



PERSONAGE IN SCIENCE

Academician A.M. Samoilenko

On His 75th Birthday

A.A. Boichuk¹, A.G. Mazko¹, A.A. Martynyuk^{2*} and M.O. Perestyuk³

¹ *Institute of Mathematics National Academy of Science of Ukraine,
Tereschenkiwska Str. 3, Kyiv, 01601, Ukraine*

² *Institute of Mechanics National Academy of Science of Ukraine,
Nesterov Str. 3, Kyiv, 03057, Ukraine*

³ *Taras Shevchenko National University of Kyiv, 01601, 64 Volodymyrska Str., Kyiv, Ukraine*

Received: January 8, 2013; Revised: April 8, 2013

The paper contains biographical data and a survey of scientific achievements of Anatoly Mykhailovych Samoilenko, a prominent expert in the field of differential equations.

1 Brief Biography of A.M. Samoilenko

Anatoly Mykhailovych Samoilenko was born on January 2, 1938 in the village of Potivka (Zhytomyr Region, Ukraine) to the family of Mykhailo Grygorovych and Mariya Vasylivna Samoilenko. Somewhat later, his family moved to the city of Malyn (Zhytomyr Region).

In 1955, he finished school and entered the Geological Faculty of the Shevchenko Kyiv State University. Quite soon he understood that mathematics is his vocation and continued his education at the Faculty of Mechanics and Mathematics of the same university and graduated from this faculty with honors in 1960.

By the invitation of Academician Yu.O. Mitropolsky, Anatoly Samoilenko entered a the post-graduate course at the Institute of Mathematics of the Ukrainian Academy of Sciences, where he became a member of the Krylov–Bogolyubov Kyiv Scientific School. In 1961, he published his first scientific works. In 1963, he defended his Candidate–Degree Thesis “Application of Asymptotic Methods to the Investigation of Nonlinear Differential Equations with Irregular Right-Hand Sides.”

In 1965, A.M. Samoilenko started his pedagogic career at the Chair of Differential Equations of the Shevchenko Kyiv State University.

* Corresponding author: <mailto:center@inmech.kiev.ua>

For a fairly short period of four years, he prepared and defended (in 1967) his Doctoral-Degree Thesis “Some Problems of Periodic and Quasiperiodic Systems.”

In 1963–1974, A.M. Samoilenko worked at the Kyiv Institute of Mathematics. In 1974, he received the academic title of professor and headed the Chair of Integral and Differential Equations at the Kyiv University, where he was a teacher of a great number of future scientists. Many of his former students are now well known throughout the world. Together with his colleagues from the Chair of Integral and Differential Equations, he prepared a series of textbooks on the theory of differential equations. Several editions of these textbooks were published, and they still remain popular in Ukraine and in the countries of the former USSR.

In 1978, Prof. Samoilenko was elected to become a Corresponding Member of the Academy of Sciences of the Ukrainian SSR.

In 1987, he returned to the Institute of Mathematics, where he headed the Department of Ordinary Differential Equations.

In 1988, he was elected by the staff of the Institute to become the Director of the Institute, and he occupies this position up to now.

In 1995, Prof. Samoilenko was elected to become a Full Member of the Ukrainian National Academy of Sciences.

In 1997, he became the Editor-in-Chief of the “Nonlinear Oscillations” journal founded on his initiative.

In 1998–2011, he also headed the Chair of Differential Equations at the “Kyiv Polytechnic Institute” National Technical University of Ukraine. Under his guidance, researchers of the Institute of Mathematics started to teach students at this chair, and its scientific life was significantly intensified.

Since 2006, he works as the Academician-Secretary of the Department of Mathematics of the Ukrainian National Academy of Sciences.

Academician Samoilenko is the author of more than 600 scientific works, including 30 monographs and 15 textbooks. Most of his works are translated into English and other languages. He is a member of the editorial boards of several Ukrainian and foreign journals. As an excellent teacher, he gives much attention to training highly qualified scientific personnel. Among his disciples, there are 33 Doctors and Candidates of Science in Physics and Mathematics. They successfully work in numerous mathematical centers throughout the world. He is also deeply involved in the social life. His activities are aimed at the support of young Ukrainian mathematicians and talented children.

