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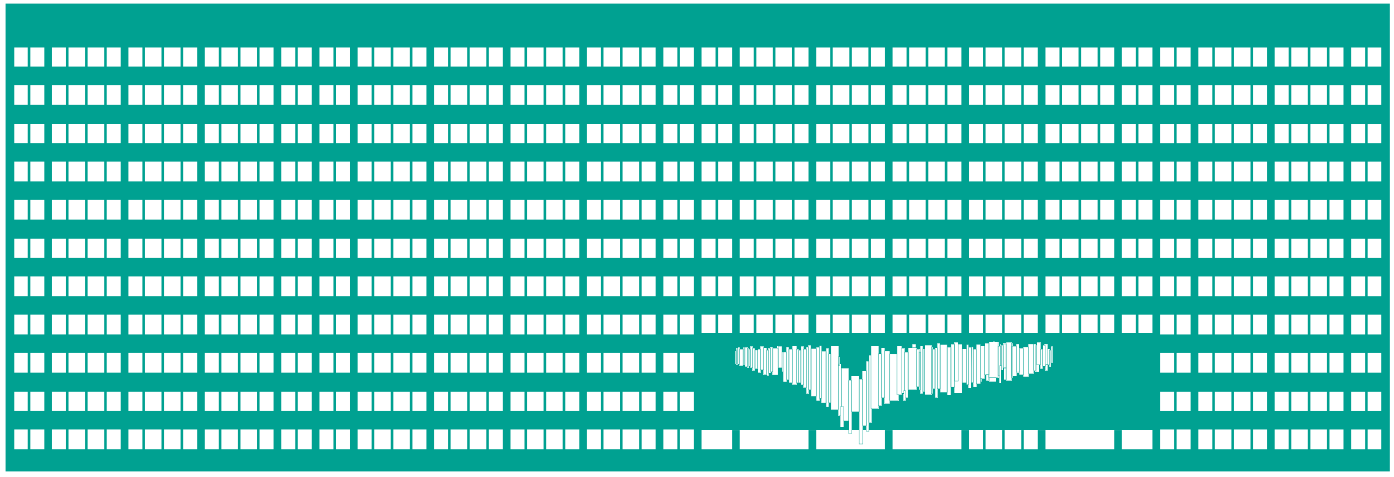

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Quantum Optimization of a Community Energy Network Using a Simulator and a Real Quantum Computer

High Performance Computing in Science and Engineering
HPCSE 2026

Jiří Tomčala

VSB – Technical University of Ostrava

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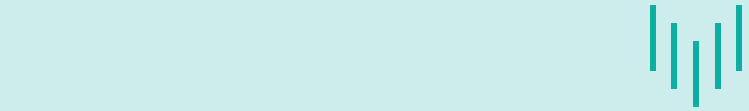
20 May, 2026

Community Energy

The Benefits of Community Energy



- **Greater energy self-sufficiency:** thanks to community energy initiatives, people and businesses will not be completely dependent on traditional electricity supplies from the grid.
- **Price:** the price of shared electricity is set by members of the community group; it can be significantly lower than the supplier's rate.
- **Higher subsidies for photovoltaics:** starting in February 2025, participation in electricity sharing will be a requirement to receive a higher subsidy for photovoltaic systems under the New Green Savings program.
- **Better utilization of the renewable energy potential:** many homeowners cannot use all the electricity generated by their solar panels. Thanks to community energy initiatives, they can share it with others, such as family members, and thus make full use of its generation potential.
- **Environmental sustainability:** community energy is based primarily on the production of clean energy from sources that will never run out: the sun, wind, or water. Therefore, it contributes to decarbonization and accelerates the transition from fossil fuels to low-emission and zero-emission sources.

