

Директору Математичког института САНУ
Проф. др Зорану Огњановићу
Научном већу Математичког института САНУ
академику Драгошу Цветковићу

Стручни извештај о учешћу у научном скупу



The 5-th international conference on nonlinear dynamics in Kharkov, September 27-30, 2016

Nonlinear Dynamics Kharkov 2016, September 27- 30, 2016

У раду ове међународне конференције учествовала сам као члан Научног комитета и као пленарни предавач, а и као члан председништва на свечаном отварању ове традиционалне конференције са једном уводном беседом.

Пленарно предавање које сам одржао је публикувано у штампаној књизи и у електронском облику на ЊЕБ сајту Конференције, и са следећим је библиографским подацима:

Katica (Stevanović) Hedrih, (2016), From geometry, kinematics and dynamics of billiards to the extended theory of skew collision between two rolling bodies and methodology of vibro-impact dynamics (Review paper), Plenary Lecture, **The 5-th international conference on “Nonlinear Dynamics” in Kharkov, September 27-30, 2016, Dedicated to the 90th Anniversary of Academician V.L. Rvachov**, National Technical University “Kharkov Polytechnic” et al., N49-Proceedings 538p, pp. 108-116. ISBN 978-966-97613-0-9.

<http://nd.khpi.edu.ua/NDKhPI2016/schedConf/presentations>

После одржаног предавања постављена су ми четири питања, учесника из УК, Русије, Украјине и Италије, на која сам са задовољством одговорила. И после предавања у паузама био је већи број младих заинтересованих за научне комуникације са мном, као и за разговоре, као и за успостављање сарадње. Ту посебно истичем младог професора Фотиаса Георгиадиса са Линколн Универзитета у УК, докторанта познатог професора Вакакиса (УСА), који ми је у тку Конференције послао свој докторат и једну књигу у ПДФ фајлу из Дунамике удара аутора Спонсеа. Он је изразио жељу да успоставимо научну сарадњу у области теорије судара и нелинеарне динамике, и на ту тему смо после Конференције разменили неколико е-маилова. Прихватила сам и да напишем одзив на докторат А. Ларина са Харковске политехнике.

Имајући у виду да сам учествовала у дискусијама по већем броју саопштења, као и давала коментаре и научне информације и инструкције, један број учесника старије и млађе генерације, изразио је дивљење ширини мојих знања, која сам уложила у научни рад конференције. Коментар је био,

и нивоа оцена, да су на конференцијама које су специјализоване веома ретко сретали научнике тако широких знања и јаућних видика. Наравно, то је најлепше, што један учесник међународне Конференције, може да доживи од својих саврееника, а посебно оних најстаријих. Лепота научних емоција, и сећање на изузетну пажњу коју сам овде доживела и од сасвим младих истраживача, као и оних који су у поодмаклим годинама представља за мене изузетну енергију коју сам са ове конференције донела у Србију, где је тешко добити и најмању похвалу од својих колега и признање за достигнуте стваралачке и научне резултате!

Учесницима Конференције, као сувенир, подељена је једна књижица о историји ове Конференције, а која садржи и кратке приказе о знаменитим Харковским механичарима, као што су то: Кирпичов, Бабаков, Љапунов, Филипов, Рвачов и други. Свакако међу њима је најзнаменитији Александар Михаилович Љапунов, који је формулисао Теореме о стабилности, и тиме утемељио Теорију стабилности, која данас доживљава широку примену у разним областима наука. Такође, треба рећи да је на Харковској политехници раио Лав Ландау, физичар и добитник Нобелове награде.

Како сам учесник у свим конференцијама ове серије, са пленарним и секцијским уводним предавањима, као и члан научних комитета и неколико мојих слика се нашло у овој публикацији, па се осећам почаствована да сам уписана у историју ове импозантне Харковске политехнике, и међу великанима Теоријске и примењене механике, који су радили и градили своје научне доприносе у Хаковску политехнику..

Организација Конференције је била добра, предавања и саопштења на високом научном нивоу. На овој конференцији је било већи број младих учесника него ранијих година, што посебно радује. Међу организаторима су професори Лидиа Курпа, Јури Миклин, А. Ларин и А. Оситрон, Тања Шматко, поред једне веће групе млађих истраживача и доктораната.

На крају, да напоменем и да је један број предавања и саопштења би одржан путем скајпа и интернет веза са комуникацијама у дискусијама.

НАПОМЕНА: Током писанја овог извештаја добила сам следећо позив:

" **From:** [Journal of Mathematics and System Science](#)

Sent: Friday, October 21, 2016 4:02 AM

To: [khedrih](#)

Subject: Greetings and call for paper from Journal of Mathematics and System Science (ISSN 2159-5291, USA)

From Knowledge to Wisdom

Journal of Mathematics and System Science, USA

ISSN 2159-5291 (Print); ISSN 2159-5305 (Online)

Dear Katica R. Hedrih,

This is **Journal of Mathematics and System Science** (ISSN 2159-5291, USA).

We have learned your paper "**From Geometry, Kinematics and Dynamics of Billiards to the Extended Theory of Skew Collision between Two Rolling Bodies and Methodology of Vibro-Impact Dynamics**" at the **ND-KHPI2016, September 27-30, 2016, Ukraine.**

We are very interested in publishing some papers from you. If you have any unpublished papers, you can send them to us at any time."

То само по себи говори о одзиву и оцени мојих научних резултата у широј и међународној научној јавности, а приказаних на Конференцији **Nonlinear Dynamics Kharkov 2016, September 27- 30, 2016**, само десетак дана пре овог позива , а који су резултат истраживања по теми Пројекта ОН174001, који се реализује у Математичком институту САНУ. Самим тим, ти резултати представљају и промоцију Математичког института САНУ и Одељења за механику, као интитуције које стоје као подршка аутору наведених резултата, и који су у њој остварени.

Овом приликом, изражавам захвалност Математичком институту САНУ, који ми је по члану 24 АКТ-а Министарства дао сагласност, као и и Министарству просвете, науке и технолошког развоја Републике Србије, за добијену сагласност и могућност да наставим истраживања и руковођење пројектом ОН174001 "Динамика хибридних система сложених структура" уз официјелну подршку, која је сваком истраживачу изузено значајна.

