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Fit for the Leap into the Quantum Age

With the "IAIS Evo Annealer" from Fraunhofer IAIS, companies can explore their potential in the field of quantum technologies of tomorrow – today.

Ready for quantum technologies: The Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS supports companies in preparing for the challenges and the changes of the quantum age. For this purpose, the scientists have developed the "IAIS Evo Annealer" with which companies, e.g. from the field of logistics, finance or production, can already use the potential of quantum technologies today without having to access a quantum computer. The technology will be presented for the first time at the "Laser World of Photonics 2022" from April 26 to 29, 2022. The Fraunhofer IAIS exhibit can be found at the joint booth of the Fraunhofer-Gesellschaft in the special area "World of Quantum". Interested companies are invited to bring their own mathematical problems and issues and have them computed on site.

Whether major breakthroughs in medicine and engineering or disruptive influences on the security of current encryption technologies – quantum technologies have the potential to bring abrupt and lasting change to our economy and society in the future. For companies this means that they must prepare now for the associated challenges and explore possible business prospects at an early stage. In order to not be surprised by the change and to achieve so-called "quantum readiness", Fraunhofer IAIS scientists offer companies their expertise and experience in the field of Quantum Machine Learning (QML). "With the help of our consulting services, companies can assess to what extent they need to prepare for this potentially disruptive technology and where it can be concretely realized as a competitive advantage," says Dr. Nico Piatkowski, Senior Scientist in QML at Fraunhofer IAIS. "It is important to us, not to present Quantum Machine Learning as a solution for all problems. There are certain requirements that companies have to meet – but we also advise on this and help build expertise."

Logistics, finance, production - potential for many sectors

Quantum technologies are particularly promising for very computationally intensive tasks, such as mathematical problems that need to be solved in short-term or contain a particularly large number of variables. "These include optimization problems of all kinds that cannot be solved optimally up until now, or that take a very long time to

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compute. This is the case, for example, with route calculation in logistics, portfolio analyses in the financial sector or the calculation of material requirements in production," explains Piatkowski. The scientists also see a lot of potential in quantum computing for Artificial Intelligence (AI) in particular. Part of their research at Fraunhofer IAIS currently involves making the technology usable for Machine Learning and AI with the help of quantum computers from D-Wave and IBM.

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To enable companies to evaluate in advance how they can benefit from quantum technologies, Fraunhofer IAIS has developed the so-called "IAIS Evo Annealer". With the help of this technology, companies can already access faster calculations for mathematical questions and thus also test their compatibility with quantum technologies. "Without having to access a quantum computer, our customers can use the IAIS Evo Annealer to test the extent to which their mathematical problems can be solved with quantum computing in the future. In doing so, they are already achieving profitable results," says Piatkowski. While computation with the IAIS Evo Annealer is not nearly as fast as computation on a quantum computer, he says, it is already possible to do it much more efficiently than before. "Depending on the size, some problems can even be solved in real time. Our experiences with our customers confirm this practice."

Companies can see the technology for themselves at "Laser World of Photonics 2022", the world's leading trade fair for photonics components, systems and applications. In the special "World of Quantum" area, interested visitors will find a demonstrator of the Fraunhofer IAIS Evo Annealer at the joint booth of the Fraunhofer-Gesellschaft. Companies are invited to bring their own mathematical problems and have them computed directly at the booth.

Further information:

For the computation at the booth, interested visitors can bring a combinatorial optimization problem, a so-called "Quadratic unconstrained binary optimization" (QUBO) problem, where the dimension must be at most $n=512$. The QUBO coefficient matrix must also be in NumPy format (file extension .npz). A detailed definition of the QUBO coefficient matrix "Q" can be found here:

https://en.wikipedia.org/wiki/Quadratic_unconstrained_binary_optimization

More information about the IAIS Evo Annealer can be found here:

<https://www.iais.fraunhofer.de/quantum-machine-learning>

About Fraunhofer IAIS

The **Fraunhofer-Gesellschaft** based in Germany is the world's leading applied research organization. Prioritizing key future-relevant technologies and commercializing its findings in business and industry, it plays a major role in the innovation process. A trailblazer and trendsetter in innovative developments and research excellence, it is helping shape our society and our future. Founded in 1949, the Fraunhofer-Gesellschaft currently operates 76 institutes and research units throughout Germany. Over 30,000 employees, predominantly scientists and engineers, work with an annual research budget of €2.9 billion. Fraunhofer generates €2.5 billion of this from contract research.

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As part of the largest organization for application-oriented research in Europe, the Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS based in Sankt Augustin near Bonn is one of the leading scientific institutes in the fields of Artificial Intelligence, Machine Learning and Big Data in Germany and Europe. With its more than 300 employees, the institute supports companies in the optimization of products, services, processes and structures as well as in the development of new digital business models. Fraunhofer IAIS thus shapes the digital transformation of our working and living environment.

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