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Abstract

In this paper, we consider the singularly perturbed Mackey-Glass equation. By letting the perturbation parameter tends to zero, such an equation is formally reduced to a scalar difference equation. Local stability analysis of fixed points is investigated. The method of steps is employed to discretize the system. Moreover, Numerical simulations including Lyapunov exponent, bifurcation diagrams and phase portraits are carried out to confirm the theoretical analysis obtained and to explore more complex dynamics of the system.

Keywords: Singular perturbed equations, Mackey-Glass, fixed points, local stability, lyapunov exponent, bifurcation and chaos.

1 Introduction

Delay differential equations (DDEs) are employed in modeling many problems in science, engineering, biology and medicine. That is because the delay term in such equations increases the reliability in modeling real phenomena and makes the prediction of long term behavior of such models more accurate.
Indeed, (DDEs) represent dynamical system of infinite dimensions which are opposite to ordinary differential equations. That is to say, (DDEs) are a very important topic in dynamical systems. The original stimulus for the study of (DDEs) mainly lies in the application of control theory and the study of stability and automated management.