UDC 539.3

"NONLINEAR DYNAMICS - 2016" CONFERENCE

V.A. Bazhenov[1]
Doctor of Technical Sciences, Professor, Academician of the Ukraine National Academy of Pedagogical Sciences

O.S. Pogorelova[1]
Candidate of Physico-mathematical Sciences, Senior Research Officer, Senior Research Officer

T.G. Postnikova[1]
Candidate of Engineering Sciences, Senior Research Officer, Senior Research Officer

[1]*Kyiv National University of Construction and Architecture*

There is short description of problem state on nonlinear dynamics in this paper. Information about some contemporary journals and recent Conferences on this subject is given. Information about 5th International Conference on Nonlinear Dynamics which was holding in National Technical University "Kharkov Polytechnic Institute" in September 2016 and impression about it are presented.

The questions that were discussed at this conference are in domain of our special interests. Dynamic behaviour of non-smooth systems with discontinuous right-hand side is the main contemporary question. Many new phenomena unique to non-smooth systems are observed under variation of system parameters. Such nonlinear problems are arising in many different domains of science and engineering, for example in mechanics, physics, radio technique, biology, chemistry, economics, ecology, sociology, and so on. The investigations of nonlinear dynamics problems in general and very complex phenomenon of chaos in particular were begun quite recently – only in the end of 20-th century.

Vibroimpact system is one example of nonlinear systems. It is strongly nonlinear non-smooth discontinuous system because the set of its motion differential equations contains the discontinuous right-hand side. The bifurcations of different kind occur in vibroimpact system under system parameter variation. The bifurcation analysis execution and the bifurcation diagrams building allow to find and to distinguish the safe, explosive, and dangerous bifurcations in dissipative dynamical systems. In systems with discontinuous right-hand side the discontinuous bifurcation can occur when system parameter is varying. Discontinuous bifurcations that occur in non-smooth vibroimpact systems are dangerous ones. At 5th International Conference on nonlinear dynamics (ND-KhPI2016, Kharkiv, Ukraine) we presented the talk entitled "Discontinuous Bifurcations under 2-DOF Vibroimpact System Moving". We offered numerical analysis by parameter continuation method of vibroimpact system dynamic behaviour. We simulated impact by nonlinear contact force according to Hertz's contact law. In such way we have obtained the possibility to find the motion law along the whole timebase including the impact phase, to determine the impact duration and to find the contact impact forces. We have found dangerous discontinuous bifurcations and have observed phenomena unique for non-smooth systems with discontinuous right-hand side. We have observed the fold dangerous bifurcation in our vibroimpact system.

Keywords: nonlinear dynamics, conference, vibroimpact system, discontinuous bifurcation.

1. Introduction

It is known that nonlinear problems are arising in many different domains of science and engineering. It has been recognized that nonlinear dynamics are ubiquitous in many natural and engineering systems such as occur in plasmas,

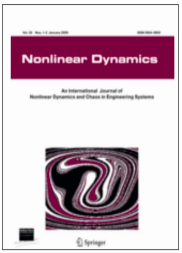
fluids, optical systems, solid-state devices, etc. For example they are the systems with mechanical impacts, stick-slip motion from friction, electronic switches, hybrid dynamics in control, and genetic networks [1-7]. Many new phenomena unique to non-smooth systems are observed under variation of system parameters. Jumps and switches in a system's state represent the grossest form of nonlinearity. Recently the investigations of such systems are developed rapidly. But today it has become clear that many aspects of dynamical behavior of non-smooth systems aren't investigated and understood. Especially systems with impacts are of the particular interest for scientists. Under variation of system parameters a nonlinear system can often exhibit catastrophic bifurcations that destroy the desirable system state.

Many scientists are working over the nonlinear problems. The monographs are publishing in whole world [8-12].

