

# Diffusive Lotka-Volterra system: symmetries, exact solutions and their applications

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## Abstract:

Reaction-diffusion systems of the Lotka-Volterra type is the most common systems for modeling different types of interaction between species. Although the classical Lotka-Volterra system (without diffusion) was introduced about 100 years ago, its different generalizations are widely studied at the present time because of their importance for mathematical modeling various processes in biology, ecology, chemistry, social sciences etc.

In this talk, an extensive introduction is presented in order to highlight applicability of nonlinear differential equations in biology and importance of exact solving such equations. Furthermore some recent results for two- and three-component diffusive Lotka-Volterra systems, which were derived by symmetry based methods, are presented. At the first step, Lie and conditional symmetries in the form of linear first-order differential operators for systems in question are constructed. The next step consists in application of the symmetries obtained in order to reduce the diffusive Lotka-Volterra systems (with correctly-specified coefficients) to the systems of ordinary differential equations (ODE). Solving the ODE systems obtained, a wide range of exact solutions for the diffusive Lotka-Volterra systems are found.

Finally, an analysis of some exact solutions are presented in order to establish asymptotical behaviour and to satisfy biologically motivated boundary conditions. It is shown that they describe different scenarios of competition between populations in the case of two or three species.

The talk is based on the joint results with Dr. Davydovych (IM NAS of Ukraine) published in several papers during the last decade, including the monograph '**Nonlinear Reaction-Diffusion Systems – Conditional Symmetry, Exact Solutions and their Applications in Biology.**' Springer (2017).