С поштовањем,

У Београду, 12 октобра 2016.



Katica R. (Stevanović) Nedrih
Руководилац пројекта ОМ174001

Напомена2. Трошкове авио карата и учешћа у конференцији сам финансирала од пензије, а организатори су ме ослободили котизације, као предавача са пленарним предавањем!



5th INTERNATIONAL CONFERENCE NONLINEAR DYNAMICS - 2016

dedicated to the 90th anniversary of Academician Rvachev V.L.
27-30 September, 2016, Kharkov, Ukraine

<http://web.kpi.kharkov.ua/nd-khpi/>

The objective of the Conference is to bring together scientists and engineers to present and discuss recent developments on the different problems of nonlinear dynamics.

MAIN TOPICS OF THE CONFERENCE:

- Analytical and Numerical Methods in Nonlinear Dynamics;
- Resonances, Stability Analysis and Bifurcations in Nonlinear Systems;
- Nonlinear Normal Modes;
- Transient, Localization of Energy;
- Chaotic Dynamics;
- Nonlinear Dynamics of Continuous Systems, in particular, Plates and Shells;
- Vibro-Impact Systems and other Non-Smooth Systems;
- Problems of Control in Nonlinear Systems;
- Nonlinear Dynamics of Structures and Machines and other problems of Engineering Applications.

MINI-SYMPOSIUM «The R-FUNCTIONS THEORY, it's DEVELOPMENT and RECENT APPLICATIONS» will take place in the framework of the conference.

ORGANIZERS:



National Technical
University "KhPI"
(Kharkov, UKRAINE)



McGill University
(Montreal, CANADA)



Institute of Mechanics
NAS of Ukraine
(Kyiv, UKRAINE)



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Institute for Mechanical
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Prof. Shevchenko A. (Detroit, USA)
Prof. Kushnir R.M. (Lviv, Ukraine)
Prof. Stoyan Yu.G. (Kharkov, Ukraine)
Dr. Tsukanov I. (Miami, USA)

KEYNOTE LECTURES:

- MARCO AMABILI (Montreal, Canada)
 - JOSE M. BALTHAZAR (Sao Jose dos Campos, Brasil)
- LEONID I. MANEVITCH (Moscow, Russia)
 - CHRISTOPHE PIERRE (Urbana – Champaign, USA)
- GIUSEPPE REGA (Roma, Italy)
 - ALEXANDER VAKAKIS (Urbana – Champaign, USA)

ABSTRACTS and PROCEEDINGS Participants are invited to fill a Pre-Registration Form on the conference web-site and submit a single page plane text Abstract. Authors of accepted presentations will be invited to send their PAPERS (extended abstract).

IMPORTANT DATES

March 14, 2016	Pre-Registration and Submission of the single page Abstracts deadline
March 28, 2016	Author Notification on Abstract Acceptance
March 28, 2016	The Registration procedure opening
June 5, 2016	Submission of the EXTENDED ABSTRACTS deadline
June 26, 2016	Author notification on the papers (extended abstracts) acceptance
September 2, 2016	The registration fee transfer deadline
September 27- 30, 2016	Conference sessions

Conference organizers consider as their pleasant duty to notice the approaching of 100th anniversary of the outstanding Ukrainian mathematician, Academician Yu. A. Mitropolsky, who contributed immensely to asymptotic methods of nonlinear dynamics.

Updated and extended information can be found on the site: <http://web.kpi.kharkov.ua/nd-khpi/>
You can also contact us via e-mail: ndkhpi2016@gmail.com

NONLINEAR DYNAMICS 2016

THE 5th INTERNATIONAL
CONFERENCE ON
NONLINEAR DYNAMICS
“ND-KHPI2016”
September, 27-30, 2016

National Technical University
"Kharkov Polytechnic Institute"
Frunze str. 21, Kharkov, 61002, UKRAINE
Phone: +(38)-057-7076032
E-mail: NDKhPI2016@gmail.com
web-site: <http://nd.khpi.edu.ua/NDKhPI2016/index>

CERTIFICATE OF ATTENDANCE

Prof. **Katica R. Hedrih (Stevanović)** took part in the 5th International Conference “Nonlinear Dynamics” (ND-KhPI2016) that was organized by the *National Technical University “KhPI”* and was held in Kharkiv, Ukraine, 27-30 September 2016. He took part at the work of Scientific Committee of conference and made the plenary lecture:

“FROM GEOMETRY, KINEMATICS AND DYNAMICS OF BILLIARDS TO THE EXTENDED THEORY OF SKEW COLLISION BETWEEN TWO ROLLING BODIES AND METHODOLOGY OF VIBRO-IMPACT DYNAMICS”

Secretary of the Organizing Committee
of the conference on Nonlinear Dynamics (ND-KhPI2016)



Dr. O.O. Larin

Vice-Rector
of NTU “KhPI”



Prof. R.P. Migushenko





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МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ ТЕХНІЧНИЙ УНІВЕРСИТЕТ
«ХАРКІВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ»

Україна, 61002, м. Харків, вул. Фрунзе, 21, тел.: +38(057) 707-66-00, факс: +38(057) 707-66-01
E-mail: omsroot@kpi.kharkov.ua

№ _____
На № _____ від _____

Dr. **Katica R. Hedrih (Stevanovic)**
Mathematical Institute SANU Belgrade,
Kneza Mihaila 36,
Belgrade, 11001, Serbia

Faculty of Mechanical Engineering,
University of Niš, Serbia

INVITATION LETTER

Dear Dr. **Katica R. Hedrih (Stevanovic)**

We are glad that you plan to attend and participate in the **5th International Conference on Nonlinear Dynamics (ND-KhPI 2016)**, which will be held September 27-30, 2016 in Kharkiv, Ukraine. We are looking forward to your presentation entitled

“FROM GEOMETRY, KINEMATICS AND DYNAMICS OF BILLIARDS TO THE EXTENDED THEORY OF SKEW COLLISION BETWEEN TWO ROLLING BODIES AND METHODOLOGY OF VIBRO-IMPACT DYNAMICS”.