There are many journals on nonlinear dynamics problems, for example:

An International Journal of Nonlinear Dynamics and Chaos in Engineering Systems.
Ali H. Nayfeh (Editor-in-Chief)
2015 Impact Factor 3.00
Publisher Springer Netherlands

http://link.springer.com/journal/11071



Journal of Applied Nonlinear Dynamics
J. A. Tenreiro Machado (Editor)
Albert C.J. Luo (Editor)
L&H Scientific Publishing

https://www.lhscientificpublishing.com/Journals/JAND-Default.aspx

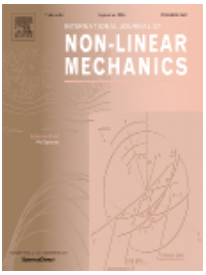
Journal Discontinuity, Nonlinearity, and Complexity
Valentin Afraimovich (Editor),
Xavier Leoncini (Editor),
Lev Ostrovsky (Editor),
Dimitry Volchenkov (Editor)
L&H Scientific Publishing

https://www.lhscientificpublishing.com/

Journals/JAND-Default.aspx

International Journal of Non-Linear Mechanics
P.D. Spanos (Editor-in-Chief)
2015 Impact Factor 1.920
Publisher Springer Netherlands

http://www.journals.elsevier.com/international-journal-of-non-linear-mechanics

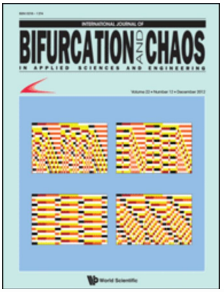


Journal of Nonlinear Dynamics
Mohamed Belhaq (Editor)
Publisher: Hindawi

https://www.hindawi.com/journals/jndy/

International Journal of Bifurcation and Chaos in Applied Sciences and Engineering
L.O. Chua (Honorary Editor-in-Chief),
Guanrong (Ron) Chen (Editor-in-Chief)
World Scientific Publishing Co Pte Ltd

http://www.worldscientific.com/doi/abs/10.1142/S0218127415300013



Applied Mathematics and Nonlinear Sciences
Juan L.G. Guirao (Editor-in-Chief),
UP4, Institute of Sciences, S.L.

http://journals.up4sciences.org/applied_mathematics_and_nonlinear_sciences.html

The numerous conferences and symposiums are holding in different countries, for example:

International Conference on Nonlinear Dynamics Complexity.

XVIII International Symposium "Dynamics of Vibroimpact (strong nonlinear) Systems" dedicated to Prof. Aron Kobrinskiy's 100th anniversary took place in Russia in May, 2015.

The third International Conference on Structural Nonlinear Dynamics and Diagnosis.

The next International Conference on Structural Nonlinear Dynamics and Diagnosis will be held in Tangier, Morocco, in June, 2018.

International Conference **"Perspectives in Nonlinear Dynamics"** took place in Berlin in July, 2016.

The tenth Conference on Nonlinear Systems and Dynamics will be held in December, 2016 at Indian Institute of Science Education and Research, Kolkata.

ENOC 2017, 9th European Nonlinear Dynamics Conference will be starting in June, 2017 at the Budapest University of Technology and Economics.

Of course there are many scientific articles at this topic, for example [1-7, 13-18].

