MSc Thesis Seminar

Stanislav Opanasenko
Memorial University

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Extended symmetry analysis of isothermal no-slip drift flux model

Abstract:

Extended group analysis for the system of differential equations modeling an isothermal no-slip drift flux is carried out. The maximal Lie invariance algebra of this system is proved to be infinite-dimensional. Using this we have found its complete point symmetry group found using the megaideal-based version of the algebraic method. Optimal lists of one- and two-dimensional subalgebras of the admitted maximal Lie invariance algebra are constructed and employed as a basis for finding Lie reductions of the system under study to systems of ordinary differential equations and to systems of algebraic equations, respectively. Since the system under consideration contains a subsystem of two equations which involves only two of three dependent variables, we also perform group analysis of this subsystem. The latter can be linearized by a two-dimensional hodograph transformation and thus reduces to the Klein--Gordon equation. We also touch upon the generalized hodograph method for finding solutions of the system under study. We have found genuinely generalized symmetries for our system and present the connection between them and the Lie symmetries of the subsystem we mentioned earlier. We have also obtained the recursion operator of our system; this operator does not have a differential part. We classify an infinite family of hydrodynamic conservation laws for our system parameterized by solutions of the Klein--Gordon equation. Finally, we construct an infinite family of Hamiltonian structures for the system.