

OSCILLATORY AND NONOSCILLATORY CRITERIA OF FIRST ORDER DIFFERENTIAL EQUATIONS WITH GENERALIZED PIECEWISE CONSTANT DELAY

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Abstract. In this paper, we investigate first-order differential equations with piecewise constant argument of generalized type (DEPCAG), and derive several theoretical results concerning the oscillatory behavior of the solutions. Various examples are presented to verify the validity of the obtained theoretical results. Furthermore, simulation graphs are included to visually demonstrate the oscillatory behavior of the proposed examples.

Keywords. Piecewise constant argument of generalized type, oscillatory, nonoscillatory, simulation, first-order differential equations.

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1 Introduction and Preliminaries

Over the past decades, the oscillatory and nonoscillatory behavior of solutions to ordinary differential equations has become one of the central topics in qualitative analysis. When the delay term is defined as the integer part of time, the resulting delay differential equations are referred to as differential equations with piecewise constant arguments (DEPCAs). The first mathematical model involving a piecewise constant argument was introduced by Busenberg and Cooke [5] in the biomedical field, where the delay argument was taken as the integer part of time. Moreover, in the studies by Shah and Wiener [11], Cooke and Wiener [9], Aftabizadeh and Wiener [1], Aftabizadeh, Wiener and Xu [2], Wiener [12], Zhang and Parhi [13], and Györi and Ladas [10], where $h(t)$ is a piecewise constant function defined by the integer part of time, several qualitative properties of solutions of DEPCAs of the form

$$x'(t) = f(t, x(t), x(h(t)))$$