Olga Rossi Commemorative Meeting
VŠB – Technical University of Ostrava, August 22, 2022
Abstracts of talks

Ján Brajerčík (University of Prešov)
Topology: Non-equivalent spherically symmetric solutions of the Einstein equations
Two topologically non-equivalent spherically symmetric solutions of the Einstein equations are discussed.

Pavel Exner (Doppler Institute for Mathematical Physics and Applied Mathematics, Prague)
Leaky quantum structures: geometry imprints in the spectrum
I am going to take you through one area where Olga's interests kept crossing with mine. The topic will concern Schrödinger operators with an attractive singular 'potential', supported by a manifold or a geometric complex of codimension one, formally written as $-\Delta - \alpha\delta(x-\Gamma)$; the focus will be on the ways in which spectral properties of such systems are influenced by the geometry of the interaction support, with the main attention paid to situations when the coupling constant is large or the geometric perturbation is weak, and asymptotic expansions can be derived. It will also be shown how these can be approximated by regular potentials or by arrays of point interactions, and discuss effects arising from the presence of a magnetic field, in particular, the influence of an Aharonov-Bohm flux on the so-called Welsh eigenvalues. Finally, if time allows a few words will be said about the analogous problem for Dirac operators.

Giovanni Falcone (University of Palermo)
Compact derivations of nilpotent Lie algebras, Olga Rossi's prompting in my scientific collaborations
Through some memories of a biennial project that gave me the privilege to meet Olga, I will express her my gratitude for having supported my collaboration with Rory Biggs and my talk at the "Differential Geometry and its Applications" conference in Brno, 2016. I will recap what I introduced in that occasion, into the broader frame of my further results. The talk will be as expository as possible. We classify finite-dimensional real nilpotent Lie algebras with 2-dimensional central commutator ideals admitting a Lie group of automorphisms isomorphic to $SO(2,\mathbb{R})$. More in general, we settle whether such a real nilpotent Lie algebra admits a compact Lie algebra of derivations. Along with the classification, we introduce the tools which have been used, where it seems to me that they can be of general interest: split quaternions, reduction to canonical form of a pair of (skew-)Hermitian forms, Wirtinger derivatives, and Weyl algebras.
Bibliography:
Rory Biggs, Giovanni Falcone, "A class of nilpotent Lie algebras admitting a compact subgroup of automorphisms", Differential Geometry and its Applications 54 (2017), 251–264.
Giovanni Falcone, Ágota Figula, "The action of a compact Lie group on nilpotent Lie algebras of type $\{n,2\}$", Forum Mathematicum 28 (2016), 795–806.

Demeter Krupka (Lepage Research Institute, Prešov)
On the Hamilton form in variational geometry
Regularity of the Lepage equivalents of second-order Lagrangians in field theory is discussed. In particular, it is shown that the Hilbert (scalar curvature) Lagrangian is regular, and the corresponding version of the Einstein-Hamilton equations is given. The talk is based on the paper: D. Krupka,

O. Stepankova, “On the Hamilton form in second order calculus of variations”, in: Proc. Internat. Meeting “Geometry and Physics”, Florence, October 1982, Pitagora, Bologna, 1983, 85–101.

Ari Laptev (Imperial College London)
A two dimensional version of Calogero inequality

Tom Mestdag (University of Antwerp)
Nonlinear splittings in geometric mechanics and Finsler geometry
In this talk I introduce the notion of a nonlinear splitting on a fibre bundle as a generalization of an Ehresmann connection. We derive the basic properties of this concept and show how it appears in the contexts of reduction of a Lagrangian system with a symmetry group, nonholonomic systems, and submersions between Finsler spaces. This talk is based on joint work with Sandor Hajdu.

Zoltán Muzsnay (University of Debrecen)
The inverse problem of the calculus of variations and the problem of metrizability
During long years of connection, I shared with Professor Olga Rossi the common interest, even the passion for the inverse problem of the calculus of variations of second-order differential equations (SODE). We discussed these topics many times by attending conferences, workshops, or visiting each other in Debrecen, Opava, or Brno. This talk introduces this topic and presents some tools and results that can be used effectively in the investigation of this problem. Special attention will be paid to the particular case of the metrizability problem of SODEs.

Geoff Prince (La Trobe University)
Covariant derivatives for Ehresmann connections
Covariant derivatives are constructed for some quite general Ehresmann connections on fibre bundles. A vertical endomorphism allows construction of covariant derivatives separately on both the vertical and horizontal distributions of the connection which can then be glued together on the total space. Application is made to some familiar situations. This is joint work with David Saunders.

David Saunders (Lepage Research Institute, Prešov)
Olga Rossi: Colleague and friend
I first met Olga in the summer of 1989. In this talk I shall combine a review of some of her mathematical work over these thirty years with memories and photographs of our collaboration and friendship.

Artur Sergyeyev (Silesian University, Opava)
Multidimensional integrability revisited
The search for partial differential systems that are integrable in the sense of soliton theory in the case of four independent variables, which is of utmost relevance for possible applications in physics, is a longstanding open problem that has attracted attention of many researchers. While for a long time it appeared that such systems are extremely scarce, we show that this is not really the case. Namely, we will present an explicit effective construction that produces two infinite families of such systems as well as e.g. the first example of an integrable system in four independent variables with a nonisospectral Lax pair which is algebraic, rather than rational, in the spectral parameter.

Dmitry Zenkov (North Carolina State University)

Hamel's formalism for continuum mechanics

Hamel's formalism is a representation of Lagrangian mechanics in which position and velocity are measured relative to different reference frames, leading to a notable reduction of complexity of equations of motion. This approach has originated in the work of Euler on the dynamics of rigid bodies and of d'Alembert and Euler on the dynamics of fluids. It has been made systematic around 1900, independently, by Maggi, Volterra, Boltzmann, Poincaré, and Hamel. Starting from the 1950s, it is also known as Kane's method following Professor Thomas Kane's success in applications of this approach to numerical simulations of complex mechanical systems. The talk will present a contemporary exposition of this formalism and will extend its utility to the dynamics and structure-preserving numerical algorithms in continuum mechanics. This is joint work with Anthony Bloch, Donghua Shi, Shan Gao, and Zhipeng An.

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