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Editorial

Approximate and Iterative Methods

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The iterative methods are very successful in descriptions of many issues and solving various problems in mathematics and its applications (numerous examples can be found in iteration theory, dynamical systems, bifurcation theory, fixed point theory, computational matrix algebra, etc.). They are based mainly on iterations of operators that satisfy some equations. But, on the other hand, the natural phenomena are subject to certain disturbances (noises) and their descriptions, in general, can be expressed by equations only approximately; that is, frequently instead of equations we rather should use inequalities.

So, it is important to know when, why, and to what extent we can replace those inequalities by suitable equations and what errors we thus commit. This is actually the issue of Ulam's type stability, which nowadays is understood as follows: specify conditions under which a function, which fulfills an equation approximately, is close to a solution of the equation. It has been motivated by a problem posed by S. M. Ulam in 1940, concerning approximate group homomorphisms. The first partial answer to this question was published in 1941 by D. H. Hyers. The further pursuit of solution to that problem, but also to its generalizations and modifications for various classes of (difference, functional, differential, and integral) equations and inequalities, is a quickly growing area of research and it is the subject of many papers as well as talks presented at various conferences. On June 2–6, 2014, the Department of Mathematics of the Pedagogical University of Cracow organized the Conference on Ulam's Type Stability, the first meeting dedicated in its entirety to this topic.

Some recent results concerning stability of the translation equation, dynamical systems, and their envelopes show that those approximate and iterative approaches can be combined together. This has motivated us to pay a special attention to the mutual relations between the iterative methods and the approximate approaches, especially in applications to real-world problems. Apart from the issues connected to Ulam's type stability, the topics of this volume have included among others iterative procedures in operator theory, bifurcation theory for perturbed discrete dynamical systems, topological and symbolic dynamics, and numerical stability analysis of iterative methods.

This volume includes several research articles and a survey. They have been written by numerous authors from various countries. Most of the papers deal with linear and nonlinear functional equations and ordinary and partial differential equations as well as equations with fractional derivatives. The survey paper presents stability results for the linear functional equation in single variable.

Some papers concern the behavior of networks. One of them describes an immunization strategy to prevent virus infecting of nodes of a network by using immunization agents randomly placed on a few individuals of network and spread out from these individuals on the whole network in a propagation method. A second one gives a stochastic method for soil carbon and water content monitoring networks.

This volume also contains papers which deal with a discrete zero-one knapsack problem in which items have profits and weights and the problem is to select the subset whose total weight does not exceed a fixed constant and whose total profit is maximal, with a leader-following group consensus problem for multiagent systems in a sampled-data setting and with a dynamic Cournot duopoly game model with team players in exploitation of a renewable resource. Moreover, one of the papers gives a construction of a fractal interpolation function for analyzing given experimental data.

Several other papers of this volume provide examples of simulations to demonstrate that the proposed solutions are efficient, effective, and robust for solving the considered problems.

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