



**THE 14-th INTERNATIONAL  
WORKSHOP ON DIFFERENTIAL GEOMETRY AND  
ITS APPLICATIONS**

*UPG, Romania, July 9-th – 11-th, 2019*

**DGA 14**

*"Geometry is the stillness of happening."  
Nichita Stanescu*

The MDPI open access journal Axioms  
<<https://www.mdpi.com/journal/axioms>>  
sponsors the "Best Poster Award" for best presented papers to support young  
scholars (including post-docs up to 35 years old).  
They will be announced and awarded by the chairs during the workshop.

## FOREWORD

The contribution of Romanian mathematicians to the field of geometry, especially differential geometry, is very significant. In this context, the Institute of Mathematics of the Romanian Academy from Bucharest (IMAR), has played an important role. The institute was founded 70 years ago (in 1949) and, despite the period 1975 – 1990 (which was – from social point of view – dramatic, and – from cultural point of view – tragic) is still today an outstanding research institute of top scientific level.

Taking into account on one hand the long tradition in the study of differential geometry in Romania and, on the other hand, the fact that after 1989 organizing international meetings in Romania became easier, twenty five years ago (in 1993) I began to organize every second year (together with some of my younger colleagues) a series of international workshops on differential geometry and its applications. The first twelve workshops were organized in various university centers from Romania.

Between 1997 and 2007, in cooperation with my colleague Tudor ZAMFIRESCU, I also organized a series of four German – Romanian Seminars on Geometry: two in Romania (in 1997 – Sibiu and in 2003 – Cluj-Napoca) and two in Germany (in 2000 and 2007 in Dortmund).

In 2019, the organizers of the workshop are Radu IORDĂNESCU and Florin NICHITA from IMAR, the local organizers being Cristian MARINOIU, Gabriela MOISE, and Rafail Mihai PASCU from Petroleum-Gas University of Ploiești. I take this opportunity to mention here that forty years ago (in 1979) Prof. Dr. Gheorghe VRANCEANU, which was a big Romanian personality working in the field of differential geometry, passed away.

The main goal of these meetings was to offer, especially to young Romanian mathematicians, the opportunity of direct contact with outstanding personalities over the world and to establish further scientific cooperations with them. In this respect, more than 30 talented Romanian young geometers (from Arad, Bucharest, Constanța and Timișoara) obtained – through above mentioned workshops and seminars – grants for summer schools, as well as master, Ph. D. or postdoc grants in Switzerland, France, Germany, Italy, Spain and the USA.

As a consequence of these workshops three important and efficient scientific agreements were signed, namely: between the West University of Timișoara and the University “La Sapienza” (Rome, Italy), between the “Ovidius” University (Constanța) and the University of Granada (Spain) and between the West University of Timișoara and the University of Santiago de Compostela (Spain). These agreements continue to offer an interchange of professors and students of the above mentioned universities, the main beneficiaries being – also this time – the young Romanian geometers having special abilities for scientific research. After the second workshop (Constanța, 1995), the “Ovidius” University of Constanța developed (and is still developing) a strong mathematical cooperation with IMAR: members of IMAR have given courses in Constanța, and some of them hold part-time positions at “Ovidius” University.

It is worth being mentioned here the fact that these workshops were attended by almost all Romanian geometers of international level from Bucharest, Brașov, Cluj-Napoca,

Constanța, Iași and Timișoara, and also the fact that the invited lectures, as well as some communications, were published in special volumes, which was – again – for the benefit of young Romanian geometers (attending or not these meetings).

I think that it is important to point out that among the participants from abroad were outstanding mathematical personalities, and also brilliant Romanian mathematicians from famous universities over the world. I would like to mention here that two invited speakers at our workshop from 2007 (namely, Prof. Dr. Wend WERNER from Münster University-Germany and Prof. Dr. Dušan REPOVŠ from Ljubljana University-Slovenia) have been invited as visiting professors at IMAR. In September 2011, Prof. Dr. Nicolae ANGHEL from North Texas University-USA, which was invited speaker at our workshops from 2009 and 2011, was visiting professor at IMAR. In December 2014, Prof. Dr. Dmitri ALEKSEEVSKY from Masaryk University – Czech Republic, which was invited speaker at our workshops from 1999 and from 2013, was visiting professor at IMAR. In 2015 Prof. Dr. Remi LEANDRE from Besançon Univ. (France ) was one of the invited speakers; he previously (in 1988) obtained the BRONZE MEDAL FOR RESEARCH from CNRS – Paris.

The libraries of the universities which have co-organized with IMAR the workshops have benefited – also as a consequence of the workshops – from book donations and some facilities concerning mathematical journals, as well as a more easy and rapid access to the mathematical information (with the help of Zentralblatt für Mathematik).

The first four workshops have contributed to the very good evaluation of IMAR in the competition organized by European Commission – General Directorate for Research – in the frame of the Programme “Confirming the International Role of Community Research” (Support for Centers of Excellence). Consequently, in 2000, IMAR became Center of Excellence of the European Union for the period March 2001 – June 2004.