Vibroimpact system is one example of nonlinear systems. It is strongly nonlinear non-smooth discontinuous system because the set of its motion differential equations contains the discontinuous right-hand side. At present vibroimpact machines and equipment are often encountered in many engineering practice applications. Therefore their dynamic behaviour is studied very intensively now. Big attention is paid to investigate stability in systems with impacts, periodic motions, bifurcations, singularities at vibroimpact dynamics. The bifurcations of different kind occur in vibroimpact system under system parameter variation. The bifurcation analysis execution and the bifurcation diagrams building allow to find and to distinguish the safe, explosive, and dangerous bifurcations in dissipative dynamical systems. In systems with discontinuous right-hand side the discontinuous bifurcation can occur when system parameter is varying. Discontinuous bifurcations that occur in non-smooth vibroimpact systems are dangerous ones. They are hard bifurcations. Just hard bifurcations can portend the crisis and catastrophe [16–18]. A crisis is a sudden discontinuous change in a chaotic attractor as a system parameter is varied. The crisis can be considered as a catastrophe that one endeavours to avoid. Catastrophic events can occur in different form in various kinds of nature, physics and mechanic systems. After the crisis the system state is quite different from that one before the crisis. If the nonlinear dynamical system state before the crisis is normal and desirable then the state after the crisis may be undesirable or destructive. The hard bifurcations were the subject of Catastrophe theory. Catastrophe theory was introduced in 1960s by the renowned Field Medal mathematician Rene Thom as a part the general theory of local singularities. Since then it has found applications across many areas, including biology, economics, and chemical kinetics. By investigations the phenomena of bifurcation and chaos, Catastrophe theory proved to be fundamental to the understanding of qualitative dynamics. The famous books [19, 20] are devoted to this topic. The theory was very fashionable at 70^{th} years of 20^{th} century. Then this fashion went away and terminology returned to singularities, discontinuous bifurcations and so on. But the catastrophes and crises remained. Blue Sky Catastrophes, the Swallow's Tail bifurcation are learnt by contemporary scientists [21]. Let us note by the way that very power school on nonlinear oscillations, bifurcations, and chaotic vibrations is in Saratov State University named after N.G.Chernyshevsky, Russia (Saratov group of theoretical nonlinear dynamics). There are the set of monographs, textbooks and articles published by its scientists [22, 23]. Y.A.Kuznetsov (now Department of Mathematics, Utrecht University, NL) is one of the authors of well known software MatCont. MatCont is a Matlab software project for the

numerical continuation and bifurcation study of continuous and discrete parameterized dynamical systems [24-26].

So there are crying needs for investigations of arising of the safe, explosive and dangerous bifurcations in dynamical systems, of the crises and catastrophes for chaotic attractors.

These subjects studying had been begun in Scientific Research Institute of Structural Mechanics, Kyiv National University of Construction and Architecture (then Problem Scientific Research Laboratory of Thin Wall Spatial Constructions) long ago. Professors V.I. Gulyayev, V.A. Bazhenov, E.A. Gotsuliak, E.S. Dechtyaruk, had begun these investigations [27].

The authors of this article are developing these topics. We had published monograph [28], the set of scientific articles [29-36]. We made several contributions to International Conferences. At second International Conference on Structural Nonlinear Dynamics and Diagnosis (CSNDD'2014), Agadir, Morocco we made contribution "Change of impact kind in vibroimpact system due its parameters changing". We had the publication in Proceeding of this Conference [37].

We delivered the talk "Bifurcation Points under 2-DOF Vibroimpact System Moving. Numerical Analysis by Parameter Continuation Method" at International Conference on Nonlinear Dynamics Complexity (NDC2015), La Manga, Spain. We have written the article about this conference and our impression [38].

At 5th International Conference on nonlinear dynamics (ND-KhPI2016) Kharkiv, Ukraine we presented report entitled "Discontinuous Bifurcations under 2-DOF Vibroimpact System Moving" (Fig. 1).

