

BACKGROUND INFORMATION: RESEARCH LIGHTHOUSES AT SILICON AUSTRIA LABS

From power electronics in e-mobility to sensor technologies in photovoltaic systems to the next generation of 6G data transmission– in the top research center Silicon Austria Labs (SAL), research on future technologies in the field of electronic-based systems (EBS) is conducted in cooperation with industrial and scientific partners.

SAL is focusing on five key technologies, the so-called research lighthouses: High Power Density Converters, Photonics, More than Moore, 6G and Dependable EBS.

HIGH POWER DENSITY CONVERTERS LIGHTHOUSE

Power electronics are at the heart of the development toward ecologically compatible mobility and energy-efficient digitalization. Invisible from the outside, it is hidden in almost every electronic-based system today – be it in the smartphone, the laptop or e-car.

To meet the growing demands on electronic components and the need for a high-performance and reliable integrated power supply, the SAL team is working on power electronics systems along the entire EBS value chain, from design to component characterization to hardware.

As part of the “**Tiny Power Box**” project, a holistic, three-dimensional simulation methodology was developed. This enables design to be checked and optimized in terms of their power density, efficiency and functionality – even before a physical prototype is produced. This minimizes development time and maximizes service life.

Alfred Binder, Head of Research Division Power Electronics at SAL: “In Graz we are working on a wide range of future technologies regarding power electronics. Many of these technologies are implemented within the Tiny Power Box project, making it possible for my team to demonstrate our extensive know-how and potential in this field in cooperation with well-known partners.”

Further information:

- Responsible: DI Alfred Binder, MSc
- Partner companies:
 - Fronius International GmbH
 - Infineon Technologies Austria AG
 - AT & S Austria Technologie & Systemtechnik AG
 - TDK Electronics GmbH & Co OG
 - AVL List GmbH
- Scientific partners:
 - TU Graz
 - FH Joanneum
 - FH Kärnten

PHOTONICS LIGHTHOUSE

The control of light in any form is at the heart of photonics research. Photonics is a key technology for digitalization, as it provides the basis for **optical sensor and measurement systems** that can help overcome the limits of other technologies in terms of accuracy, sensitivity, miniaturization and safety.

Complete photonic systems that can analyze at high speed are essential, for example, for digitalized industrial production (**Industry 4.0**), **autonomous driving**, but also **consumer electronics** such as smartphones and tablets of the next generation.

At SAL in **Villach**, a team of top researchers specializes in the multidisciplinary research and development of optical, optoelectronic and mechanical components. The competences range from the production of components in SAL's own clean room to the integration of photonic components and competences in the field of miniaturized optical systems.

Christina Hirschl, Head of Research Division Sensor Systems at SAL: "Photonics is a key technology to strengthen industrial innovations, to address social challenges and to create sustainable and advanced economic systems. This allows us to make our world greener, more intelligent and more efficient."

Further information:

- Responsible: Dr.ⁱⁿ Christina Hirschl
- Partner companies, among others:
 - AVL List GmbH
 - TDK Electronics GmbH
 - EV Group GmbH
 - Philips Austria GmbH
 - Tomra Sorting GmbH
 - Molecular Devices, LLC
 - Liebherr GmbH
 - AT&S GmbH
 - Hasslacher Norica Timba GmbH
- Scientific partners, among others:
 - Universität Wien
 - TU Graz
 - Polymer Competence Center Leoben (PCCL)
 - Montanuniversität Leoben
 - Ecole polytechnique fédérale de Lausanne (EPFL), CH
 - Supmecca Paris, FR

MORE THAN MOORE LIGHTHOUSE

"More than Moore" refers to a law observed by Gordon Moore in 1965, according to which the number of circuit components on a chip doubles every one to two years while costs remain the same. But the current trend shows that even more is possible - **more functionality and more efficiency in even smaller components**. Or to put it in other words: "More than Moore".

The research goals on More-than-Moore technologies at SAL are reduction of complexity, miniaturization and increase in efficiency of components. SAL in **Villach** covers the entire research value chain and combines it with high-tech manufacturing technology.

Christina Hirschl, Head of Research Division Sensor Systems at SAL: “In Villach, an interdisciplinary and international team is conducting research on new sensor technologies that are small, efficient and sustainable. This way, we are helping to turn Carinthia into a hot spot for microelectronics.”

