Opportunities and challenges of Quantum Reservoir Computing
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Abstract:

Brain-inspired unconventional computing is a successful approach in a wide range of applications, which are also growing due to the availability of large amounts of data. Recent proposals go beyond classical substrates and move towards quantum machine learning, as in Quantum Reservoir Computing. The classical version of this approach has been successfully developed over the last 20 years, and moving from classical to quantum physical reservoirs has the potential to remarkably increase the processing power in temporal tasks by exploiting quantum coherences and not requiring error correction.

Furthermore, it is naturally suited to fully quantum information processing (with quantum inputs). However, it also opens up a number of new challenging questions, both fundamental and implementation-related. Examples include the identification of the best quantum operating regimes, strategies for continuous measurement, the role of statistics, or the potential advantage of quantum coherence and entanglement.

After introducing quantum reservoir computing and showing how memory and nonlinearity arise in a quantum formalism, we will discuss some of these issues and give an overview of the field.