Real-time error mitigation for variational optimization on quantum hardware

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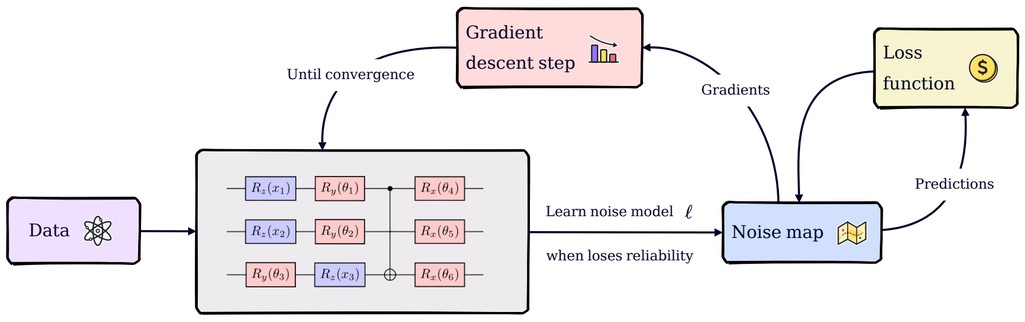
Aim

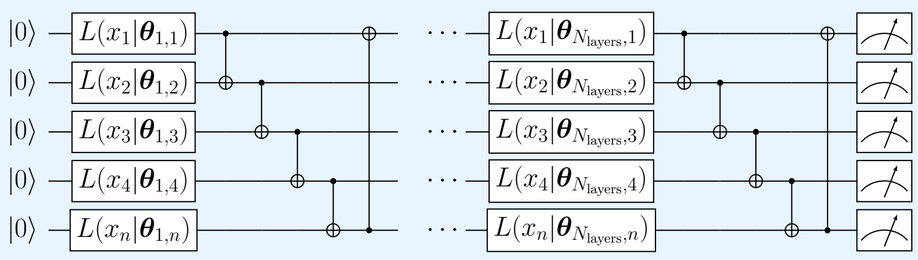
we put forward the inclusion of error mitigation routines in the process of training Variational Quantum Circuit (VQC) models. In detail, we define a Real Time Quantum Error Mitigation (RTQEM) algorithm to coadiuvate the task of fitting functions on quantum chips with VQCs.

Schematic pipeline of the RTQEM algorithm



Ansatz

We tackle multi-dimensional regression problems using a VQC as Quantum Machine Learning (QML) model. The data $\boldsymbol{x}$ are encoded into the circuit via Data Reuploading:



where we use the following definition of the uploading channel:

$$L(x_j|\boldsymbol{\theta}_{l,j}) = R_z(\theta_3\, x_j + \theta_4) R_y(\theta_1\, \kappa(x_j) + \theta_2)\ , \tag{1}$$

which uploads the j-th component of $\boldsymbol{x}$ at the circuit layer l.

Noise of a quantum hardware

We consider a quantum system affected by local pauli noise with parameters $\boldsymbol{q} = (q_X, q_Y, q_Z)$ and readout noise parametrized by flip probability q_M.

References