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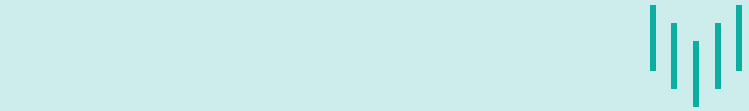

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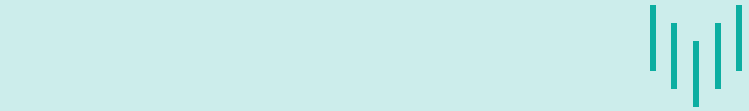

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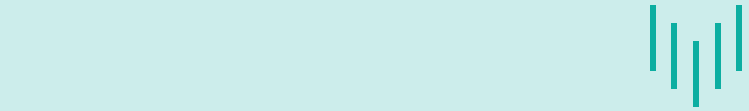

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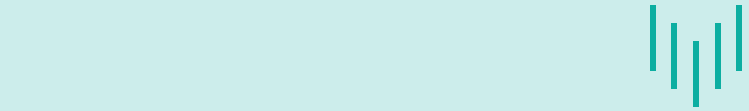

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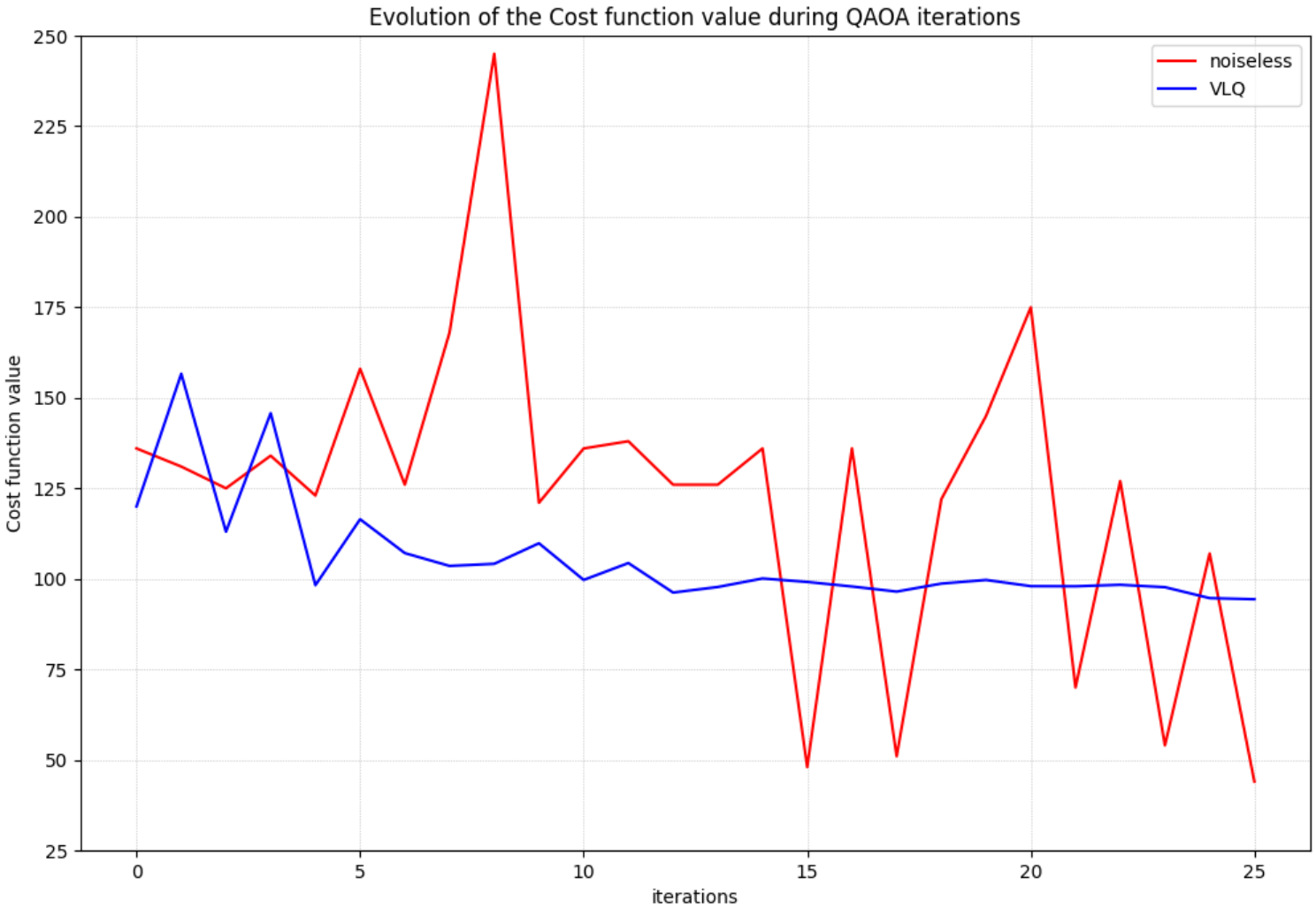
Introductory video presentation...

