to improve and establish equal living conditions across Germany. Among other issues, Dr. Frehse's department is responsible for ensuring greater access to services such as high-capacity mobile phone coverage and mobility offerings. The department also places special emphasis on strengthening rural regions impacted by demographic change, which can benefit from digitalization.

LARS WEBER

— Deputy Chairman of the Advisory Board
— Managing Director, Stadtwerke Schneverdingen-Neuenkirchen GmbH

The Schneverdingen-Neuenkirchen public utility companies have been operating electricity, gas, water, waste water and heating networks and delivering gas and electricity to customers for more than 100 years. These companies are now designing a modern infrastructure to increase the attractiveness of the local communities they serve. This includes the creation of a new branch responsible for expanding fiberglass broadband coverage, digitalizing internal processes and offering local safety-critical IT applications such as IT hosting.

PROF. DR. BERNHARD BAUER

— Dean of the School for Applied Computer Sciences, University of Augsburg
— Professor for Software Methodologies for Distributed Systems

Professor Bernhard Bauer conducts research into software technologies for distributed systems at the University of Augsburg with a focus on how distributed concepts can be utilized in safety-critical applications such as in the automotive industry. Prof. Bauer is also a member of the board at aitiRaum e.V., an association that brings together members from industry, research and IT to share information and experiences, transfer knowledge and create synergies in the Bavarian-Swabia region.

THOMAS GALLNER

— Continental Automotive GmbH
— Head of Corporate Innovation Management

Continental develops pioneering technologies and services for the sustainable and connected mobility of people and their goods. Founded in 1861, the company offers safe, efficient, intelligent and affordable solutions for vehicles, machinery, transportation and transport.

DR. PETER STEINER

— Managing Director, Audi Electronics Venture GmbH

Dr. Peter Steiner and his team at Audi Electronics Venture develop digital technology applications with the aim of helping to shape the urban mobility of tomorrow. By exploiting the potential of artificial intelligence, swarm functions, end-to-end architectures and intelligent solutions, Audi Electronics Venture brings the real and digital worlds together to create a new driving experience.

HANS-JÜRGEN THÖNNISSEN-FRIES

— ESG Elektroniksystem- und Logistik-GmbH
— Head of the Center of Excellence for Systems Engineering

ESG has been an innovative technology partner providing consulting, system development, system integration, logistics, training and engineering and IT services in the area of security-relevant systems for more than 50 years. Hans-Jürgen Thönnißen-Fries and his team ensure that these complex, technologically-challenging projects can be successfully carried out with the help of state-of-the-art processes, as well as systems engineering methods and tools.

MR DR. STEFAN WIMBAUER

— Bavarian State Ministry for Economic Affairs, Energy and Technology
— Head of Department 43 – applied research, cluster policies

Dr. Stefan Wimbauer oversees applied research and cluster policies within the Bavarian State Ministry for Economic Affairs, Energy and Technology. His area of responsibility encompasses support for non-academic applied research institutes, in particular the Fraunhofer-Gesellschaft, in addition to bringing together players from industry and research within the framework of the Bavarian Cluster Offensive. He is also deputy head of the department for innovation, research, technology and digitalization at the Bavarian State Ministry for Economic Affairs.

FRAUNHOFER IKS

A team for the future – and for a dependable world!

Looking ahead, the Fraunhofer IKS team is expecting an exciting, but challenging task. All the more reason to pull together to tackle these forthcoming issues.

Well-connected – locally and globally!

At the Fraunhofer Institute for Cognitive Systems IKS, our employees work within interdisciplinary and international teams. This diversity is a resource that is reflected in our various ideas and innovative concepts. This effect is further reinforced by agile collaboration methods. The institute is also committed to increasing the number of female researchers in this area. Our employees utilize their individual skills to support one another within each of the technical areas, letting their research topics and solutions flow together in order to achieve the bigger goal: designing cognitive systems that are both safe and cost-effective. Teamwork is written with a capital T, whether in our day-to-day activities or during the Science Day & Team Cooking.
Our employees are not only well-connected with one another, but also within the German research landscape, especially other research institutes and universities in Munich and across Bavaria.