Tremendous scientific achievements of A.M. Samoilenko are explained by his great mathematical talent and persistence and efficiency in his work.

A significant role in his life is played by his strong family. His wife, Lypa Hryhorivna, also a scientific researcher, worked for many years at the Institute of Cybernetics of the Ukrainian National Academy of Sciences. His son is a talented geneticist, and the father of two children.

We wish Academician Samoilenko good health, family happiness, creative inspiration, and subsequent successes in his scientific work.

2 Main Scientific Interests

2.1 Theory of invariant manifolds of differential systems

The notion of the Green function of the problem of invariant torus for the linear extension of a dynamical system on the torus introduced by A.M. Samoilenko at the Fifth

International Conference on Nonlinear Oscillations in Kyiv and investigated in detail in his work [6] appeared to be extremely fruitful and gave a new impetus to the development of various aspects of the theory of perturbations and stability of toroidal manifolds. In the mathematical literature, this notion is known as the “Green–Samoilenko function.” This name was introduced by a Moldavian mathematician I.U. Bronshtein. A survey of the main subsequent results in the field of toroidal manifolds of autonomous differential systems can be found in the monograph [XI].

The works of A.M. Samoilenko in the theory of multifrequency oscillations made an important contribution to this theory and opened new directions in their investigation and development. In the works written with V.L. Kulyk, the authors developed the theory of alternating Lyapunov functions for the investigation of the solutions of linear autonomous differential systems bounded on the entire axis and linear extensions of dynamical systems on the torus. The results obtained in this field were generalized, together with Yu.V. Teplinskii, to the case of countable systems and, together with O.M. Stanzhitskii, to the case of stochastic differential equations.

2.2 Asymptotic methods of nonlinear mechanics

Continuing the investigations of M.M. Krylov, M.M. Bogolyubov, A.M. Kolmogorov, V.I. Arnold, J. Moser, and Yu.O. Mitropolsky, A.M. Samoilenko proposed a modification of the asymptotic method of successive changes of variables, which was called the “method of accelerated convergence” in 1969 in the monograph [I]. In [9], together with Yu.O. Mitropolsky, he generalized the asymptotic averaging method and established sufficient conditions for the “averaging” operator under which the asymptotic solutions are separated into naturally varying and slowly varying components. The theory has been further developed, in particular, in his joint works with R.I. Petryshyn.

2.3 Nonlinear boundary-value problems

In 1965–1966, the papers [2, 3] were published, in which an original method was proposed for the determination of periodic solutions of ordinary differential systems. In subsequent publications, the Soviet mathematicians called it “the Samoilenko numerical-analytic method.” Later, in joint works with M.I. Ronto, V.I. Trofimchuk, and their disciples, this method was generalized to a broad class of boundary-value problems.

On the basis of the theory of generalized inverse operators, A.M. Samoilenko, together with O.A. Boichuk, developed the theory of Fredholm boundary-value problems for differential equations, delay equations, impulsive equations, and singularly perturbed systems. The obtained results are presented in the monograph [XXIX]. This theory was later developed for the determination of solutions, bounded on the entire real axis, for systems of differential and difference equations under the condition of dichotomy on semiaxes for the corresponding homogeneous system.

2.4 Theory of impulsive differential systems

Apparently, the best-known series of works of A.M. Samoilenko is devoted to the theory of impulsive differential equations. This field of investigations is traditionally associated with the Kiev Mathematical School. As early as 1937, M.M. Krylov and M.M. Bogolyubov showed that asymptotic methods of nonlinear mechanics can be efficiently applied to impulsive equations. However, the systematic study of these prob-

lems is associated with the name of A.M. Samoilenko. The first scientific paper of A.M. Samoilenko, published in 1961, was devoted to these problems. In 1967, in the joint work [4], A.D. Myshkis and A.M. Samoilenko formulated general theorems on the existence of solutions and their extendability and also on the uniqueness of a solution of the Cauchy problem for impulsive systems. In 1987, the monograph of A.M. Samoilenko and M.O. Perestyuk (complemented and translated into English in 1995 [XVI]) became the first monograph in the world literature in which fundamental results of the theory of impulsive systems were presented.