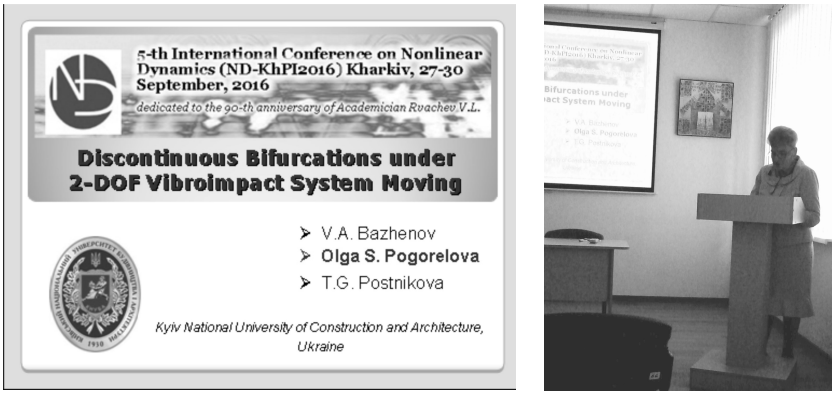


Fig. 1

Now we have the publication in Proceeding of this Conference (Fig. 2) [39].

2. About 5th International Conference "Nonlinear Dynamics – 2016"

This Conference was dedicated to the 90th anniversary of Academician Rvachev V.L. The Conferences "Nonlinear Dynamics" are holding every 3 years, the 1st one was at 2004 year.

This 5th Conference organized by the:

- National Technical University "Kharkov Polytechnic Institute" (Kharkov, Ukraine);
- Institute of Mechanics NAS of Ukraine (Kiev, Ukraine);
- McGill University (Montreal, Canada);
- Technion - Israel Institute of Technology (Haifa, Israel);
- A.Podgorny Institute for Mechanical Engineering Problems NAS of Ukraine (Kharkiv, Ukraine)
- National Committee of Ukraine on Theoretical and Applied Mechanics, NAS of Ukraine.

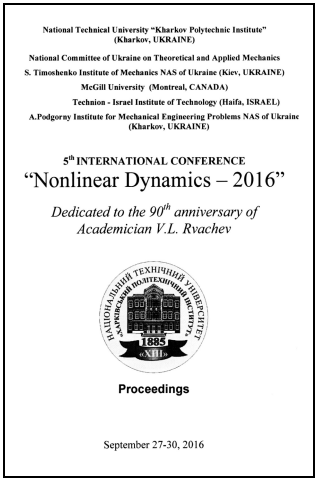

National Technical University "Kharkov Polytechnic Institute" (Kharkov, UKRAINE)
National Committee of Ukraine on Theoretical and Applied Mechanics
S. Timoshenko Institute of Mechanics NAS of Ukraine (Kiev, UKRAINE)
McGill University (Montreal, CANADA)
Technion - Israel Institute of Technology (Haifa, ISRAEL)
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

Fig. 2

Organizing Committee of the Conference consists of 6 Professors and 4 Doctors. Professors L.V.Kurpa and Yu.V.Mikhlin were the leaders of Conference, they were vice-Chairmen. They were V.L.Rvachev's collaborators and his followers. The Conference was held in the National Technical University "Kharkov Polytechnic Institute".

Department of Applied Mathematics and Department of Dynamics and Strength of Machines gave the big contribution to Conference organization and holding. The Conference lasted 4 whole days and was held at high scientific level. There were 54 talking and 24 poster presentations. At Opening ceremony Rector of National Technical University "Kharkov Polytechnic Institute" welcomed the Conference participants. Then there was the film about Academician V.L.Rvachev which was finished by words: "Thank you, the Teacher".

The Conference participants are photographed on the stairs in front of KhPI (Fig.3). Some Conference participants are photographed at Conference Banquet (Fig. 4).

We would like to note some aspects. At first quite excellent organization. There was no error in the Program, Proceedings were ready before Conference beginning, and all actions were made in time. All contacts were very friendly and pleasant.

The conference working language was English one. It is necessary to note excellent fluency in English by more young participants and well proficiency of all participants including the participants of older age. There are 3 departments of foreign language in Kharkov Polytechnic Institute. The collaborators are learning English regularly with help of teachers of these departments.

Fig. 3

Fig. 4

Many foreign participants delivered the talks. There were the participants from Italy, Australia, Serbia, United Kingdom, Germany, Poland, Russia, Israel, USA, Canada, Brasil, Sweden, Latvia, and Lithuania. Among them there were former collaborators, pupils, and disciples of KhPI scientists. Kharkov's scientists support close connections with their followers, with scientists from other countries and other towns.