The conference is organized by the National Technical University “KhPI” and will be held at the Kharkiv. The details of the meeting are available on the conference web site: <http://web.kpi.kharkov.ua/nd-khpi/>

We are pleased to **invite** you Dr. **Katica R. Hedrih (Stevanovic)** to visit National Technical University “Kharkiv Polytechnic Institute” for collaboration and participation at the Conference.

Thank you again for your interest and we are looking forward to see you in Kharkiv.

On a behalf of the Organizing Committee,

Vice-rector of the NTU “KhPI”,
Professor

Executor: Dr. Olexiy Larin
(Secretary of Organizing Committee of ND-KhPI2016 Conference)
Associate Professor
Dynamic and Strength of Machines Department
Ph.: +38 057 707 63 43;
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G. S. Khrypunov

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A. Podgorny Institute for Mechanical Engineering Problems NAS of Ukraine

National Committee of Ukraine on Theoretical and Applied Mechanics

The 5th International Conference
“Nonlinear Dynamics – 2016”

*Dedicated to the 90th Anniversary
of Academician V.L. Rvachev*



(ND-KhPI2016)

Conference Program

September, 27-30, 2016

Kharkiv
NTU KhPI

THURSDAY, SEPTEMBER, 29

Plenary lectures		Library Building
Chairs: V. Gristchak, K. Hedrih, A. Manevich		
10.00-10.25	<u>Katica R. Hedrih (Stevanović)</u> <i>(Belgrade, Niš, Serbia)</i> FROM GEOMETRY, KINEMATICS AND DYNAMICS OF BILLIARDS TO THE EXTENDED THEORY OF SKEW COLLISION BETWEEN TWO ROLLING BODIES AND METHODOLOGY OF VIBRO-IMPACT DYNAMICS.	
10.25-10.50	<u>Arkadiy Manevich</u> <i>(Dnipro, Ukraine)</i> NONLINEAR INTERACTION OF OSCILLATION AND ROTATION IN OSCILLATOR-VIBRATOR SYSTEMS.	

Coffee Break

Plenary lectures		Library Building
Chairs: V. Gristchak, K. Hedrih, A. Manevich		
11.10-11.35	<u>Julian Stephen Gosliga, Olga Ganilova</u> <i>(Sheffield, UK)</i> IMPROVEMENT OF PIEZOELECTRIC ENERGY HARVESTER EFFICIENCY THROUGH OPTIMAL PATCH CONFIGURATION.	
11.35- 12.00	<u>Victor Belan, Alexander Kovalev, Anastasiya Peretyatko</u> <i>(Kharkiv, Ukraine)</i> BREATHING MODES INDUCED BY LOCALIZED RF RADIATION: ANALYTICAL AND NUMERICAL APPROACHES.	

Poster Session	Library Building
12.00-13.15	

Lunch (12:50-13:50)

Tour (Excursion) (14:30)

5th INTERNATIONAL CONFERENCE
NONLINEAR DYNAMICS — 2016

*Dedicated to the 90th Anniversary
of Academician V.L. Rvachev*

September 27–30, 2016



PROCEEDINGS

**National Technical University “Kharkov Polytechnic Institute”
(Kharkov, UKRAINE)**

**National Committee of Ukraine on Theoretical and Applied Mechanics
S. Timoshenko Institute of Mechanics NAS of Ukraine (Kiev, UKRAINE)**

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**A.Podgorny Institute for Mechanical Engineering Problems NAS of Ukraine
(Kharkov, UKRAINE)**

5th INTERNATIONAL CONFERENCE

“Nonlinear Dynamics – 2016”

*Dedicated to the 90th anniversary of
Academician V.L. Rvachev*



Proceedings

September 27-30, 2016

UDC: 531; 534; 621
N 49

N 49

Nonlinear Dynamics — 2016 : Proceedings of 5th International Conference (September 27-30, 2016) / National Technical University "Kharkov Polytechnic Institute" at al. — Kharkov, 2016. — 538 p.

ISBN 978-966-97613-0-9

The book of Proceedings includes extended abstracts of presentations on 5th International Conference on Nonlinear Dynamics dedicated to 90th anniversary of Academician V.L. Rvachev.

UDC: 531; 534; 621

ISBN 978-966-97613-0-9

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Scope of the conference

The objective of the Conference is to bring together scientists and engineers to present and discuss recent developments on the different problems of nonlinear dynamics.

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Prof. Andrianov I. V. (Keln, Germany)
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From Geometry, Kinematics and Dynamics of Billiards to the Extended Theory of Skew Collision between Two Rolling Bodies and Methodology of Vibro-Impact Dynamics

Katica R. (Stevanović) Hedrih^{1*}

Abstract

Starting from explanation of geometry, kinematics and dynamics of game billiards, and phenomena of impact a rolling ball into different types of curved surfaces and direct and skew central collision of two rolling, same dimension, balls we open question of collision of two rolling axially symmetrically bodies with different dimensions and different forms. Use elementary approach and Petrović's theory presented in two books "Elements of mathematical phenomenology" and "Phenomenological mappings", extended theory of direct and skew central collision of two rolling, axially symmetric, but different dimensions and forms, bodies is formulated with all additional and new analytical expressions, theorems, to define all pre- and post-collision kinetic states. Use these new results complete methodology of vibro-impact system dynamics is formulated and applied for investigation kinetic parameters and phenomena in vibro-impact systems with successive collisions between two or a finite number of rolling bodies. Energy jumps in collisions between rolling bodies in vibro-impact system dynamics are indicated and analytically described in a number of these systems.

Keywords

Billiards, theory of rolling body collision, vibro-impact dynamics

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Introduction

"In connection with the game of billiards there are various dynamic tasks, whose solutions contain in this event. I think that people who know Theoretical mechanics and even students of polytechnics, with interest familiarize themselves with explanations of the entire original phenomenon that can be observed from the time of movement billiard balls".