2.5 Integrability of dynamical systems on symplectic manifolds

A.M. Samoilenko and Ya.A. Prykarpatsky proposed and described new analytic and topological-geometric approaches to the problem of imbedding of integral manifolds for completely integrable dynamical systems and their perturbations. The main results are presented in the monograph [XXV].

2.6 Linear theory of ordinary differential equations

In 2011, the paper [21] was published, in which A.M. Samoilenko considered problems of the linear theory of systems of ordinary differential equations related to the investigation of invariant hyperplanes of these systems, the notion of equivalence for these systems, and the Floquet–Lyapunov theory for periodic systems of linear equations. In particular, a new Floquet-type formula was proposed for periodic systems.

2.7 Theory of functions

In 1968, the paper [5] was published, in which A.M. Samoilenko solved a problem posed by V.I. Arnold, namely, he gave a purely analytic proof of the equivalence of a smooth function and its Taylor polynomial in a neighborhood of a critical point of finite type. This investigation was continued in the paper [20] published in 2007. The local behavior of smooth functions in the neighborhoods of their regular and critical points was investigated, and theorems on the average values of the considered functions of the type of the Lagrange theorem on finite increments were proved. The symmetry of the derivative of an analytic function in a neighborhood of its multiple zero was also studied, and new statements of the Weierstrass preparation theorem related to the critical point of a function of finite smoothness were proved. The nongradient vector field in the neighborhood of the critical point was determined, and one critical case of stability of the equilibrium position of a nonlinear system was considered.

3 Participation in Scientific Institutions and Editorial Boards

A.M. Samoilenko is a full member of the National Academy of Sciences of Ukraine and the European Academy of Sciences, a foreign member of the Academy of Sciences of the Republic of Tajikistan, and a member of the Ukrainian Mathematical Society and the American Mathematical Society. He is the editor-in-chief of the journals “Ukrains’kyi Matematychnyi Zhurnal,” “Nelineini Kolyvannya,” and “Ukrains’kyi Matematychnyi Visnyk” and a member of the editorial boards of the journals “Dopovidi Natsional’noi Akademii Nauk Ukrainy,” “U Sviti Matematyky,” “Nonlinear Mathematical Physics,” “Memoirs on Differential Equations and Mathematical Physics,” etc.

4 Awards

A.M. Samoilenko was awarded the Order of Friendship of Peoples (1984), the third class Order of Merit (2003), the fifth class Order of Prince Yaroslav the Wise (2008), and a Certificate of Honor of the Presidium of the Supreme Soviet of Ukraine (1987). He was also awarded the State Prize of Ukraine in the Field of Science and Engineering (1985, 1996), the State Prize of Ukraine in the Field of Education (2012), M. Ostrovsky Prize (1968), M. Krylov Prize (1981), M. Bogolyubov Prize (1998), M. Lavrent'ev Prize (2000), M. Ostrogradsky Prize (2004), Yu. Mitropolsky Prize (2010), and the titles of a “Soros Professor” (1998) and an Honored Scientist of Ukraine (1998).

