ANALYTICAL SOLITARY WAVE SOLUTIONS FOR THE BOUSSINESQ EQUATION CONTAINING NONLINEARITY IN THE TIME-DERIVATIVE TERM

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The Boussinesq equation and similar types of this equation are used to analyze the behavior of water waves in aquifers under various boundary conditions. According to the properties of boundary conditions, for example in the presence of suddenly changing water heights or in inclined aquifers, the Boussinesq equation can have nonlinear terms. Nonlinear terms in such nonlinear Boussinesq equations often appear within the space-derivatives. Sometimes, nonlinear terms can be encountered in the time-derivative of the Boussinesq equation, for example, while analyzing the propagation of the electrical signal in a transmission line containing a semiconductor diode with nonlinear capacitance-voltage characteristics. Such equations are desired to be analytically solved to accurately determine the ultimate behavior and stability of the corresponding systems. In this work, we study the analytical solitary wave solutions of a Boussinesq equation with nonlinearity in the term in which the time-derivative exists. For this purpose, first the partial differential equation is transformed to an ordinary differential equation by performing the change of variables $\xi = x-ct$. Then, using specially selected function series expansions, a system of overdetermined algebraic equations is obtained from the ordinary differential equation, where the unknowns are the coefficients of the series. This system of algebraic equations is solved with Mathematica and the coefficients of the series are found. Using these coefficients, the behaviors of the possible solutions of the partial differential equation are investigated.

Keywords - Boussinesq equation, nonlinear partial differential equation, solitary wave solution

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