Gaspar-Gistav de Koriolis, Mathematical theory of billiards game

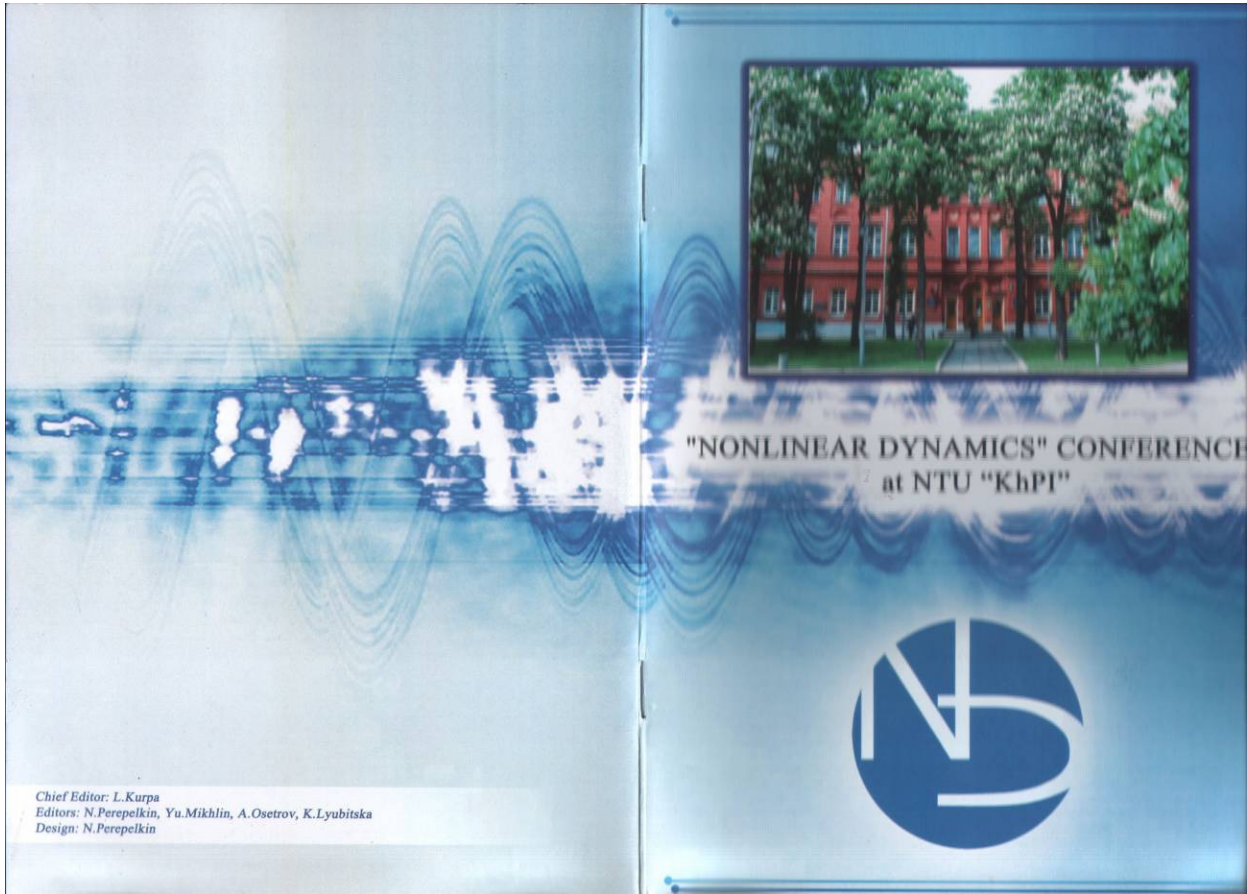
In the Reference [1] by *Gaspar-Gistav de Koriolis*, complexity and numerous various dynamic tasks, whose solutions contain in the game of billiards, are pointed out. Main are rolling of the rigid balls and impact of balls into vertical surface and central of skew collision between two or more rolling balls. Elements of geometry, kinematics and dynamics of billiards are presented in Reference [2]. In the Reference [3] dynamics of elliptic billiards and rolling ball impacts are presented. In Figure 1, a trajectory of billiards' rolling ball, along horizontal plane, bounded by boundary elliptic-cylindrical surface, with plan of the impact and outgoing angular velocities before and after impacts, are presented.

In Figure 2.a*, possible impact points at a rolling ball along horizontal trace to the boundary vertical cylindrical surface with plans of component and resultant impact translator velocities and angular velocity are presented. In same Figure 2, schematically presentation of kinematic state of the skew (b^* and c^*) impacts of a rolling ball to a boundary convex curvilinear vertical cylindrical surface with traces of ball rolling pre- and post- collision states are presented.

Let's expose, in short, the source of theory of impacts of rigid bodies. Beginning was with the competition and London Royal Society. Royal Scientific Society in London in 1668 announced a