» DEPENDABILITY IS EVERYTHING – NOT ONLY WITH AI, BUT WITHIN THE TEAM. «

Eva von Wardenburg,
head of PR & marketing at Fraunhofer IKS

03

02

Career opportunities at Fraunhofer IKS! Find a new job by applying today:

01

01 Working together, even when cooking at the Hasenöhrl-Hof seminar and event center..

02 Science Garden during the Fraunhofer-Gesellschaft 70-year anniversary activities: Fraunhofer-Gesellschaft namesake Joseph von Fraunhofer, played by an actor, presents a telescope to department head Philipp Schleiß. In the middle: Prof. Dr. Alexander Kurz, member of the Fraunhofer-Gesellschaft board.

03 Prof. Dr. Mario Trapp, Executive Director of Fraunhofer IKS, shares his vision of the institute for the coming years.

04 Department head Dr. Gereon Weiß (right) discusses artificial intelligence validation at an event organized by the Fraunhofer-Alumni. (also in the picture, from the left: Viktor Deleski from the Fraunhofer-Gesellschaft and Dr.-Ing. Nils Klingbeil , e.GO Mobile)

04

OUTLOOK

New building on the Garching research campus

The Fraunhofer Institute for Cognitive Systems IKS will be developed into a lighthouse institute. As a result, the institute will grow from a personnel standpoint. By the year 2025, around 195 full-time employees and roughly 60 research assistants will work at the institute. Given that the current facilities rented on Hansastraße in Munich cannot accommodate this growth, a new modern institute building will be constructed.