5 List of Monographs of A.M. Samoilenko

- [I] Bogolyubov, N.N., Mitropolsky, Yu.A. and Samoilenko, A.M. *Method of accelerated convergence in nonlinear mechanics*. Kiev: Naukova Dumka, 1969. [Russian]
- [II] Samoilenko, A.M. and Ronto, N.I. *Numerical-analytic methods for investigation of periodic solutions*. Kiev: Vyshcha shkola, 1976. [Russian]
- [III] Bogoliubov, N.N., Mitropolsky, Yu.A. and Samoilenko, A.M. *Methods of accelerated convergence in nonlinear mechanics*. Springer, Berlin – New York, 1976.
- [IV] Samoilenko, A.M. and Ronto, N.I. *Numerical-analytic methods of investigating periodic solutions*. Moscow: Mir, 1979.
- [V] Mitropolsky, Yu.A., Samoilenko, A.M. and Martynyuk, D.I. *Systems of evolution equations with periodic and quasiperiodic coefficients*. Kiev: Naukova Dumka, 1984. [Russian]
- [VI] Samoilenko, A.M. and Ronto, N.I. *Numerical-analytic methods for investigation of boundary-value problems*. Kiev: Naukova Dumka, 1985. [Russian]
- [VII] Samoilenko, A.M. and Perestyuk, N.A. *Impulsive Differential equations*. Kiev: Vyshcha shkola, 1987. [Russian]
- [VIII] Mitropolsky, Yu.A. and Samoilenko, A.M. *Mathematical problems of nonlinear mechanics*. Kiev: Vyshcha shkola, 1987. [Russian]
- [IX] Samoilenko, A.M. *Elements of the mathematical theory of multifrequency oscillations. Invariant tori*. Moscow: Nauka, 1987. [Russian]
- [X] Mitropolsky, Yu.A., Samoilenko, A.M. and Kulik, V.L. *Studies in the dichotomy of linear systems of differential equations by means of Lyapunov functions*. Kiev: Naukova Dumka, 1990. [Russian]
- [XI] Samoilenko, A.M. *Elements of the mathematical theory of multi-frequency oscillations*. (Mathematics and Its Applications, V. 71). Kluwer, Dordrecht, Netherlands, 1991.
- [XII] Samoilenko, A.M. and Tkach, B.P. *Numerical-analytic methods in the theory of periodic solutions of partial differential equations*. Kiev: Naukova Dumka, 1992. [Russian]
- [XIII] Samoilenko, A.M. and Ronto, N.I. *Numerical-analytic methods in the theory of boundary-value problems for ordinary differential equations*. Kiev: Naukova Dumka, 1992. [Russian]
- [XIV] Samoilenko, A.M. and Teplinskii, Yu.V. *Countable systems of differential equations*. Kiev: Institute of Mathematics of NAS of Ukraine, 1993. [Russian]
- [XV] Mitropolsky, Yu.A., Samoilenko, A.M. and Martynyuk, D.I. *Systems of evolution equations with periodic and quasiperiodic coefficients*. (Mathematics and Its Applications, V. 87). Kluwer, Dordrecht – Boston – London, Netherlands, 1993.
- [XVI] Samoilenko, A.M. and Perestyuk, N.A. *Impulsive Differential Equations*. (World Scientific Series on Nonlinear Science, Ser. A, Vol. 14.) Singapore, World Scientific, 1995.
- [XVII] Boichuk, A.A., Zhuravlev, V.F. and Samoilenko, A.M. *Generalized inverse operators and Noether boundary-value problems*. Proceeding of Institute of Mathematics of NAS of Ukraine, Vol. 13. Kiev, 1995. [Russian]