References

- [1] Coriolis G. *Théorie mathématique des effets du jeu de billard; suivi des deux celebres memoires publiés en 1832 et 1835 dans le Journal de l'École Polytechnique: Sur le principe des forces vives dans les mouvements relatifs des machines & Sur les équations du mouvement relatif des systèmes de corps* (Or. publ. by Carilian-Goeury, 1835 ed.). Éditions Jacques Gabay; 1990.
- [2] Hedrih (Stevanovic) K.R. Elements of Geometry, Kinematics and Dynamics of Billiards. *MECHATRONICS AND CONTROL, COLLOQUIUM IN HONOUR OF THE 65TH BIRTHDAY OF PROF. NENAD D. PAVLOVIĆ AND PROF. TOMISLAV PETROVIĆ, THE 3rd INTERNATIONAL CONFERE MECHANICAL ENGINEERING IN XXI CENTURY, Proc.* September 17 - 18, 2015, NIŠ, University of Niš, p. 313-318.
- [3] Hedrih (Stevanovic) K.R. DYNAMICS OF THE ELLIPTIC BILLIARDS AND ROLLING BALL IMPACTS. *Proc. of the 5th International Congress of Serbian Society of Mechanics.* Arandjelovac, June 15-17, 2015: Published by Serbian Society of Mechanics and Faculty of Technical Sciences Novi Sad, p. 98.
- [4] Hedrih (Stevanovic) K.R. Rolling heavy disk along rotating circle with constant angular velocity. *Computer Algebra Systems, in Teaching and Research, Chapter 2. Problems of Classical Mechanics* (Eds. A.N. Prokopenya, M. Jakubiak), Siedlce University of Natural Sciences and Humanities, Siedlce, 2015, Vol.V, p. 293-304.
- [5] Hedrih (Stevanovic) K.R. Vibro-impact dynamics of the rolling disks along rotate circle in vertical plane. *Dynamical Systems, Control and Stability* (Eds. J. Awrejcewicz, M. Kazmierczak, J. Mrozowski, P. Olejnik), 2015, Vol. 13/3, p. 251-262.
- [6] Hedrih (Stevanovic) K.R. Dynamics of impacts and collisions of the rolling balls. *13th Conference on Dynamical Systems. Theory and Applications, DSTA, Abstracts*, (Eds. J. Awrejcewicz, M. Kazmierczak, P. Olejnik, J. Mrozowski), Łódź, December 7-10, 2015, Lodz University of Technology, 2015, p. 149.
- [7] Hedrih (Stevanovic) K.R. Elements of mathematical phenomenology: I. Mathematical and qualitative analogies, *Труды МАИ*, 2015, №84, p. 42 (1-42).
- [8] Hedrih (Stevanović) K.R. Elements of mathematical phenomenology: II. Phenomenological approximate mappings. *Труды МАИ*, 2015, №84, p. 29 (1- 29).
- [9] Hedrih (Stevanovic) K.R. ELEMENTS OF MATHEMATICAL PHENOMENOLOGY AND PHENOMENOLOGICAL MAPPINGS: UNIVERSAL METHOD ACROSS DIFFERENT AREA OF SCIENCES AND TRANSIENT OF KNOWLEDGE FLOWS. Kyiv, February, 20, 2016, XIII Academic Reading in memory of V.I. Striha, Academy of Science of Higher School of Ukraine, 2016.
- [10] Hedrih (Stevanovic) K.R. VIBRO-IMPACT DYNAMICS IN SYSTEMS WITH TRIGGER OF COUPED THREE SINGULAR POINTS: COLLISION OF TWO ROLLING BODIES (is accepted). IUTAM ICRAM, Montreal, 2016.
- [11] Elements of mathematical phenomenology and phenomenological mapping in non-linear dynamics. *Special Issue of International Journal of Non-Linear Mechanics* (Eds. K.R. (Stevanovic) Hedrih, I. Kosenko, P. Krasilnikov and P.D. Spanos), 2015, Vol.73, p. 1-128.
- [12] Kozlov V.V., Treschev D.V. *Billiards. Genetic introduction into dynamics of systems with impacts.* Moscow: Moscow State Univ. Publishing; 1991 (in Russian).
- [13] Petrović, M. *Elementi matematičke fenomenologije (Elements of mathematical phenomenology)*. Beograd: Srpska Kraljevska Akademija, 1911.
- [14] Petrović M. *Fenomenološko preslikavanje (Phenomenological mapping)*, Beograd: Srpska Kraljevska Akademija; 1933 (In Serbian).
- [15] Petrović M. *Mécanismes communs aux phénomènes disparates.* Paris; 1921.
- [16] Rešković D. *Mehanika III-Dinamika (Mechanics III-Dynamics.* Beograd: Naučna Knjiga; 1965.



"NONLINEAR DYNAMICS" CONFERENCE
at NTU "KhPI"

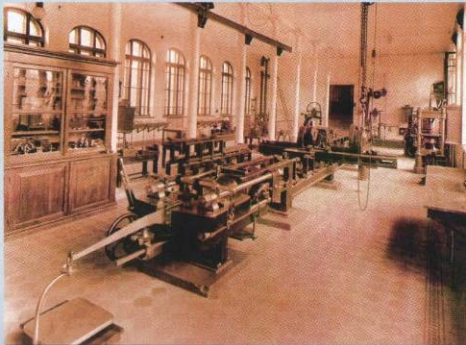


Chief Editor: L.Kurpa
Editors: N.Perepelkin, Yu.Mikhlin, A.Osetrov, K.Lyubitska
Design: N.Perepelkin

NTU "KhPI" AND THE HISTORY OF ITS CREATION



The Mechanical Engineering Laboratory



Inside of the Mechanical Engineering Laboratory.
Equipment for material testing purposes

NTU "KhPI" AND THE HISTORY OF ITS CREATION



Professor of the St.-Petersburg Technological Institute, **Victor Lvovich Kirpichev** was assigned as the first rector of Kharkov Technological Institute.

V.Kirpichev was a great scientist in the field of mechanics and strength of materials, the outstanding figure of Russian and Ukrainian higher engineering school. V.Kirpichev had great influence on natural science and technological development and promoted technical progress in engineering industry.

V.Kirpichev carried out a number of original researches in metal mechanics and the theory of machinery. He was an author of many textbooks, such as "Strength of Materials" (1902), "Basics of Graphical Statics" (1902), "Discussions about Mechanics" (1907) and others, which were very popular among Russian engineers and technically qualified persons.

V.Kirpichev paid great attention to educational process and science development at the Technological Institute.

The most outstanding scientists in mechanics and mathematics invited by Kirpichov worked in Kharkov Technological Institute.

National Technical University "Kharkov Polytechnic Institute" became famous all over the world due to a great contribution of many outstanding scientists (A.M. Lyapunov, V.A. Steklov, K.A. Andreev, M.A. Tichomandritsky, N.N. Beketov and others). A great role in consolidation of such reputation was played, in particular, by Nobel Prize Laureate L.D. Landau, V.S. Knabbe, P.P. Kopnyaev, G.F. Proskura, I.I. Sikorskiy, I.M. Babakov, A.K. Valter, L.S. Palatnik, A.P. Philippov, N.I. Akhiezer, I.M. Glazman, A.S.Volmir, V.L.Rvachev and many others.



At the Director's office

NONLINEAR DYNAMICS AT NTU "KhPI"



Historically, scientists at our University were engaged in nonlinear dynamics since the University creation. **Aleksander Mikhailovich Lyapunov** - world-famous scientist - worked within the walls of the Kharkov Institute of Technology from 1887 to 1893.