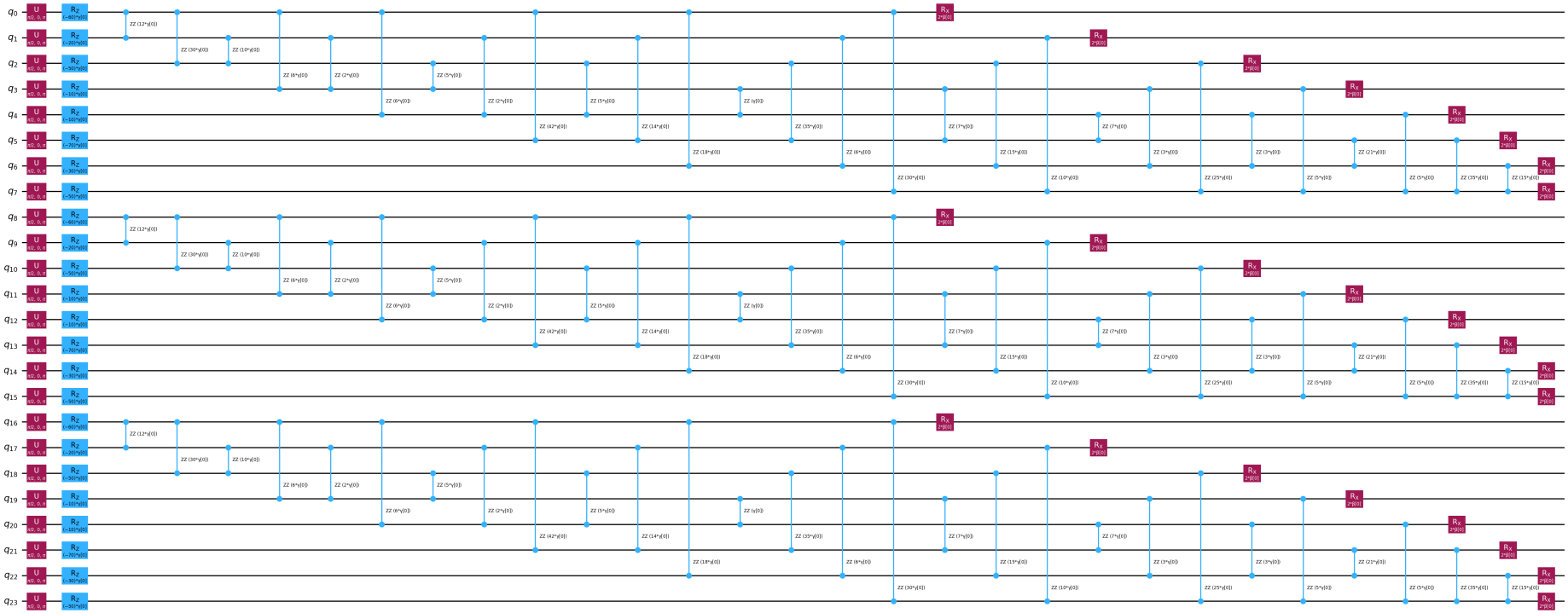
Analysis of results

Cost function value during QAOA iterations