Further information:

- Responsible: Dr.ⁱⁿ Christina Hirschl
- Partner companies:
 - TDK Electronics GmbH
 - RF360 Europe GmbH
 - Infineon Technologies AG
 - AVL List GmbH
 - EV Group GmbH
 - EVATEC AG
 - Lam Research AG
 - Ortner Reinraum Technik GmbH
 - Miba eMobility GmbH
 - E+E Elektronik GmbH
 - Bosch GmbH
- Scientific partners:
 - Alpen-Adria-Universität Klagenfurt
 - Universität Graz
 - JKU Linz
 - TU Wien
 - Ecole polytechnique fédérale de Lausanne (EPFL), CH
 - TU Berlin, DE
 - Georgia Tech, USA

6G LIGHTHOUSE

The 6th generation of wireless communication - 6G for short - enables the transmission of large volumes of data in nearly real time, while at the same time providing high reliability. This key technology thus plays an essential role for **wireless "machine-to-machine" communication in industry**, which requires high speed data transmission with low latency. At the same time, the connections must be extremely resistant to interference in order to replace wired communication, even in safety-relevant areas. This is to be ensured with the current generation of wireless communication (5G) and even more so with 6G.

Currently, the necessary fundamental research for a market launch of 6G starting in 2030 is beginning to form internationally. At Silicon Austria Labs in **Linz**, research is being conducted on essential "enabling technologies" for 6G. A new feature of 6G will be the targeted use of artificial intelligence with AI chips and algorithms to reduce the complexity, costs and energy consumption of future applications.

Thomas Buchegger, Head of Research Division Intelligent Wireless Systems: “With our research in Linz, we are making an important contribution to the development of 6G. For domestic industry, 6G enables production and products to be designed more dynamically and flexibly and to develop new business models from this – key words being the sharing economy and the circular economy.”

Further information:

- Responsible: DI Dr. Thomas Buchegger, MBA MSc
- Partner companies:
 - Fronius International GmbH
 - voestalpine Stahl GmbH
 - AVL List GmbH
 - Linz AG
 - Liwest
 - NXP Semiconductors Austria GmbH & Co KG
 - Infineon Technologies AG
- Scientific partners:
 - JKU Linz
 - Linz Center of Mechatronics
 - TU Wien
 - TU Gdansk, PL
 - EURECOM Antibes, FR
 - University Bordeaux, FR
 - CEA-Leti, FR
 - KU Leuven, BE
 - IKERLAN, Mondragon, ES
 - National Institute For Standards and Technology, USA
 - Johns Hopkins University, USA
 - TU Brno, CZ
- Memberships and alliances:
 - 5G Alliance for Connected Industries and Automation (5G-ACIA)
 - 6G Smart Networks and Services Industry Association (6G-IA)

DEPENDABLE EBS LIGHTHOUSE

In everyday life, we increasingly rely on smart devices; billions of devices are constantly connected in the **Internet of Things (IoT)**, and industrial production is also increasingly digital (**Industry 4.0**). It is therefore essential that electronic-based systems (EBS) that form the backbone of digitalization are reliable and trustworthy: They must meet high requirements in terms of their functionality and security, be capable of continuing to operate ("fail operational") even in the event of failure, comply with data protection guidelines, and much more.

The SAL team in Graz is researching various technologies that contribute to the dependability of EBS, from software development for the Internet of Things to the question of the explainability of artificial intelligence ("Explainable AI"). Of particular interest in the future is the combination of model-based artificial intelligence on the one hand with machine learning on the other, in order to combine the advantages of both approaches in the areas of performance, robustness and practicality.

Industrial application areas include quality control, process optimization and maintenance/servicing ("predictive maintenance").

Willibald Krenn, responsible for the Dependable EBS research area at SAL: “From smart-home to smart-mobility to smart-farming – virtually nothing works anymore without dependable EBS, and they are the backbone of a sustainable and ecological future. The technical fundamentals needed for this kind of dependability and safety are being developed and applied by the SAL team around Dependable EBS in projects with industry and academia.”

Further information:

- Responsible: Dr. Willibald Krenn
- Scientific partners:
 - TU Graz
 - Alpen-Adria-Universität Klagenfurt
 - FH Salzburg
 - Uni Udine, IT
 - Fondazione Bruno Kessler, IT

ABOUT SILICON AUSTRIA LABS (SAL)

Silicon Austria Labs GmbH (SAL) is Austria's top research center for electronic-based systems, which are the technological backbone of digitization. At the sites in Graz, Villach and Linz, research is conducted on key technologies in the areas of Microsystems, Sensor Systems, Power Electronics, Intelligent Wireless Systems and Embedded Systems. This way, SAL is connecting important actors from industry and academia, centralizes important expertise and know-how, and conducts cooperative application-oriented research along the value chain. The goal is to accelerate the value creation process from idea to innovation – with excellent research and economic impact. Shareholders are the Republic of Austria (50,1%), the federal states of Styria and Carinthia (10% respectively), the federal state of Upper Austria (4,95%) and the Austrian Association for the Electric and Electronics Industry (FEEI, 24,95%).

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