A. Lyapunov is an outstanding scientist in mathematics and mechanics, Doctor in mathematics (1882), Professor (1893), Member of Petersburg Academy of Science (1901), A. Lyapunov also was elected a Foreign Member of Roman Academy, Corresponding Member of Academy of Science in Paris and other Academies and scientific societies, Honorary Member of a number of Russian universities.

A. Lyapunov is known all over the scientific world as the founder of the theory of stability of mechanical systems with finite degrees of freedom. He is the author of world-famous monograph "The general problem of the stability of motion".

A. Lyapunov offered a new method of investigation in the theory of probability which is known now as the method of characteristic functions. He prepared and published a lot of research works, introduced a large number of new concepts in mathematical analysis. A lot of Lyapunov's investigations became sources of many new directions in mathematics.

In 1930 Physics-Mechanics (since 1945 – Engineering & Physics) Faculty was founded in Kharkov Polytechnic Institute. The training of high level specialists in the fields of Metal Science and Dynamics of Machines was the main task of the faculty staff. Well-known scientists who worked there made a great contribution to the theory of oscillations and theory and applications of nonlinear dynamics.

Let us mention only some of them.

Ivan Mikhailovich Babakov.



Professor **I. Babakov** is the author of the unique textbook "Theory of Vibrations", which has obtained the world-wide recognition. The book has been republished three times during two decades after the first edition.

For nearly 25 years I. Babakov had been one of the leaders of the university. He was also the Head of Theoretical Mechanics Department from 1925 to 1962.



A great contribution to the theory of dynamics of machines and hydraulic turbines was made by an outstanding scientist, Academician **Anatoly Petrovich Filippov**, who had worked at Kharkov Polytechnical Institute for many years.

Academician **A. Filippov** is the author of many fundamental monographs that are still popular, for example, "Vibrations of elastic systems" (1956), "Vibrations of mechanical systems" (1956), "Vibrations of deformable systems" (1970), "Non-stationary oscillations of mechanical systems" (1966), "Impact of dynamic loads on the structural elements" (1974).

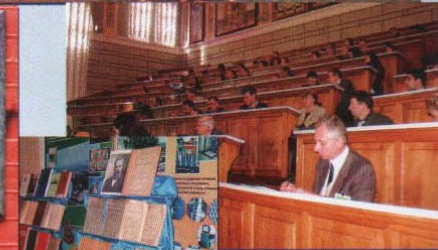


Arnold Sergeevich Volmir was a specialist in structural mechanics, aircraft and motors, stability and dynamics of structures, doctor of technical science (1949), Professor. He graduated from Kharkov Polytechnic Institute and was invited to work as Chair of Strength of Materials Dept.

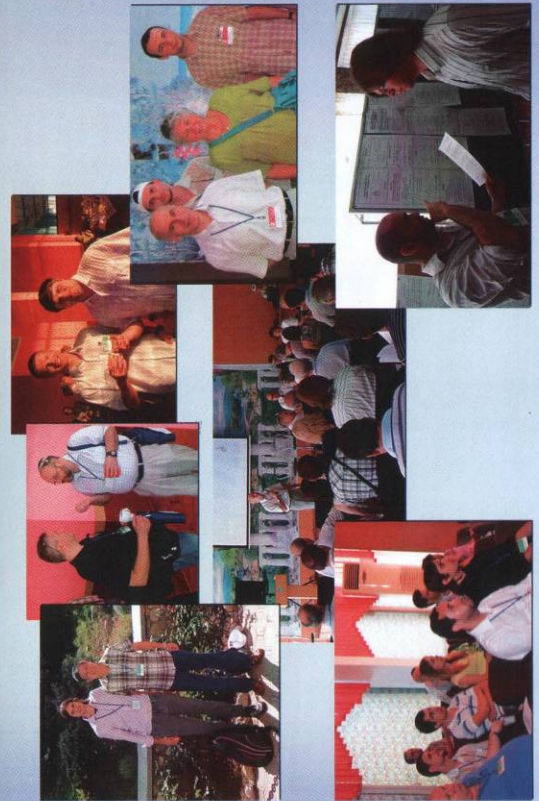
He created the theory of stability of thin-walled structures for different types of static loading based on common conception of stability of elastic systems and nonlinear dynamics. Results of those investigations were widely used when designing new models of aircrafts. Series of investigations devoted to nonlinear dynamics were completed with publication of fundamental monograph "Flexible plates and shells" in 1956. Investigations in the field of stability of thin-walled structures were published in monographs: "Stability of Elastic Systems" (1963), "Stability of Deformable Systems" (1967), "Nonlinear Dynamics of Plates and Shells" (1972).

A. Volmir is the author of more than 200 science articles and monographs and also textbooks which have been translated into English, German, Chinese, Roman and other languages and published abroad.

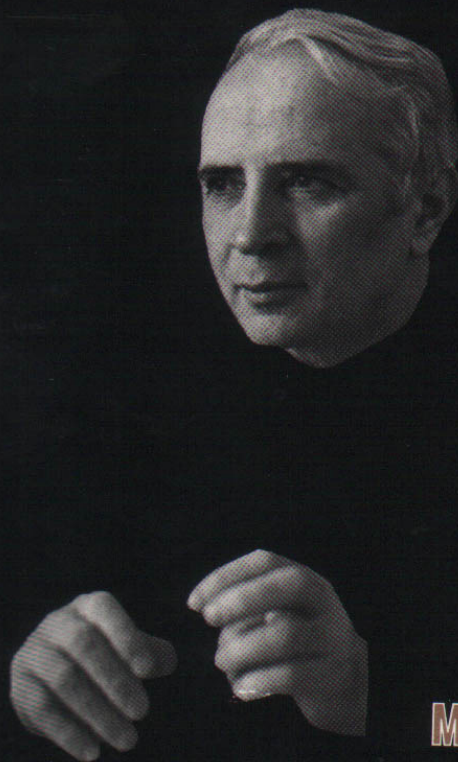
He carried out great work on education of scientific specialists. Scientific school of Volmir includes 10 doctors of science and 62 PhDs.