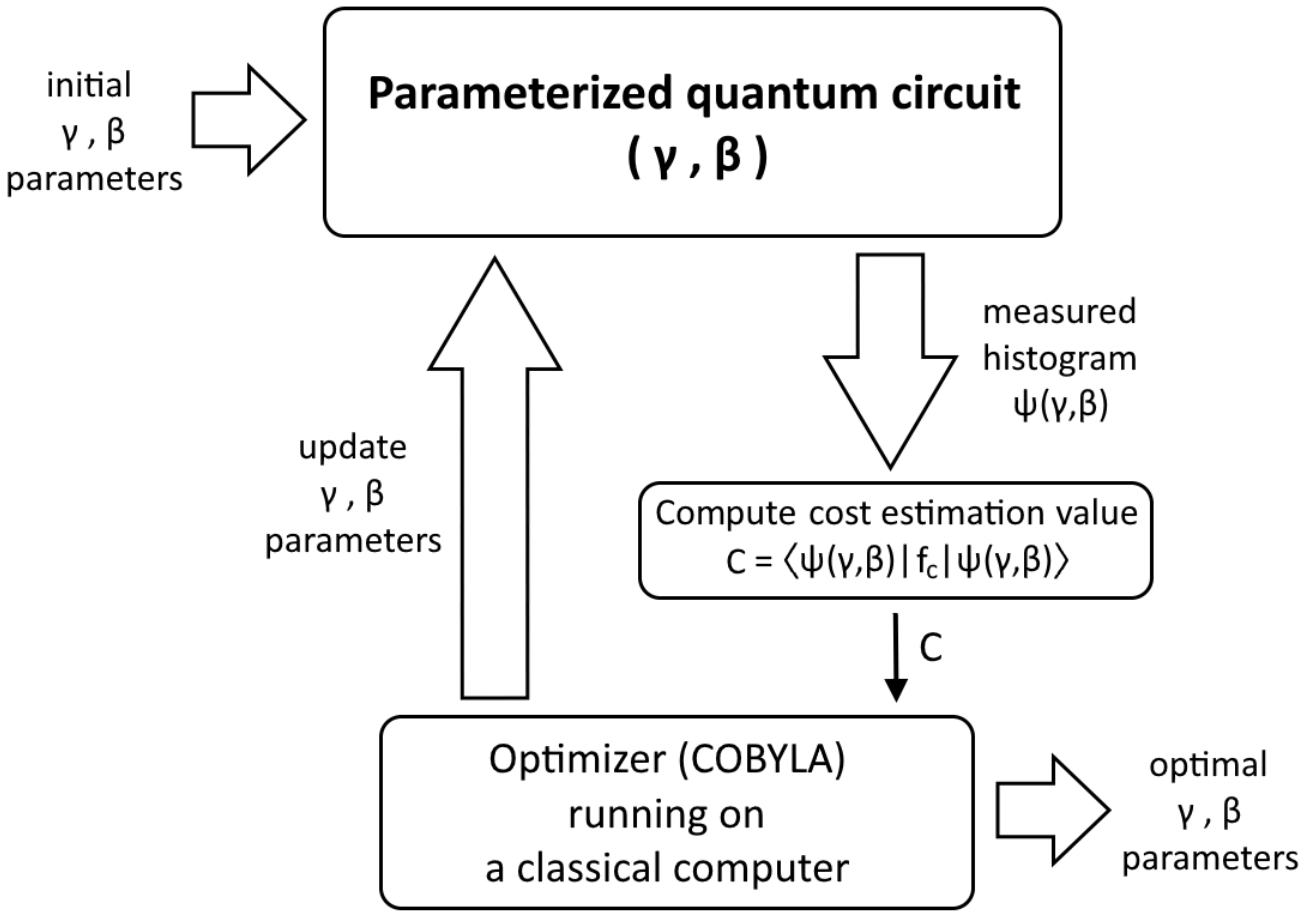


Parameters surfing

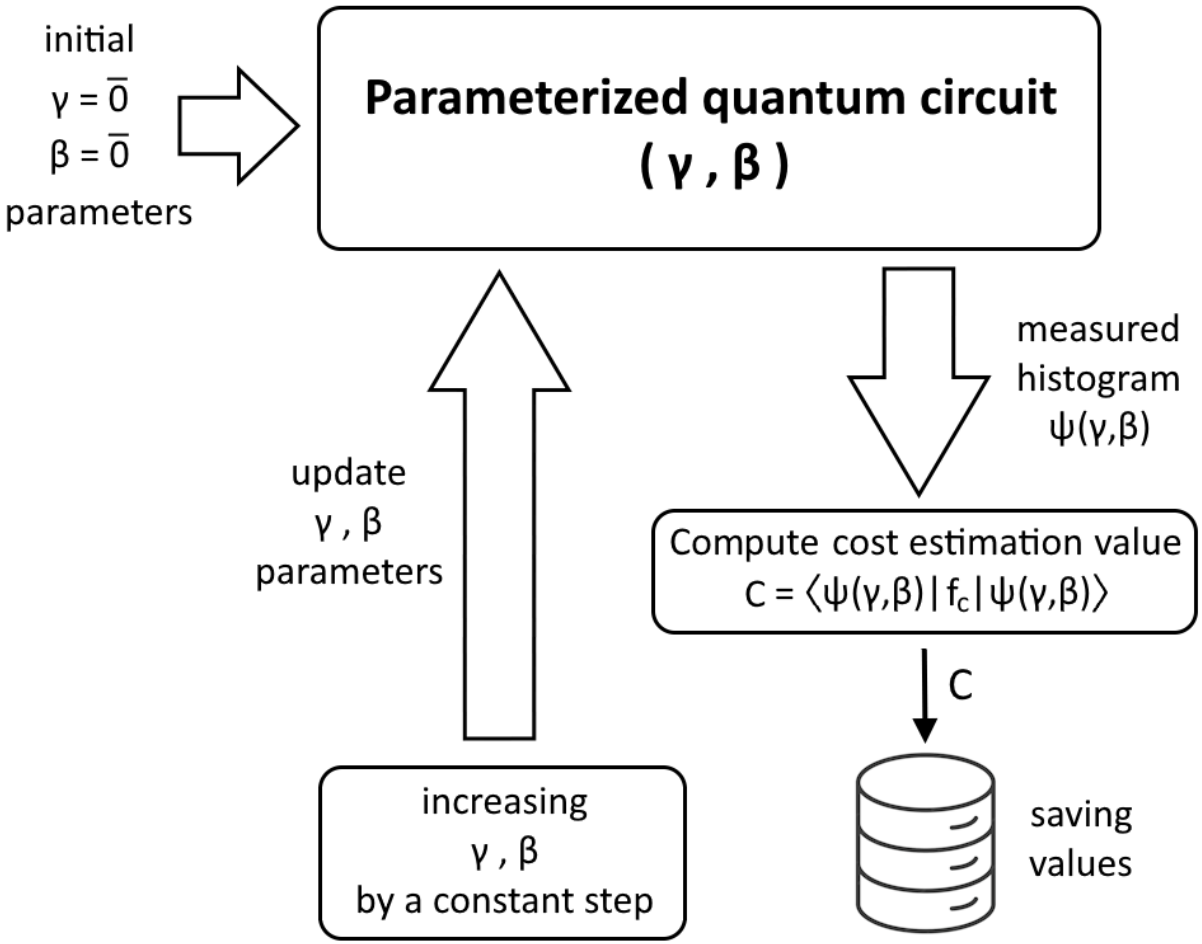
Parameterized Quantum Circuit (PQC) - ansatz



Variational Quantum Circuit (VQC)

