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An Optimal Quantum Error-Correcting Procedure Using Quanti er Elimination

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Abstract Quantum communication channels suffer from various noises, which are mathematically modelled by error super-operators. To combat these errors, it is necessary to design recovery super-operators. This paper aims to construct the optimal recovery that maximizes the minimum delity through the noisy channel. It is typically a MAX-MIN problem, out of the scope of convex optimization. Compared to existing methods, our method is exact and complete by reduction to quanti er elimination over real closed elds in a fragment of two alternative quanti er blocks. Finally the complexity is shown to be in EXP.

Keywords quantum error-correction quanti er elimination complexity

1 Introduction

Quantum communication channels are often affected by various noises, which potentially bring disastrous outcomes. So it is necessary to combat the errors caused by those noises for protecting the information resource. To achieve this goal, the theory of error-correction, including quantum error-correction (QEC), came into being and was increasingly developed in the past decades [5]. Nowadays, it is also closely related to many important topics in quantum information theory, such as quantum process tomography [21] and fault-tolerant quantum computation [1].

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