NEIGHBORHOOD ENVIRONMENT

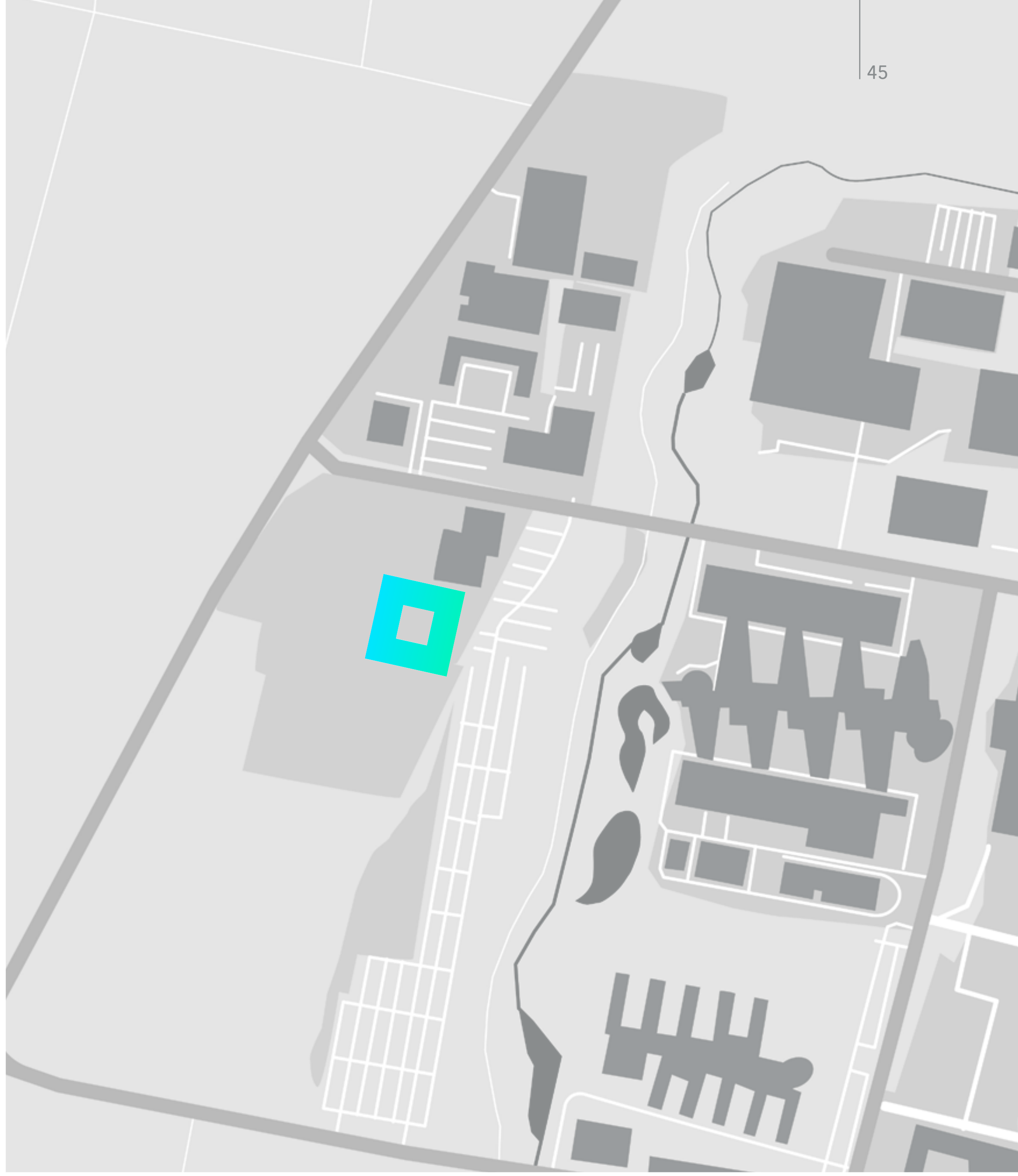
The Fraunhofer quarter on the Garching research campus was selected for a reason. The close vicinity to the Technical University Munich Garching campus will allow the Fraunhofer Institute for Cognitive Systems IKS to position itself as an attractive employer for students and to offer extensive opportunities for internships, university assistant positions and graduate work. Early contact with young university researchers will furthermore help the institute attract new employees, especially given the strong competition for qualified specialists in the field of artificial intelligence.

The Garching location will also make it easier to operate and consolidate the activities of the High Performance Center »Safe Intelligent Systems«. Fraunhofer AISEC, one of the partners in the center, is located in the immediate vicinity of the future Fraunhofer IKS premises.

MODERN LABORATORY INFRASTRUCTURE

The new institute facility will feature around 4,400-square-meters of usable space. Apart from offices for the research and administrative employees, the Technology Center will represent an important element. Among other things, the plan is to include a demonstrator center where customers and interested parties can experience highlights of the institute's research activities first-hand.

The Technology Center will also house state-of-the-art laboratory facilities, including software development labs for agile and cross-department project groups within the institute. Furthermore, an interdisciplinary Living Lab for prototype development will be created, where the Fraunhofer IKS Model Factory will be installed for highly-flexible production with automated guided vehicles and mobile stations.
A realistic research environment will thus foster the transfer of institute developments into concrete applications scenarios for our customers. Customer teams and institute employees will also enjoy access to other collaborative innovation labs where they can work together to implement solutions for specific customer applications.



FLEXIBLE SPACES FOSTER AGILE METHODS

The design of the offices and the open spaces is intended primarily to foster an atmosphere of openness and innovation, in addition to encouraging an agile work approach, which the institute is already testing as part of the »New Work« pilot project (read the interview on page 8). The Fraunhofer Institute for Cognitive Systems IKS has adopted special measures that allow our employees to reconcile family and career responsibilities. This aspect will also be incorporated into the design of the new building in Garching, including the creation of special offices for employees who want to bring their child to work if needed. Spaces will also be set aside for temporary child daycare in cases where normal daycare facilities or schools are unexpectedly closed. Plans are also in place to have quiet spaces that can be used by pregnant or breastfeeding employees.

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