Special WEB session made great impression. The leading scientists from different far countries delivered their talks and showed its at big screen. All participants who were in Kharkov's auditorium and in other countries asked their questions and obtained the answers! (Fig. 5).

Special WEB Session	Main Building, Room 12
Chairs: Yu.Mikhlin, F.Pellicano	
17.15-21.00.	
1	**Marco Amabili** *(Montreal. Canada)* IDENTIFICATION OF NONLINEAR DAMPING FOR LARGE-AMPLITUDE VIBRATIONS OF PLATES AND CURVED PANELS **Key lecture.**
2	**Jose Manoel Balthazar** *(Sao Jose dos Campos. Brasil)* NONLINEAR DYNAMIC INTERACTIONS AND PHENOMENA: VIBRATING SYSTEMS WITH LIMITED POWER SUPPLY AN EMERGENT TOPIC AFTER PROF KONONENKO **Key lecture**
3	**Alexander Yakakis** (*Urbana. USA)* NONLINEAR SONIC VACUA **Kev lecture**
4	**Si Mohamed Sah. Richard Rand** *(Stockholm, Sweden: Ithaca. USA)* THREE WAYS OF TREATING A LINEAR DELAY DIFFERENTIAL EQUATION
5	**Pol Spanos** *(Houston. USA)* POTENT METHODS FOR STOCHASTIC ANALYSIS OF NONLINEAR DISCRETE DYNAMIC SYSTEMS **Kev lecture**
6	**Shiyang Chen, Bogdan Lpureanu** *(Ann Arbor. USA)* FORECASTING BIFURCATION OF PARAMETRICALLY EXCITED SYSTEMS: THEORY & EXPERIMENTS

Fig. 5

3. Conclusions

1. Our talk was successful. We answered at all questions.
2. Our active attendance of all section meetings and numerous questions to lecturers were estimated positively.
3. It was possible to establish scientific ties.
4. The participation in work of scientific conferences in particular international ones is very useful: it gives the possibility to see own level and own place in contemporary science; to establish the scientific contacts; to understand the development tendencies; to get the scientific ideas.

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Баженов В.А., Погорелова О.С., Постнікова Т.Г.

КОНФЕРЕНЦІЯ “НЕЛІНІЙНА ДИНАМІКА – 2016”

В роботі представлений короткий опис стану проблем, пов‘язаних з нелінійною динамікою. Надаються відомості про деякі сучасні журнали та останні конференції за цією тематикою. Представлена інформація про 5-ту Міжнародну конференцію з нелінійної динаміки, яка відбулася в Національному технічному університеті "Харківський політехнічний інститут" у вересні 2016 року і враження від неї.

Ключові слова: нелінійна динаміка, конференція, віброударна система, розривні біфуркації.

Баженов В.А., Погорелова О.С., Постникова Т.Г.

КОНФЕРЕНЦИЯ “НЕЛИНЕЙНАЯ ДИНАМИКА – 2016”

В работе представлено краткое описание состояния проблем, связанных с нелинейной динамикой. Даны сведения о некоторых современных журналах и последних конференциях по этой тематике. Представлена информация о 5-й Международной конференции по нелинейной динамике, состоявшейся в Национальном техническом университете "Харьковский политехнический институт" в сентябре 2016 года и впечатления о ней.

Ключевые слова: нелинейная динамика, конференция, виброударная система, разрывные бифуркации.

UDC 539.3

Bazhenov V.A., Pogorelova O.S., Postnikova T.G. **“Nonlinear Dynamics - 2016” Conference** // Strength of Materials and Theory of Structures. – 2016. – Issue. 97. – P. 3 - 15.

