Deutsches Zentrum
für Luft- und Raumfahrt
German Aerospace Center

Linder Höhe
D-51147 Köln
Telephone: +49 (0)2203 601-0
Internet: https://www.dlr.de

Deutscher Akademischer Austauschdienst
German Academic Exchange Service

Kennedyallee 50
D-53175 Bonn
Telephone: +49 (0)228 882-0
E-mail: dlr-daad-program@daad.de
Internet: https://www.daad.de/dlr

DLR – DAAD Fellowships

Fellowship No. 534

Research Area : Space

Research Topic: **Quantum Machine Learning for Radar Remote Sensing**

DLR Institute: Microwaves and Radar Institute (HR), Radar Concepts Department, DLR Oberpfaffenhofen, Germany

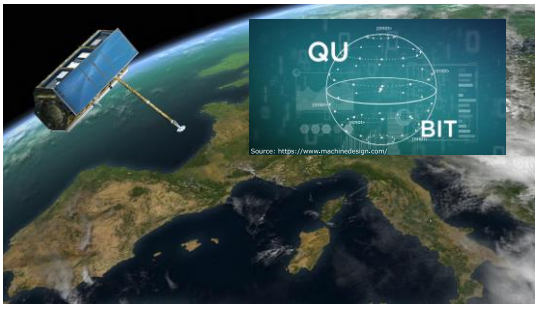
Position: Doctoral Fellow

Openings: 1

Job Specification:

Your Mission

Quantum computing is a highly dynamic research field. The Microwaves and Radar Institute, with its world-wide renown expertise in the conception and development of Earth observation missions, has launched research activities in the field of quantum computation aimed at solving processing and optimization problems for radar remote sensing applications.



A major challenge persists in the scientific and automated analysis of the vast amount of data provided by imaging radar systems and needed by the scientific community. This PhD thesis will research novel strategies to combine quantum computing concepts with the principles of machine learning and artificial intelligence. As part of a team, the PhD candidate is encouraged to explore novel ideas, such as hybrid approaches to quantum machine learning, where certain computationally demanding sub-routines are executed on a quantum computer. With the demonstration of quantum machine learning concepts, this PhD will contribute not only in terms of novel algorithms but also in terms of improved data analysis strategies for a better understanding of our environment in the face of climate change.

Your Tasks

Literature, soft- and hardware research on the state-of-the-art of analog and digital quantum computation as well as hybrid approaches for quantum machine learning with application to radar remote sensing:

- Study of the relevant literature, scientific publications, presentations and lectures in the field of Quantum Computing and Machine Learning
- Development of a well-founded understanding of the potentials and challenges for the transfer of radar signal processing and machine learning algorithms to quantum computers
- Investigation of the present possibilities and limitations with respect to execution and simulation of quantum algorithms on state-of-the-art quantum computers such as universal gate-based architectures or quantum annealers, provided for instance by IBM or D-Wave Systems
- Analysis of already existing approaches to quantum machine learning such as Grover search-based algorithms

Conception, implementation and verification of new quantum machine learning algorithms for radar remote sensing:

- Conception and development of quantum information processing strategies for encoding classical data to be accessible to quantum computers; conception of the entire machine learning processor including input and output
- Development of training concepts and algorithms for quantum neural networks and quantum convolutional neural networks using for instance photons, layered variational circuits or quantum Ising-type models
- Implementation of hybrid concepts based on classical computers and sub-routines executed on quantum computers; development of strategies to process large amounts of radar data under consideration of constraints due to memory, stability of quantum states, etc.
- Development of robust methods and mitigation strategies for error sources in the processing chain
- Demonstration and verification of quantum machine learning approaches using real quantum computers and hybrid architectures

Collaboration, documentation and reporting:

- Supervision of master students in the field of quantum computing for radar remote sensing applications
- Documentation of the results in terms of software, technical reports and presentations to colleagues in the institute
- Support to industry and university projects in multi-national teams
- Presentation of the research on national and international conferences as well as publication in peer-reviewed journal papers
- Compilation of the relevant results in a doctoral thesis

Your Benefits
Look forward to a fulfilling job with an employer who appreciates your commitment and supports your personal and professional development. Our unique infrastructure offers you a working environment in which you have unparalleled scope to develop your creative ideas and accomplish your professional objectives. Our human resources policy places great value on a healthy family and work-life-balance as well as equal opportunities for persons of all genders (f/m/x). Individuals with disabilities will be given preferential consideration in the event their qualifications are equivalent to those of other candidates.

Required Qualification: A master‘s degree/diploma well above average in electrical engineering, informatics, computer science, mathematics, physics or a related discipline

- profound knowledge in quantum computing and machine learning
- good analytical skills and programming experience (e.g. Python, Matlab, or C/C++)
- good self-organization and a high degree of initiative in dealing with complex technical and scientific problems
- strong communication skills and ability to work together as part of an interdisciplinary team

Advantageous Skills: Knowledge in quantum physics and quantum information theory is helpful.

English competence: See requirements on www.daad.de/dlr

The communication and working language is English. English skill level for reading and writing research articles and reports is required.

Earliest Start Date: Immediately

Application Deadline: Until position filled

Further Information: http://www.dlr.de/en
http://www.dlr.de/hr/en/
http://www.daad.de/dlr

Technical Contact: Dr. Sigurd Huber (Sigurd.huber@dlr.de)