

The Qiskit Function: QUICK-PDE - The Quantum Multiphysics Partial Differential Equation (PDE) Solver

1 Utility

The Qiskit function allows developers, simulation engineers, and researchers to easily solve Partial Differential Equations (PDEs) modeling multiphysics phenomena on IBM Quantum computers.

2 Objective

Paving the way for practical applications in industrial simulation. This is a first step toward multiphysics simulations relevant to industry.



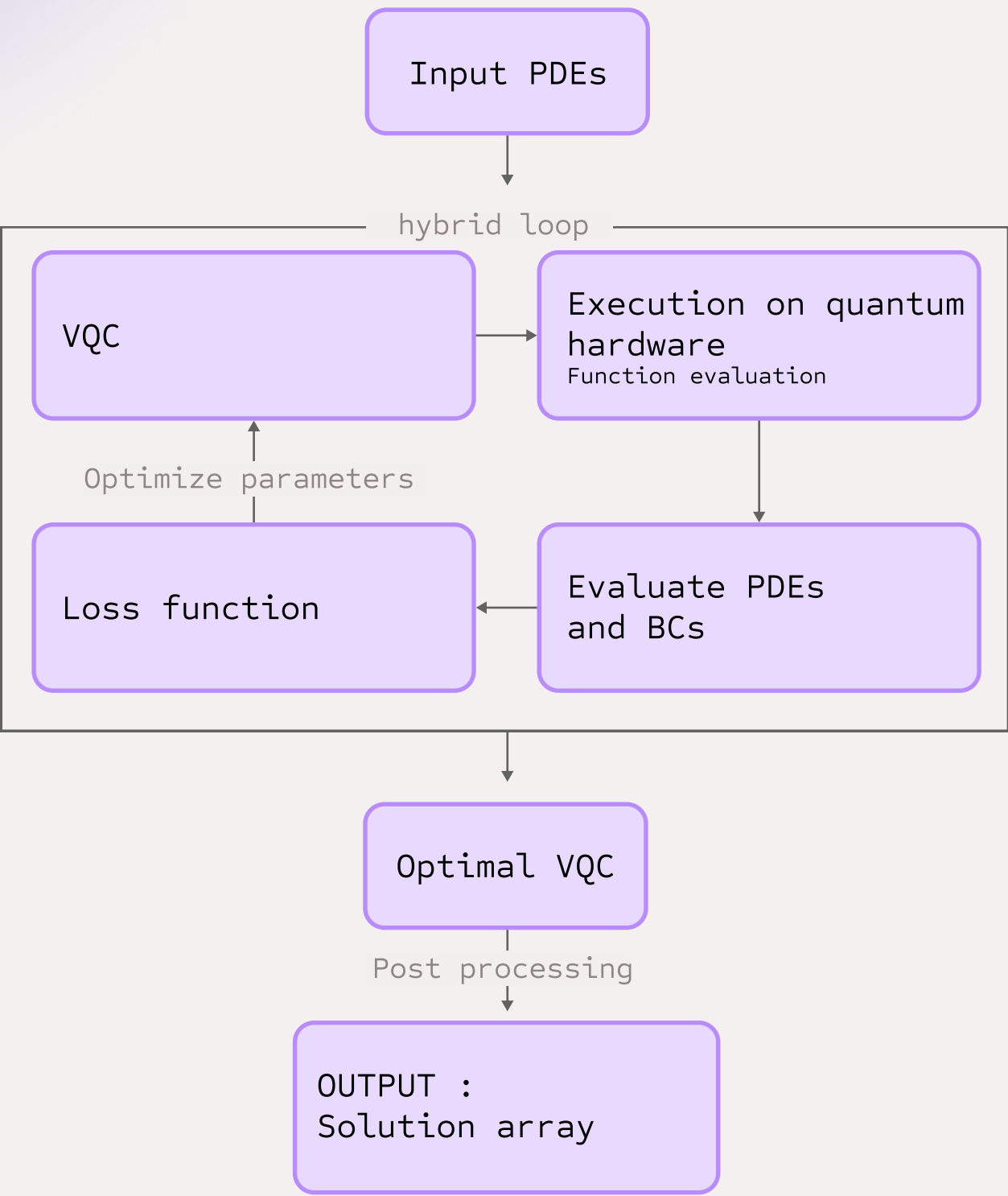
3 Flexibility

Allows the user to adjust a wide range of parameters, including those related to quantum computation (number of qubits, circuit depth, initialization strategy) and those related to physical simulation (initial flow, material parameters).

Technology & Advantages

H-DES is a hybrid (classical/quantum) **Variational Quantum Algorithm (VQA)**. It translates the PDE solving problem into an optimization problem.

The function finds the solutions to the PDEs through a **spectral decomposition** that leverages the expressiveness of quantum computing. The solutions are encoded as linear combinations of orthogonal functions.



Precision

Thanks to a clever encoding of the solution and an optimized quantum measurement strategy, the algorithm can achieve high precision with a limited number of qubits.

Scalability

The algorithm has scalability properties that allow it to provide satisfactory solutions even as the complexity of the differential equations increases: order of derivatives, dimension (number of variables), number of equations, coupling, nonlinearity, discontinuities, turbulence, and more.

Versatility

The H-DES algorithm is designed as a universal partial differential equation solver, capable of being applied to various sectors and physical phenomena. It can handle systems of linear, nonlinear, ordinary, partial, integro-differential, stochastic, and other types of differential equations.

Useful links :

→ the function : <https://quantum.cloud.ibm.com/docs/fr/guides/colibritd-pde>
 → the catalogue : <https://quantum.cloud.ibm.com/functions>
 → the whitepaper : <https://docsend.com/v/z4rzv/colibritd-whitepaper-results>