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# Evaluation quantum gradient through quantum non-demolition measurements

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Even if error-free quantum computers are still decades away, today's generation of quantum computers should be able to attack classically unsolvable computational problems.
The paradigmatic example is the search for the energy minimum of medium size quantum systems.
These problems are usually classified as variational quantum algorithms and require a hybrid quantum-classical computer architecture.
While quantum computers allow us to estimate the energy of the quantum system, the classical counterpart uses a classical algorithm (such as the gradient-descendent algorithm) to drive toward the desired minimum.
In this context, it is of crucial importance the estimation the derivatives of the energy as a function of the controllable system parameters.

Quantum mechanics allows for a different way to extract information: strong projective measurements, weak measurements, non-demolition measurements and so on.
I will present a novel approach based on the non-demolition measurement that aims to simplify this process of the estimation of the derivative of the energy by introducing a quantum detector.
The information about the energy gradient is stored in the detector phase that is eventually measured.
This allows us to directly estimate the derivatives of the energy and consistently reduce the resources needed to run the variational quantum circuits.
I will discuss several advantages that this approach has with respect to the standard direct measurement approach.

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