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(Analytical study of differential equations with applications)

Abstracts

The research performed in the project can be formally separated in three parts. All these parts are related by the method of the study and the sequence of discoveries. The first part of the project deals with modeling in fluid dynamics. A systematic application of the group analysis method for modeling fluids with internal inertia is presented. The group classification separates these models into 73 different classes. The second part of the project deals with applications of the group analysis method to integro-differential equations. The research deals with an evolutionary integro-differential equation describing nonlinear waves. We discuss new approaches developed in modern group analysis and apply them to the general model considered in the present paper. Reduced equations and exact solutions are also presented. Another application of the group analysis method to integro-differential equations related with the Boltzmann equation. The group classification with respect to sources is carried out for the equations under consideration using the algebraic method. The third part of the first project is focused on the study of two problems: (a) on first integrals of second-order ordinary differential equations; (b) the complete group classification of systems of two linear second-order ordinary differential equations with constant coefficients. Here we discuss first integrals of a particular representation associated with second-order ordinary differential equations. The relationship between the integral form, the associated equations, equivalence transformations, and some examples are considered as part of the discussion illustrating some important aspects and properties. For group classification the present project corrects the way of using Jordan canonical forms for studying the symmetry structures of systems of linear second-order ordinary differential equations with constant coefficients applied in (Wafo Soh (2010)). The approach is demonstrated for a system consisting of two equations.