SOME METHODS FOR SOLVING DELAY DIFFERENTIAL EQUATIONS (DDE) WITH CONSTANT LAGS

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Abstract

Ordinary differential equations (ODEs) have been used to model mathematical and physical phenomena since the concept of differentiation was first developed. A wide theory has been built during the study of different types of ordinary differential equations and their applications. These equations are being studied more and more and the whole theory relating to them continues to develop extremely fast. Nowdays, complicated ODE models can be solved numerically with a high degree of confidence. Early, it was recognized that phenomena may have a delayed effect in a differential equation, leading to what is called a delay differential equation (DDE). In this study are treated delay differential equations (DDEs) with constant lags. DDEs are being used to model various phenomena in applied mathematics and in physical sciences. For such equations the value of the derivative at any time depends on the solution at a previous “lagged” time. Although solving DDEs is similar in some respects to solving ordinary differential equations (ODEs), it differs in some rather significant ways. There are discussed numerical methods for DDEs and in particular Runge–Kutta methods, that are so popular for ODEs, and how these methods can be extended to DDEs. Runge-Kutta methods are attractive because they are much easier to start than other numerical methods. We have discussed the solution of constant coefficient-DDEs by the "Method of Characteristics,". In the study is also shown how to solve more general DDEs using "Method of Steps". This method is often discovered by workers in the field and is one of the "natural" procedures that is easy to use. The aim of the study is to present some effective methods for solving delay differential equations with constant lags. The study analysis serves as a valuable synthesis of the treatment of these methods using the basic knowledge of the ordinary differential equations.

Keywords: *ODE-s, DDE-s, constant lags, numerical methods*