There is short description of problem state on nonlinear dynamics in this paper. Information about some contemporary journals and recent Conferences on this subject is given. Information about 5th International Conference on Nonlinear Dynamics which was holding in National Technical University “Kharkov Polytechnic Institute” in September 2016 and impression about it are presented.

Table 0. Fig. 4. Ref. 37

УДК 539.3

Баженов В.А., Погорелова О.С., Постнікова Т.Г. **Конференція “Нелінійна Динаміка – 2016”**// Опір матеріалів і теорія споруд. – 2016. – Вип. 97. – С. 3 – 15.

В роботі представлений короткий опис стану проблем, пов‘язаних з нелінійною динамікою. Надаються відомості про деякі сучасні журнали та останні конференції за цією тематикою. Представлена інформація про 5-ту Міжнародну конференцію з нелінійної динаміки, яка відбулася в Національному технічному університеті "Харківський політехнічний інститут" у вересні 2016 року і враження від неї.

УДК 539.3

Баженов В.А., Погорелова О.С., Постникова Т.Г. **Конференция “Нелинейная Динамика – 2016”**// Сопротивление материалов и теория сооружений. – 2016. – Вып. 97. – С. 3 – 15.

В работе представлено краткое описание состояния проблем, связанных с нелинейной динамикой. Даны сведения о некоторых современных журналах и последних конференциях по этой тематике. Представлена информация о 5-й Международной конференции по нелинейной динамике, состоявшейся в Национальном техническом университете "Харьковский политехнический институт" в сентябре 2016 года и впечатления о ней.

Автор (вчена ступень, вчене звання, посада)*: доктор технічних наук, професор, академік Національної академії педагогічних наук України, директор НДІ будівельної механіки БАЖЕНОВ Віктор Андрійович*
Адреса робоча: *03680 Україна, м. Київ, Повітрофлотський проспект 31, Київський національний університет будівництва і архітектури, БАЖЕНОВУ Віктору Андрійовичу*
Адреса домашня: *02001 Україна, м. Київ, вул. Заньковецької 30, кв. 22, БАЖЕНОВУ Віктору Андрійовичу*
Роб. тел. *+38(044) 245-48-29;*
мобільний тел.: *+38(067) 111-22-33;*
дом. тел.: *+38(044) 777-77-77;*
E-mail vikabazh@ukr.net

Автор (вчена ступень, вчене звання, посада)*: кандидат фізико-математичних наук, старший науковий співробітник, провідний науковий співробітник НДІ будівельної механіки ПОГОРЕЛОВА Ольга Семенівна*
Адреса робоча: *03680 Україна, м. Київ, Повітрофлотський проспект 31, Київський національний університет будівництва і архітектури, ПОГОРЕЛОВІЙ Ользі Семенівні.*
Адреса домашня: *02147 Україна, м. Київ, вул. Русанівська Набережна 18, кв. 61, ПОГОРЕЛОВІЙ Ользі Семенівні*
Роб. тел. *+38(044) 245-48-29;*
мобільний тел.: *+38(067) 606-03-00;*
дом. тел.: *+38(044) 517-25-08;*
E-mail – pogos13@ukr.net

Автор (вчена ступень, вчене звання, посада)*: кандидат технічних наук, старший науковий співробітник, старший науковий співробітник НДІ будівельної механіки ПОСТНІКОВА Тетяна Георгіївна*
Адреса робоча: *03680 Україна, м. Київ, Повітрофлотський проспект 31, Київський національний університет будівництва і архітектури, ПОСТНІКОВІЙ Тетяні Георгіївні.*
Адреса домашня: *04210, Україна, м. Київ, пр. Героїв Сталінграду 24, кв. 17, ПОСТНІКОВІЙ Тетяні Георгіївні*
Роб. тел. *+38(044) 245-48-29;*
мобільний тел.: *+38(050) 353-47-19;*
дом. тел.: *+38(044) 411-46-56;*
E-mail – posttan@ukr.net