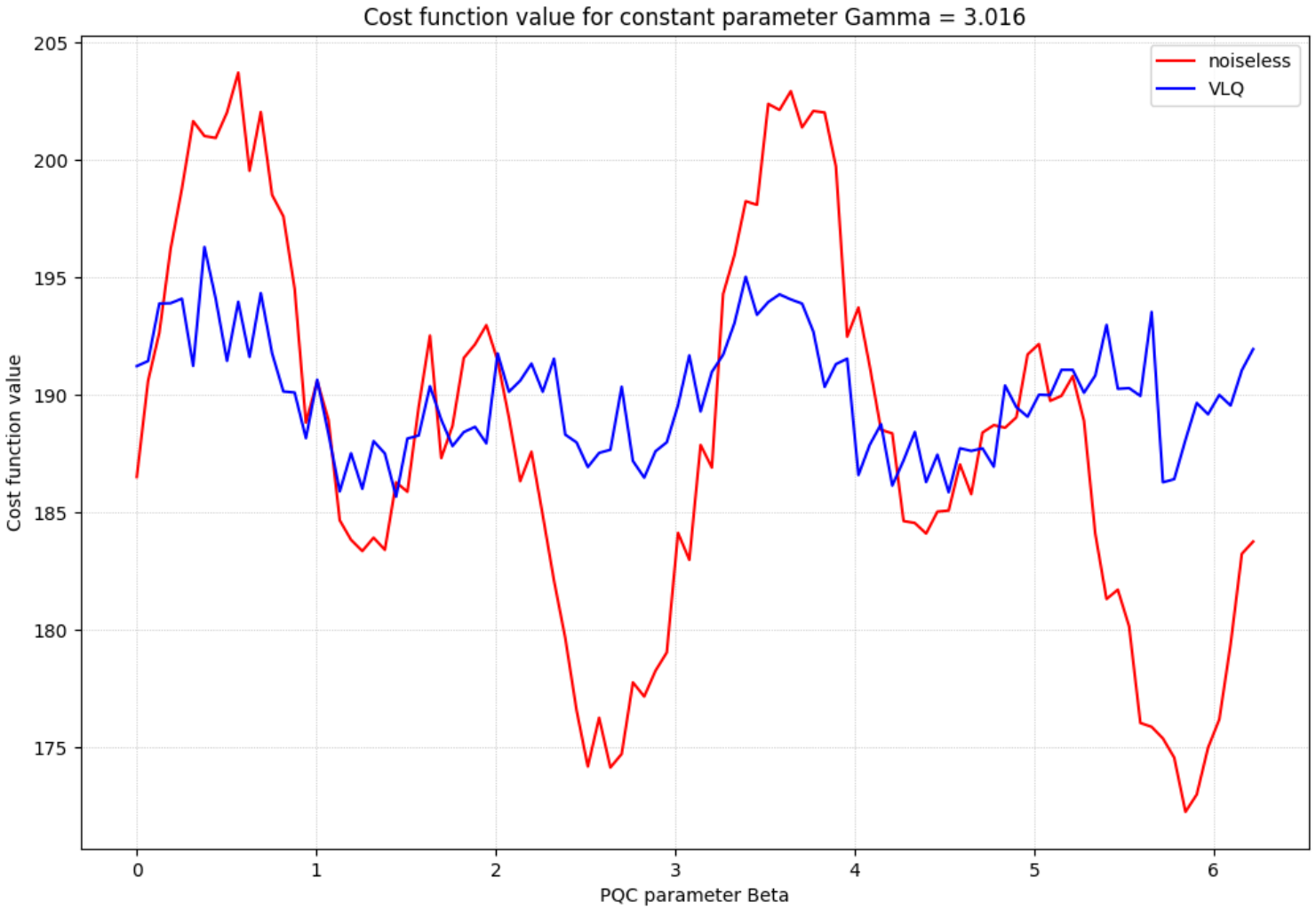


Parameters surfing loop



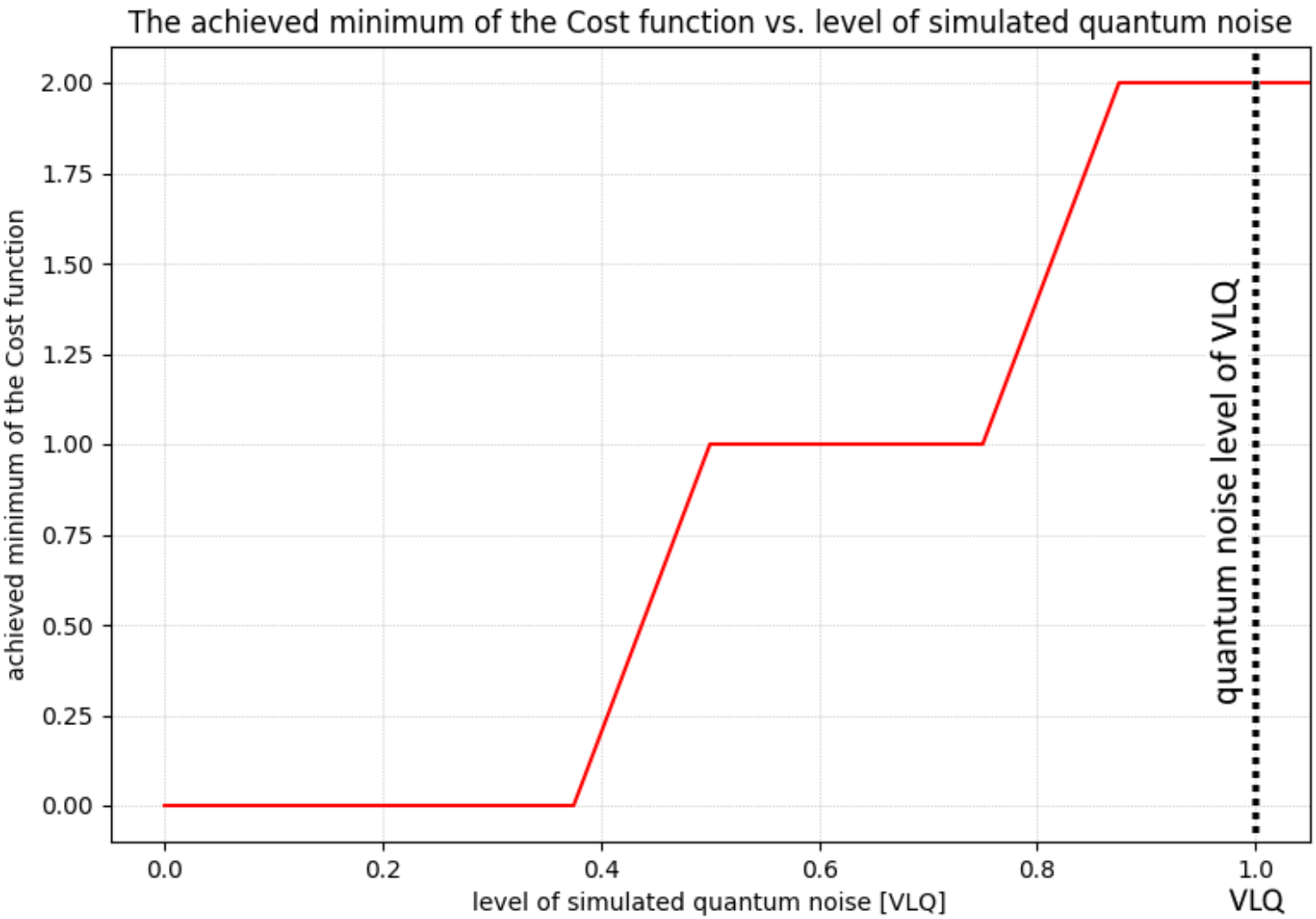
3D graph
of
Cost function value
vs.
Gamma and Beta

Cost function values vs. Beta while Gamma is constant



Estimation of the maximum quantum noise level that still allows to find the optimal solution