- [XVIII] Samoilenko, A.M. and Petryshyn, R.I. *Multifrequency oscillations of nonlinear systems*. Proceeding of Institute of Mathematics of NAS of Ukraine. Mathematics and Its Applications, Vol. 21. Kiev, 1998. [Ukrainian]
- [XIX] Samoilenko, A.M., Laptinsky, V.N. and Kenzhebaev, K. *Constructive methods in the investigation of periodic and multipoint boundary-value problems*. Proceeding of Institute of Mathematics of NAS of Ukraine. Mathematics and Its Applications, Vol. 29. Kyiv, 1999. [Russian]
- [XX] Ronto, M. and Samoilenko, A.M. *Numerical-Analytic Methods in the Theory of Boundary-Value Problems*. Singapore, World Scientific, 2000.
- [XXI] Samoilenko, A.M., Shkil, M.I. and Yakovets, V.P. *Linear systems of differential equations with degeneracies*. Kyiv: Vyshcha shkola, 2000. [Ukrainian]
- [XXII] Samoilenko, A.M., Borysenko, S.D., Matarazzo, G., Toscano, R. and Yasinsky, V.V. *Differential models. Stability*. Kyiv: Vyshcha shkola, 2000. [Ukrainian]
- [XXIII] Samoilenko, A., Borysenko, S., Cattani, C., Matarazzo, G. and Yasinsky, V. *Differential Models: Stability, Inequalities and Estimates*. Kyiv: Naukova Dumka, 2001.
- [XXIV] Samoilenko, A., Borysenko, S., Cattani, C. and Yasinsky, V. *Differential Models: Representations and Applications*. Kyiv: Naukova Dumka, 2001.
- [XXV] Samoilenko, A.M. and Prykarpatsky, Ya.A. *Algebro-analytic aspects of completely integrable dynamical systems and their perturbations*. Kyiv: Institute of Mathematics of NAS of Ukraine, 2002. [Ukrainian]
- [XXVI] Mitropolskii, Yu.A., Samoilenko, A.M. and Kulik, V.L. *Dichotomies and Stability in Nonautonomous Linear Systems*. Taylor & Francis, London – New York, 2003.
- [XXVII] Samoilenko, A.M. and Teplinskii, Yu.V. *Countable systems of differential equations*. VSP, Brill, Utrecht – Boston, Netherlands, 2003.
- [XXVIII] Samoilenko, A. and Petryshyn, R. *Multifrequency Oscillations of Nonlinear Systems*. Kluwer, Dordrecht – Boston – London, Netherlands, 2004.
- [XXIX] Boichuk, A.A. and Samoilenko, A.M. *Generalized inverse operators and Fredholm boundary-value problems*. Translated from the Russian. Utrecht, Boston: VSP. The Netherlands, 2004.
- [XXX] Samoilenko, A.M. and Petryshyn, R.I. *Mathematical aspects of the theory of nonlinear oscillations*. Kyiv: Naukova Dumka, 2004. [Ukrainian]
- [XXXI] Perestyuk, N.A., Plotnikov, V.A., Samoilenko, A.M. and Skripnik, N.V. *Impulsive differential equations with multivalued and discontinuous right-hand sides*. Proceeding of Institute of Mathematics of NAS of Ukraine. Mathematics and Its Applications, Vol. 67. Kyiv, 2007. [Russian]
- [XXXII] Samoilenko, A.M. and Teplinskii, Yu.V. *Elements of the mathematical theory of evolution equations in Banach spaces*. Proceeding of Institute of Mathematics of NAS of Ukraine. Mathematics and Its Applications, Vol. 72. Kyiv, 2008. [Ukrainian]
- [XXXIII] Samoilenko, A.M. and Stanzhitsky, O.M. *Qualitative and asymptotic analysis of differential equations with random perturbations*. Kyiv: Naukova Dumka, 2009. [Ukrainian]
- [XXXIV] Samoilenko, A.M. and Stanzhitsky, O. *Qualitative and asymptotic analysis of differential equations with random perturbations*. World Scientific Series on Nonlinear Science. Series A: Monographs and Treatises, Vol. 78. World Scientific, Hackensack, NJ, 2011.
- [XXXV] Perestyuk, N.A., Plotnikov, V.A., Samoilenko, A.M. and Skripnik, N.V. *Differential equations with impulse effects. Multivalued right-hand sides with discontinuities*. de Gruyter Studies in Mathematics, Vol. 40. de Gruyter, Berlin, 2011.

