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Allaberen Ashyralyev, Deniz Agirseven, Burcu Ceylan

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Bounded Solutions of Delay Nonlinear Evolutionary Equations

Allaberen Ashyralyev^{a,b}, Deniz Agirseven^{c,*}, Burcu Ceylan^d

^aDepartment of Mathematics, Near East University, Nicosia, TRNC, Mersin 10, Turkey

^bInstitute of Mathematics and Mathematical Modeling, 050010, Almaty, Kazakhstan

^cDepartment of Mathematics, Trakya University, Edirne, Turkey

^dDepartment of Computational Sciences, Trakya University, Edirne, Turkey

Abstract

We consider the initial value problem

$$\begin{cases} \frac{du}{dt} + Au(t) = f(u(t), u(t-w)), t \geq 0, \\ u(t) = \varphi(t), -w \leq t \leq 0 \end{cases}$$

in a Banach space E with the positive operator A . Theorem on the existence and uniqueness of a bounded solution of this problem is established for a nonlinear evolutionary equation with time delay. The application of the main theorem for four different nonlinear partial differential equations with time delay is shown. The first and second order of accuracy difference schemes for the solution of one dimensional nonlinear parabolic equation with time delay are presented. Numerical results are provided.

Keywords: delay evolutionary equations, bounded solution, difference schemes, existence and uniqueness, positive operator, Banach space

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1. Introduction

It is known that, in delay differential equations, the presence of the delay term causes the difficulties in analysis of differential equations. Moreover, there are a few works that analytic solutions are given. For this reason, the researches
 5 in numerical methods recompense the lack of theoretical studies. Especially, one of the main methods used on this area is finite difference method.

*Deniz Agirseven

Email address: denizagirseven@gmail.com (Deniz Agirseven)

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