The third conference "Nonlinear Dynamics-2010" was dedicated to the 125th anniversary of National Technical University "Kharkov Polytechnic Institute".



Владимир Логвинович
РВАЧЕВ



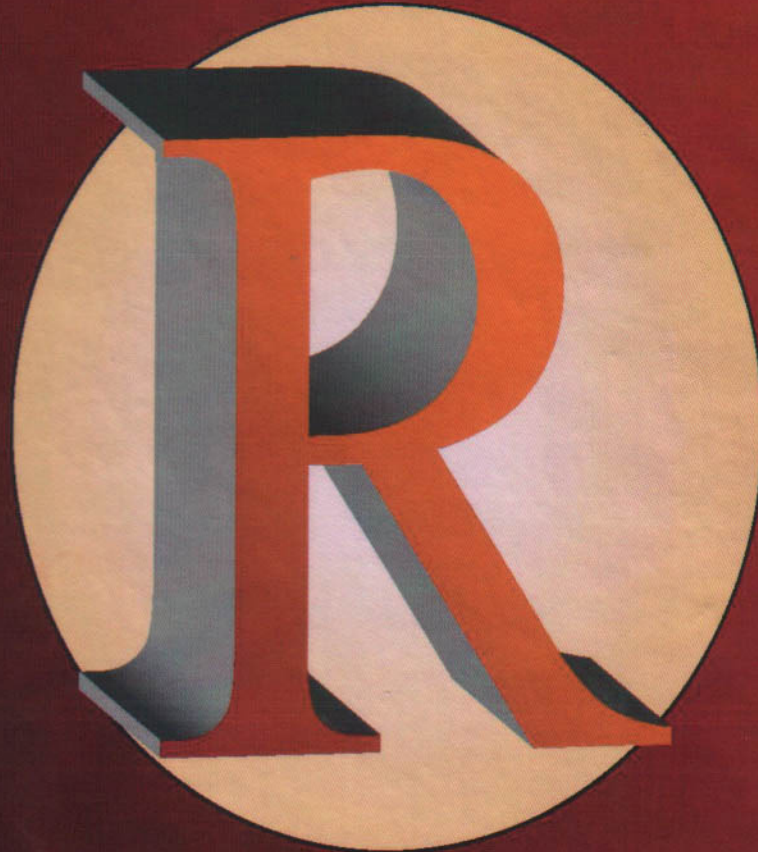
Се человек
Много званых -
Мало избранных

Дорогой проф.
Latica Hedrih
с огромным уважением
и любовью.
Автор
М. Куртс

**ПРИМЕНЕНИЕ ТЕОРИИ R-ФУНКЦИЙ
К РЕШЕНИЮ НЕЛИНЕЙНЫХ ЗАДАЧ
ДИНАМИКИ МНОГОСЛОЙНЫХ ПЛАСТИН**

Л.В.Курпа, О.С.Мазур, Т.В.Шматко

монография



МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ УКРАИНЫ

НАЦИОНАЛЬНЫЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ
«ХАРЬКОВСКИЙ ПОЛИТЕХНИЧЕСКИЙ ИНСТИТУТ»

Л.В.Курпа, О.С.Мазур, Т.В.Шматко

ПРИМЕНЕНИЕ ТЕОРИИ R-ФУНКЦИЙ
К РЕШЕНИЮ НЕЛИНЕЙНЫХ ЗАДАЧ
ДИНАМИКИ МНОГОСЛОЙНЫХ ПЛАСТИН

Монография

*To my scientific friend
prof. Katina Hedrik from
with best wishes
authors*

Харьков
НТУ «ХПИ»
2016

Л.В. Курпа, О.С. Мазур, Т.В. Шматко

**ПРИМЕНЕНИЕ ТЕОРИИ R-ФУНКЦИЙ К
РЕШЕНИЮ НЕЛИНЕЙНЫХ ЗАДАЧ ДИНАМИКИ
МНОГОСЛОЙНЫХ ПЛАСТИН**



МОНОГРАФИЯ

Монография содержит изложение методов исследования геометрически нелинейных, в том числе параметрических, колебаний многослойных пластин. Особенностью предлагаемых методов является использование теории R-функций. Особого внимания заслуживает разработанный метод дискретизации нелинейной системы уравнений движения. Предложенные методы позволяют рассматривать многослойные пластины различной геометрической формы с различными видами граничных условий. Математические модели получены в рамках двух теорий: классической и уточненной теории первого порядка, учитывающей деформации сдвига. В монографии представлено решение большого количества задач. Изучено влияние геометрических и механических параметров на частоты, критическую нагрузку, зоны динамической неустойчивости и поведение амплитудно-частотных характеристик. Полученные результаты могут быть использованы инженерами и научными сотрудниками при исследовании динамического поведения композитных элементов современных конструкций.

Монография может быть полезной научным работникам, студентам и аспирантам высших учебных заведений



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НАЦІОНАЛЬНИЙ ТЕХНІЧНИЙ УНІВЕРСИТЕТ
«ХАРКІВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ»



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ISSN 2078-9130
26'2016

ВІСНИК

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Харків

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
Національний технічний університет
«Харківський політехнічний інститут»

ВІСНИК

НАЦІОНАЛЬНОГО ТЕХНІЧНОГО УНІВЕРСИТЕТУ
«ХАРКІВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ»

Серія: Динаміка і міцність машин

№ 26 (1198) 2016

Збірник наукових праць

Видання засноване у 1961 р.