Achieved Cost minimum vs. level of quantum noise



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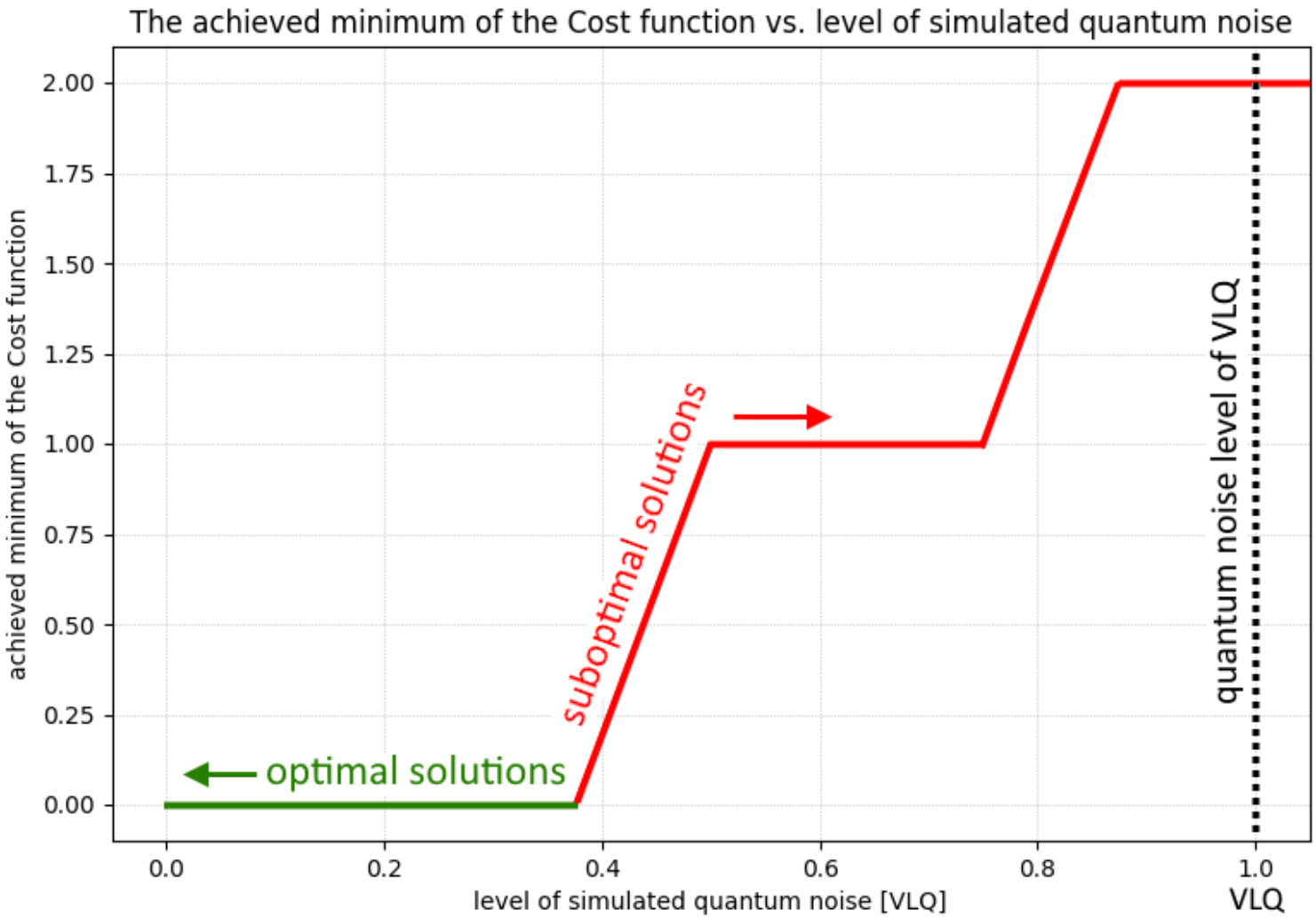

Conclusion

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- A practical, not entirely trivial, real-world optimization problem was solved on a real quantum computer. Although the quantum advantage is still out of sight, it has at least been practically demonstrated that it is possible.
- Thanks to surfing the ansatz parameters, the mechanism of how quantum noise affects the correctness of the result of quantum optimization, which was performed using QAOA, was clearly shown.
- An approximate maximum quantum noise level was estimated, which still allows to find the optimal solution to the given task of optimizing the interconnections of a community power grid.

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Thank you for your attention

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20 May, 2026

VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

This talk has been supported by EU funds under the project

"Increasing the resilience of power grids in the context of decarbonisation, decentralisation and sustainable socioeconomic development",

CZ.02.01.01/00/23_021/0008759,

through the Operational Programme Johannes Amos Comenius.

Co-funded by
the European Union