QUANTUM DISTANT CONTROL: QUANTUM GATES TELEPORTATION

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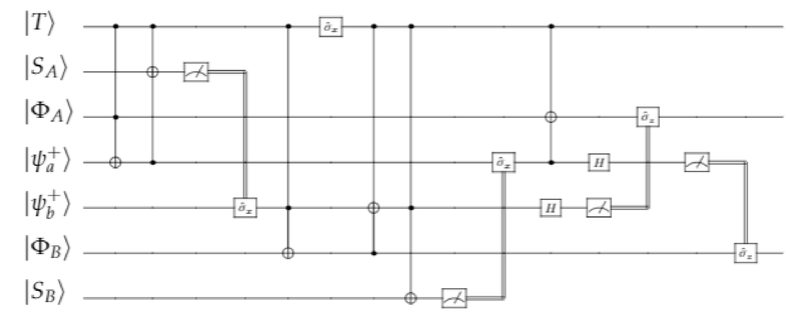
ABSTRACT

In this poster, we present a quantum scheme for the non-local implementation of arbitrary quantum gates. This teleportation of quantum gates can be considered as a quantum "remote control". Our scheme is based on a Bell state as a quantum channel with a series of $CNOT$, measurement gates and Pauli gates. Our scheme could be useful in the development of quantum communication and computational protocols and opens up new possibilities to process qubits in quantum computer.

MOTIVATION

The possibility to perform quantum operations at a distance quantum computer is an essential step for the development of quantum computing and communication processes. It is known that teleportation is a technique that allows the reliable. transfer of unknown quantum information [1]. Here, the bidirectional teleportation of quantum operation is presented and application is discussed.

PROCESSING OF THE SCHEME

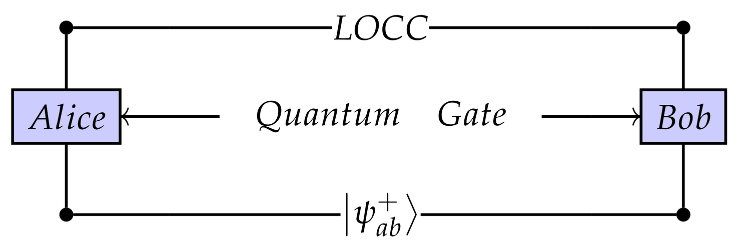


The scheme requires "5" qubits and an EPR state [2]. The main aim of us is to perform controlled operation, where the control qubit $|\Phi_A\rangle$ is at Alice's side and the target qubit $|\Phi_B\rangle$ is at Bob's hand. After performing two $toffoli$ and gets the measurements outcome, she broadcast it to Bob.

Measurments result	Bob applies
00	I $\otimes I$
01	I $\otimes \sigma_z$
10	$\sigma_z \otimes I$
10	$\sigma_z \otimes \sigma_z$

Table 1: By receiving the measurements outcome, Bob applies the adequate operator.

RESULTS



Alice and Bob, the two legitimate partners in our scheme, could exchange the application of $CNOT$ gate [2].

Alice has the state:

$$|\Phi_A\rangle = A_0|0\rangle + A_1|1\rangle \quad (1)$$

and Bob has the quantum state:

$$|\Phi_B\rangle = B_0|0\rangle + B_1|1\rangle \quad (2)$$

If Alice has the control qubit. The quantum circuit will end up with the state $|S\rangle$:

$$|S\rangle = A_0B_0|00\rangle + A_0B_1|01\rangle + A_1B_0|11\rangle + A_1B_1|10\rangle \quad (3)$$

APPLICATIONS

- Quantum control
- distributed Quantum computing.
- Blind computing.
- Quantum communication
- Quantum repeatres
- New quantum teleportation protocols
- New possibilities for processing qubits.

CONCLUSION

- The distant application of quantum operation, i.e quantum gates, is of paramount importance for several quantum areas. In this poster, we presented a new scheme for the bidirectional implementation of $CNOT$ gate. In this scheme, Alice or Bob could play the role of control depending on the state of the trigger.
- Alice could applies a $CNOT$ gate at Bob's side if the trigger qubit $|T\rangle = |1\rangle$.
- However, Bob could applies a $CNOT$ gate at Alice's side if the trigger qubit $|T\rangle = |0\rangle$.
- The present scheme could be extanded to different guantum gates such the Pauli gates and $toffoli$ gate.

REFERENCES

[1] C.H. Bennett et al. Teleporting an unknown quantum state via dual classical and einstein podolsky rosen channels. *Phys. Rev. Lett*, 1993.

[2] C. Seida et al. Bidirectional teleportation under correlated noise. *The European Physical Journal D, 75(6), 1-12*, 2021.

FUTURE RESEARCH

Quantum teleportation of quantum operations has been attracted much interested in recent years. Nevertheless, the extension of the quantum teleportation to cover a large quantum network is a new perspective.

Indeed, the decoheence is a major obstacle. So, the investigation of the decoherence and how to mitigate it is an open question.

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