*My dear scientific friend
Katica Hedrik with
best wishes.
N. Kuzma*

Харків
НТУ «ХПІ», 2016

УДК 539.3

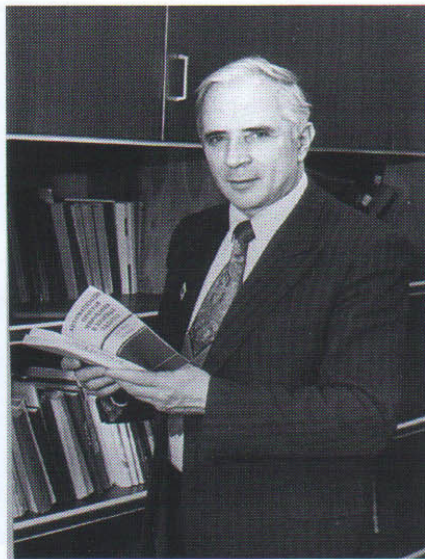
Т. И. ШЕЙКО, Л. В. КУРПА, Е. О. БЕЗДЕТКО, А. А. ОСЕТРОВ

**К 90-ЛЕТИЮ СО ДНЯ РОЖДЕНИЯ АКАДЕМИКА НАН УКРАИНЫ
ВЛАДИМИРА ЛОГВИНОВИЧА РВАЧЕВА**

Статья посвящена 90-летию со дня рождения выдающегося украинского ученого в области математики, механики и кибернетики, академика НАН Украины Владимира Логвиновича Рвачева. В статье описан жизненный и творческий путь В.Л. Рвачева. Выделены основные результаты научной деятельности В.Л.Рвачева, позволившие сделать существенный рывок в области аналитической идентификации геометрических объектов и решения красивых задач математической физики. Приведены некоторые высказывания В.Л.Рвачева, взятые из его дневников. Представлено краткое описание результатов, полученных В.Л.Рвачевым в последние годы, связанные с построением неархимедовых исчислений и их возможными приложениями в физике дальнего космоса. Представлен список основных публикаций В.Л. Рвачева.

Ключевые слова: академик В.Л. Рвачев, 90-летие со дня рождения, теория R-функций, биография.

21-го октября 2016 года исполняется 90 лет со дня рождения академика НАН Украины Владимира Логвиновича Рвачева.



Владимир Логвинович Рвачев – известный украинский ученый в области математики, механики и кибернетики, академик Национальной академии наук Украины, лауреат Государственной премии Украины в области науки и техники, заслуженный деятель науки и техники Украины, профессор, доктор физико-математических наук, крупный организатор науки, создатель всемирно признанной научной школы по методу R-функций. Он относится к плеяде выдающихся ученых двадцатого века. Его имя вошло во многие энциклопедические справочники. А главным научным открытием, прославившим Рвачева В.Л., как великого Ученого, является созданная им теория R-функций с ее многочисленными приложениями.

В.Л. Рвачев родился 21 октября 1926 г. в г. Чигирине Черкасской области в семье учителей. Отец – Рвачев Логвин Федорович преподавал дисциплины гуманитарного цикла. Он был активным участником революций 1905-1917 гг. Мать – Рвачева (Чер-

October 21, 2016 is the 90th anniversary of the academician of National Academy of Sciences of Ukraine Vladimir L. Rvachev.

Vladimir L. Rvachev is an outstanding Ukrainian scientist in the field of mathematics, mechanics and cybernetics; Academician of the National Academy of Sciences (NAS) of Ukraine; Ukrainian State Prize Winner in Science and Technology; Honoured Worker in Science and Technology of Ukraine; Professor; Philosophy Doctor in the field of Physics and Mathematics; major organizer of scientific activities; and the founder of the new world renown scientific school in the method of R-functions. He belongs to the outstanding scientists of the twentieth century. His name is in many encyclopaedic reference books. A major scientific discovery of V. Rvachev is creating the theory of R-functions with its numerous applications.

V. Rvachev was born on October 21, 1926 in the family of teachers in Chyhyryn, Cherkassy region, Ukraine. His father Logvin Fedorovich was a teacher in the humanities subjects. He was an active participant of the revolutions in 1905-1917. The mother of V. Rvachev - Ksenia A. Rvacheva (Chernomordik) taught mathematics. Influenced by mother all five children (Vladimir was the youngest) got education in Physics and Mathematics. Three of them got their Phil. Dr. degree in Physics and Mathematics. Sister of V. Rvachev – Catherine Yuschenko (Rvacheva) became the first programmer in Ukraine, internationally famous scientist and mathematician, specialist in the software field. She was elected to the members of the NAS of Ukraine and also became a member of the International Academy of Computer Sciences and Systems.

In 1937 V. Rvachev's parents were subjected to repressions. His father died in confinement, and the mother was released in 1940. In 1956 V. Rvachev's parents were exonerated.

In the beginning of the Great Patriotic War, the whole family of V.L.Rvachev was evacuated first to village Arkhangel'skoye, Voronezh region. Later they moved to Tashkent where V. Rvachev, after graduating from the secondary school, worked as a turner's apprentice at the Tashsel'mash Fabric. In 1943, he started his study at Kharkiv Institute of Railway Transport Engineers, but in 1944 he was drafted to the Navy.

After being demobilised in 1947, V. Rvachev joined the faculty of Physics and Mathematics at Lvov University.

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Kharkov Nonlinear Dynamics September 2016, Opening Ceremony. Conference auditoria in Rector Building



Kharkov Nonlinear Dynamics September 2016, Conference auditoria in Rector Building.



Kharkov Nonlinear Dynamics September 2016, Oppening Ceremony, Conference auditoria in Rector Building. Address by Katica (Stevanovic) Hedrih, Mathematical Institute SASA, Serbia.





Some of participants of Kharkov Nonlinear Dynamics, September 2016, Rector Building, Oppening Ceremony.



Some of participants of Kharkov Nonlinear Dynamics, September 2016. Rector Building place.



Some of participants of Kharkov Nonlinear Dynamics, September 2016. Nobel prize laureate Lav Davidovic Landau memory table.



Some of participants of Kharkov Nonlinear Dynamics, September 2016. Memorial plate of Aleksandr Mihailovic Lyapunov- Founder of theory of stability.



Kharkov Nonlinear Dynamics, September 2016, Rector Building, Kharkov Polytechnic museum.



Kharkov Nonlinear Dynamics, September 2016, Rector Building, Kharkov Polytechnic museum.
 Important scientist **Kirpichov**, First Rector of Kharkov Polytechnic.



Important world scientists:
 (left) Nobel prize laureate **Lav Davidovic Landau** memory table
 (right) Memorial table of **Aleksandr Mihailovic Lyapunov** - Founder of **Theory of stability**.

