International
Scientific Conference

Algebraic and Geometric Methods of Analysis

Devoted to 160 anniversary of
Dvytro Grave
(25.08.1863 - 19.12.1939)
Academician of the Ukrainian Academy of Sciences, the first director of the Institute of Mathematics of NAS of Ukraine

May 29 – June 1, 2023
Odesa, Ukraine

List of topics

- Algebraic methods in geometry
- Differential geometry in the large
- Geometry and topology of differentiable manifolds
- General and algebraic topology
- Dynamical systems and their applications
- Geometric and topological methods in natural sciences
- Geometric problems in mathematical analysis

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Homotopies to Diffeomorphisms in Symplectic Field Theory

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Homotopies between non-compact Lagrangian submanifolds are considered, and using the Fukaya conjecture relative to the Witten deformation of higher product structures conforming a Fukaya category $\mathcal{W}(H)$, from the perspective of the Floer complexes, which determine diffeomorphisms $C_{-*}(\Omega_x) \to \mathcal{W}(H)$, whose space of paths go from $\gamma(x)$, to $\phi(x)$, foreseen in $HW^*(L_0, L_1) \cong H_{-*}(\mathcal{P}_{x_0,x_1})$. Then the field ramification of the space $C_{-*}(\Omega_x)$, is a connection obtained under the following commutative category scheme [1]:

$$\begin{array}{ccccc}
mod(B) & & \xrightarrow{\mathcal{R}^{-1}} & & C \\
\nearrow \quad \downarrow & & & & \nearrow \quad \downarrow \\
O_c(\phi) \in H(\mathrm{mod} f(C_{-*}(\Omega Z)) & \longrightarrow & H(\mathcal{M}) & & \mathcal{M} \\
\downarrow \quad \nearrow \Omega Z & & \to & \downarrow \mathrm{embb} & \nearrow \\
C_{-*}(\Omega_x) & & \xrightarrow{Diff} & & \mathcal{W}(H) \ni \phi
\end{array} \qquad (1)$$

Note. Here $\mathcal{W}(H)$, represents the wrappings of the flow of geodesics, which physically represents that happen in the dual space obtained for the product of the diffeomorphism given in the Čech complex defined by $C = \oplus_I \Gamma(U_I)[-d]$, that is to say, of the "states" $\phi(x)$, which are connected by the paths of the cohomology of the paths in Z, from $\phi(x_0)$, to $\phi(x_1)$. the other conjecture that must be planted is that as consequence of the derived categories scheme(1) is:

Conjecture 1. *Direction is time and translation is space in the space-time.*

Keywords: Čech Complex, Diffeomorphisms, Floer Cohomology, Fukaya Category, Homotopy, Lagrangian submanifolds.

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Global asymptotic stability of generalized homogeneous dynamical systems

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The equivalence between uniform asymptotic stability and exponential stability for generalized homogeneous non-autonomous differential equations

$$x' = f(t,x) \tag{1}$$

is established. This results we prove in the framework of general non-autonomous (cocycle) dynamical systems.

Let $\mathbb{R} := (-\infty, +\infty)$ and $C(\mathbb{R}\times\mathbb{R}^n, \mathbb{R}^n)$ be the space of all continuous functions $f : \mathbb{R}\times\mathbb{R}^n \to \mathbb{R}^n$ equipped with the compact-open topology. Denote by $(C(\mathbb{R}\times\mathbb{R}^n,\mathbb{R}^n),\mathbb{R},\sigma)$ the shift dynamical system on $C(\mathbb{R}\times\mathbb{R}^n,\mathbb{R}^n)$, i.e., $\sigma(\tau, f) := f^\tau$ and $f^\tau(t,x) := f(t+\tau,x)$ for any $t,\tau\in\mathbb{R}$ and $x\in\mathbb{R}^n$.

Along with equation (1) we consider its *H-class* [4, 2, 6, 10], i.e., the family of equations

$$v' = g(t,v), \tag{2}$$

where $g \in H(f) := \overline{\{f^\tau |\ \tau\in\mathbb{R}\}}$, $f^\tau(t,u) = f(t+\tau,u)$ for any $(t,u)\in\mathbb{R}\times\mathbb{R}^n$ and by bar we denote the closure in $C(\mathbb{R}\times\mathbb{R}^n,\mathbb{R}^n)$. We will suppose also that the function f is *regular* [9, ChIV], i.e., for every equation (2) the conditions of existence, uniqueness and extendability on $\mathbb{R}_+$ are fulfilled. Denote by $\varphi(t,v,g)$ the solution of equation (2), passing through the point $v\in\mathbb{R}^n$ at the initial moment $t=0$.

Let $\mathbb{R}^n$ with euclidian norm $|x| := \sqrt{x_1^2+\ldots+x_n^2}$. Denote by

$$|x|_{r,p} := \left(\Sigma_{i=1}^n |x_i|^{\frac{p}{r_i}}\right)^{\frac{1}{p}}, \tag{3}$$

where $r := (r_1,\ldots,r_n)$, $r_i > 0$ for any $i = 1,\ldots,n$ and $p\ge 1$. Denote by $\rho(x) := |x|_{r,p}$ and $\Lambda_\varepsilon^r := diag(\varepsilon^{r_i})_{i=1}^n$.

Definition 1. A function $f\in C(\mathbb{R}\times\mathbb{R}^n,\mathbb{R}^n)$ is said to be:

(1) r-homogeneous ($r\in(0,+\infty)^n$) of degree $m\in\mathbb{R}$ [7, 11] if $f(t,\Lambda_\varepsilon^r x) = \varepsilon^m\Lambda_\varepsilon^r f(t,x)$ for any $\varepsilon>0$ and $(t,x)\in\mathbb{R}\times\mathbb{R}^n$;

(2) Lagrange stable [4] if the set $H(f)$ is compact in $C(\mathbb{R}\times\mathbb{R}^n,\mathbb{R}^n)$.

Remark 2. If the function $f\in C(\mathbb{R}\times\mathbb{R}^n,\mathbb{R}^n)$ is r homogeneous of degree $m\ge 0$, then $f(t,0)=0$ for any $t\in\mathbb{R}$.

Definition 3. The trivial solution of equation (1) is said to be:

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