It is worth being mentioned here that in 2015 we organized (for the first time!) in the frame of the Workshop a round table on the teaching of geometry in secondary school. We organized this round table taking into account some proposals, as well as the present status of the study of geometry in our schools. In 2017, we extended the topic of the round table to the teaching of mathematics, and it was organized just before the workshop (in the morning of 25 September 2017).

Last but not least, I would like to point out that the series of the above mentioned workshops and seminars have stimulated other younger colleagues to organize international meetings on differential geometry and related topics at the University of Bucharest, at the University Transilvania of Brașov, at the University Politehnica of Bucharest, and at the University of Civil Engineering of Bucharest.

July, 2019

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# PROGRAMME

## Monday, July 8

19.00 Welcome Cocktail

## Tuesday, July 9

9.30 Opening ceremony  
10.00 Paolo BELLINGERI  
11.00 Coffee break  
11.30 Stefan BERCEANU  
12.30 Ivko DIMITRIC  
-----Lunch & Rest-----  
15.30 Radu POPESCU  
16.30 Nicolae ANGHEL

19.00 International Music Festival for Classical and Contemporary Music  
ȚINTEA MUZICALĂ <http://www.tinteamuzicala.org/home.htm>  
Biserica romano-catolică Cristos Rege, Strada Ștefan cel Mare Nr.13

## Wednesday, July 10

9.30 Elisabeth REMM  
10.00 Gabriel Eduard VILCU  
11.00 Coffee break  
11.30 Gelu PASA  
12.30 Ovidiu PASARESCU  
-----Lunch & Rest-----  
15.30 POSTER SESSION & OTHER RELATED ACTIVITIES  
TRIP TO CLOCK MUSEUM

## Thursday, July 11

9.30 Florin NICHITA  
10.30 Laszlo STACHO  
11.30 Closing Ceremony / Related Issues  
-----Lunch & Rest-----

FREE TIME  
CONCERT  
FAREWELL DINNER

## TITLES, ABSTRACTS AND POSTERS

Nicolae Anghel (North Texas University)

### ***Heron Triangles with Constant Area and Perimeter***

*The talk undertakes a very detailed, very visual, and quite elementary study of the Heron triangles of fixed area and perimeter. It circumvents the traditional approach to Heron triangles based on elliptic curves. Its key focus is on the geometry, calculus, and algebra of the associated area curve. The main result presents a simple sufficient condition for the existence of infinitely many Heron triangles with constant area and perimeter. An application to Diophantine equations is also given.*

Paolo Bellingeri (Caen University)

### ***Virtual braid groups and permutations***

*Let  $VB_n$  the virtual braid group on  $n$  strands and  $S_n$  the symmetric group on  $n$  elements. We determine all possible homomorphisms between:*

- $VB_n$  and  $VB_m$
- $VB_n$  and  $S_m$
- $S_n$  and  $VB_m$

*when  $n > 4$  and  $n \geq m$ . As corollaries we get several results on virtual braid groups, in particular we compute their outer group and we show that virtual braid groups are hopfian and co-hopfian. The approach is completely different from Artin and Lin ones for classical braids and permutations, and it is based on Bass-Serre theory of amalgamated products of groups. This is a joint work with Luis Paris.*

Stefan Berceanu (IFIN – HH)

### ***About the five dimensional extended Siegel-Jacobi upper half plane***

*The Jacobi group, defined as the semidirect product of the Heisenberg group with the symplectic group of appropriate dimension, is an interesting object in Mathematics, with many applications in Physics. Calculating the invariant one forms, we recover the twoparameter balanced metric on the Siegel-Jacobi upper, a four dimensional homogeneous space attached to the real Jacobi group of index one. Then we determine an invariant metric depending of 3 parameters on the five dimensional extended Siegel-Jacobi upper half plane.*

Ovidiu Calin (Eastern Michigan University)\*

Ivko Milan Dimitric (Pennsylvania State Univ.)

***Chen type of spherical hypersurfaces via the second standard immersion***

*The equation of unit sphere centered at the origin defines a map from the sphere to its ambient space by inclusion. This is the first standard immersion (also an embedding) of the sphere. The second standard immersion of the unit sphere is given by the map  $\Phi$  (the projection map onto the line  $Ox$ ) from the sphere into the set of symmetric matrices of order  $n + 1$  (which is naturally an Euclidean space). On the other hand, for an isometric immersion of a Riemannian  $n$ -manifold into Euclidean space, such submanifold is said to be of finite type, according to B. Y. Chen, if this immersion allows a certain decomposition into a finite sum of vector eigenfunctions. In this talk, we study hypersurfaces of unit hypersphere for which the associated immersion is of low Chen-type. We also present several examples.*

Florin Nichita (IMAR)

***On Applications of UJLA Structures***

*In a previous talk at DGA 2015, "On Jordan Algebras and Unification Theories", we explained that Jordan algebras, Lie algebras and associative algebras can be unified at a certain level. We will extend that discussion and we will explain the geometric aspects of these constructions. We will also comment that the derivative and the coderivative (a dual concept) can be unified.*

