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On the theory and application of one-step numerical schemes for solving quantum stochastic differential equation (QSDE)

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This paper presents one-step numerical schemes for solving quantum stochastic differential equation (QSDE). The algorithms are developed based on the definition of QSDE and the solution techniques yield rapidly convergent sequences which are readily computable. As well as developing the schemes, we perform some numerical experiments and the solutions obtained compete favorably with exact solutions. The solution techniques presented in this work can handle all class of QSDEs most especially when the exact solution does not exist.

Keywords: Quantum stochastic differential equation; Boson Fock space; one-step integral method; Runge–Kutta's method.

1. Introduction

Quantum stochastic differential equations (QSDEs) have attracted the interest of both physicist and mathematicians over the past few decades. It serves as useful tool for the study of noisy quantum systems appearing in many branches of quantum physics. The mathematical basis of QSDEs was first given by Hudson and Parthasarathy [7], where the role of Brownian motion in the classical Ito theory was played by three quantum stochastic processes (annihilation, creation and gauge processes) and the concept of quantum stochastic integration of Ito type was established. The QSDEs describe open quantum system driven by quantum