6 List of Selected Papers of A.M. Samoilenko *

- [1] Samoilenko, A.M. Application of the averaging method to the investigation of oscillations induced by instantaneous impulses in self-oscillating systems of the second order with a small parameter. *Ukr. Math. Zh.* **13**(3) (1961) 103–109. [Russian]
- [2] Samoilenko, A.M. A numerical-analytic method for investigation of periodic systems of ordinary differential equations. I. *Ukr. Math. Zh.* **17**(4) (1965) 82–93. [Russian]
- [3] Samoilenko, A.M. A numerical-analytic method for investigation of periodic systems of ordinary differential equations. II. *Ukr. Math. Zh.* **18**(2) (1966) 50–59. [Russian]
- [4] Myshkis, A.D. and Samoilenko, A.M. Systems with shocks at prescribed instants of time. *Mat. Sb. (N.S.)* **74(116)**(2) (1967) 202–208. [Russian]
- [5] Samoilenko, A.M. On the equivalence of a smooth function and a Taylor polynomial in the neighborhood of a critical point of finite type. *Functional Analysis and Its Applications* **2**(4) (1968) 318–323.
- [6] Samoilenko, A.M. Preservation of an invariant torus under perturbation. *Mathematics of the USSR – Izvestiya* **4**(6) (1970) 1225–1249.
- [7] Samoilenko, A.M. Investigation of dynamical systems by means of functions of constant sign. *Ukr. Math. Zh.* **24** (1972) 374–384. [Russian]
- [8] Samoilenko, A.M. The exponential stability of an invariant torus of a dynamical system. *Differ. Uravn.* **11**(5) (1975) 820–834. [Russian]
- [9] Mitropolsky, Yu.A. and Samoilenko, A.M. On the question of asymptotic expansions in nonlinear mechanics. *Ukr. Math. Zh.* **31**(1) (1979) 42–53. [Russian]
- [10] Samoilenko, A.M. On the question of the justification of the averaging method for multi-frequency oscillating systems. *Differ. Uravn.* **23**(2) (1987) 267–278. [Russian]
- [11] Samoilenko, A.M. Reducibility of a system of linear differential equations with quasiperiodic coefficients. *Ukr. Math. J.* **41**(12) (1989) 1438–1449.
- [12] Samoilenko, A.M. Dynamical systems in $\mathcal{T}_m \times E^n$. *Ukr. Math. J.* **43**(10) (1991) 1195–1208.
- [13] Samoilenko, A.M. Investigation of a discrete dynamical system in a neighborhood of a quasiperiodic trajectory. *Ukr. Math. J.* **44**(12) (1992) 1560–1568.
- [14] Samoilenko, A.M. N.N. Bogolyubov and nonlinear mechanics. *Russian Math. Surveys* **49**(5) (1994) 109–154.
- [15] Samoilenko, A.M. Some problems in the theory of perturbations of smooth invariant tori of dynamical systems. *Ukr. Math. J.* **46**(12) (1994) 1848–1889.
- [16] Samoilenko, A.M. Perturbation theory of smooth invariant tori of dynamical systems. Proceedings of the Second World Congress of Nonlinear Analysts, Part 5 (Athens, 1996), *Nonlinear Anal.* **30**(5) (1997) 3121–3133.
- [17] Samoilenko, A.M. On the Exponential Dichotomy on \mathbb{R} of linear differential equations in \mathbb{R}^n . *Ukr. Math. J.* **53**(3) (2001) 407–426.
- [18] Samoilenko, A.M. On the asymptotic integration of a system of linear differential equations with a small parameter in the coefficients of a part of derivatives. *Ukr. Math. J.* **54**(11) (2002) 1825–1841.
- [19] Samoilenko, A.M. On one problem of the investigation of global solutions of linear differential equations with deviating argument. *Ukr. Math. J.* **55**(5) (2003) 761–772.
- [20] Samoilenko, A.M. Some results on the local theory of smooth functions. *Ukr. Math. J.* **59**(2) (2007) 243–292.
- [21] Samoilenko, A.M. Some problems of the linear theory of systems of ordinary differential equations. *Ukr. Math. J.* **63**(2) (2011) 278–314.

* For a more complete bibliography, see *Differential Equations* **34** (1998), no. 1, **44** (2008), no. 2, **49** (2013), no. 2.