Gelu Pasa (IMAR)

***A contradiction in rectangular Hele-Shaw displacements***

*We study the Hele-Shaw immiscible displacements when all surface tensions on the interfaces are zero. The Saffman-Taylor instability occurs when a less viscous liquid is replacing a more viscous one, in a rectangular Hele-Shaw cell. We prove that an intermediate liquid with a variable (continuous) increasing viscosity can almost suppress this instability. A smooth enough function can be well approximated by a "step" function. From a practical point of view, it seems easier to create a "step" profile that approximates a variable continuous viscosity. Therefore we consider a large number of constant viscosity liquid-layers, with increasing jumps in the flow direction, inserted between the initial liquids. This type of displacements, the so called multi-layer Hele-Shaw model, was studied in some previous papers. We prove that such a "step" viscosity profile gives an unstable flow: the growth rates are boundless with respect to the wave numbers of perturbations. The same amount of intermediate liquid is used in both cases, but only the continuous "equivalent" viscosity can give us very small growth rates.*

Ovidiu Pasarescu (IMAR)

***Infons and Energons, the Two Faces of a String***

*In String Theory (a, mainly, mathematical theory these days, aiming to unify the Standard Model and Relativity in Physics, essentially taking into account the development of the Relativity Theory starting with an elementary particle, the Graviton, not yet experimentally discovered) a string is a tiny vibrating chord giving, function of its vibrations, all the elementary particles (and antiparticles). In order to give a specific*

*elementary particle (as photon, or graviton) the string must vibrate (so it needs energy) in some way - amplitude, frequency,...(so it needs information). We arrive at seeing the string as a combination of two formal particles, already considered in the literature, namely the "energon" and the "infony" (in fact, inseparable, like the two faces of a coin), see [S] . We consider here a model of the infons (see [GN]), mathematically based on the Non-standard Analysis in Topoi (the notion of Topos has been initially introduced by A. Grothendieck in Algebraic Geometry, see [RAI]). The non-standard extensions of topoi (the space where we consider that the infons live) have an intrinsic logic which is a conservative extension (as the non-standard analysis of A. Robinson is, see [RAb]) of the intuitionistic logic (multi-valued, specific to topoi), see [P], as the logic of infons is (see [GN]). We apply this model for an understanding of the human brain (where the consciousness is intuitionistic, and the union between subconsciousness and consciousness is a conservative extension of consciousness). We also apply the model in order to understand the empty space, considered as containing energy and information (in fact containing "virtual particles/antiparticles"=strings which appear in pairs from nothing and shortly the pairs cancel themselves); both information and energy are related to the second Principle of Thermodynamics, via Entropy (see [S]). We add that this model is based on a kind of Quantum Physics based on truth values of propositions instead of probabilities (the model has been already considered in Physics (see [DI], [F]), but without the non-standard extension). Moreover, the quantum intuitionistic logic is considered to be the analogue of the quantum logic, but in a quantum (Everett, or Tegmark rank 3) multiverse (see [T]), considered here as the right environmental space.*

#### REFERENCES:

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- [RAb] ROBINSON, Abraham, Non-standard Analysis, Princeton Univ. Press, 1966.
- [S] STONIER, Tom, Information and the Internal Structure of the Universe, Springer-Verlag, 1990.
- [T] Tegmark, Max, Our Mathematical Universe, 2013 (Romanian translation, Ed. ASCR Cluj-Napoca, 2014).

Radu Popescu (IMAR)

#### ***Resonance varieties. Definition and applications***

*Introduced by Falk in the context of hyperplane arrangements the resonance varieties became a very important tool in different areas of topology.*

*I will give examples of results obtained using resonance varieties.*

Elisabeth Remm (Mulhouse Univ.)

***Rigidity of Lie algebras***

*There are different notions of deformations: Gerstenhaber deformations, perturbations, valued deformations. We use these tools to study some properties of this variety. The concept of rigidity is also presented. Some results on the class of rigid Lie algebras are discussed.*

Laszlo Stacho (Szeged University)

***$C_0$  – semigroups of holomorphic Caratheodory spin–isometries***

*In a previous talk at DGA 2015, “On strongly continuous one-parameter semigroups of holomorphic isometries”, we presented a new approach via dynamical triangularization through joint fixed points and resulting in explicit formulas for the continuous one parameter groups and semigroups of the unit ball of a uniformly smooth Banach space. We now consider semigroups of holomorphic Caratheodory spin–isometries.*

Vilcu Gabriel-Eduard (UPG)

***Twistor forms on manifolds equipped with remarkable geometric structures***

*We investigate the existence of conformal Killing-Yano tensors on semi-Riemannian manifolds equipped with additional geometric structures. We also give a method for extracting the special Killing forms on some spaces of current interest. This talk is based on some joint works with M. Visinescu and V. Slesar.*

\* poster presentation / to be confirmed / other cases