



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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according to the formula

$$(x, y)\tilde{\varphi} = ((x)\hat{\varphi}, (y)\hat{\varphi}), \quad x, y \in G^+.$$

Theorem 2. *Let G be an archimedean totally ordered group. Then the semigroup $\mathbf{End}^o(G)$ of o -endomorphisms of G is isomorphic to the semigroup $\mathbf{End}(\mathcal{B}^+(G))$ of endomorphisms of the monoid $\mathcal{B}^+(G)$.*

We define the category $\mathfrak{I}\mathfrak{O}\mathfrak{A}\mathfrak{G}$ by

- (1) $\mathbf{Ob}(\mathfrak{I}\mathfrak{O}\mathfrak{A}\mathfrak{G}) = \{G: G \text{ is an archimedean totally ordered group}\}$;
- (2) $\mathbf{Mor}(\mathfrak{I}\mathfrak{O}\mathfrak{A}\mathfrak{G})$ are o -homomorphisms of archimedean totally ordered groups,

and the category $\mathfrak{B}\mathfrak{E}\mathfrak{I}\mathfrak{O}\mathfrak{A}\mathfrak{G}$ in the following way

- (1) $\mathbf{Ob}(\mathfrak{B}\mathfrak{E}\mathfrak{I}\mathfrak{O}\mathfrak{A}\mathfrak{G})$ are bicyclic extensions $\mathcal{B}^+(G)$ of archimedean totally ordered groups $G \in \mathbf{Ob}(\mathfrak{I}\mathfrak{O}\mathfrak{A}\mathfrak{G})$;
- (2) $\mathbf{Mor}(\mathfrak{B}\mathfrak{E}\mathfrak{I}\mathfrak{O}\mathfrak{A}\mathfrak{G})$ are homomorphisms of monoids $\mathcal{B}^+(G) \in \mathbf{Ob}(\mathfrak{B}\mathfrak{E}\mathfrak{I}\mathfrak{O}\mathfrak{A}\mathfrak{G})$.

Theorem 3. *The categories $\mathfrak{I}\mathfrak{O}\mathfrak{A}\mathfrak{G}$ and $\mathfrak{B}\mathfrak{E}\mathfrak{I}\mathfrak{O}\mathfrak{A}\mathfrak{G}$ are isomorphic.*

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The Interaction of an Infinite Number of Eddy Flows

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The Boltzmann kinetic equation plays an important role in the kinetic theory of gases. In paper [2], we consider this equation for a model of hard spheres that describes particles of any gas which move translationally with a certain linear velocity, collide by the laws of classical mechanics and can not rotate. For this model, the equation has the form [1]

$$D(f) = Q(f, f), \quad (1)$$

$$D(f) \equiv \frac{\partial f}{\partial t} + \left(V, \frac{\partial f}{\partial x} \right), \quad (2)$$

$$Q(f, f) \equiv \frac{d^2}{2} \int_{R^3} dV_1 \int_{\Sigma} d\alpha |V - V_1, \alpha| \times \left[f(t, x, V_1') f(t, x, V') - f(t, x, V) f(t, x, V_1) \right], \quad (3)$$

and V, V_1, V', V_1' are the velocities of particles before and after collision, respectively, determined by the relations

$$V' = V - \alpha(V - V_1, \alpha),$$

$$V_1' = V_1 + \alpha(V - V_1, \alpha).$$

The solution to this equation will be look for in the next form

$$f(t, x, V) = \sum_{i=1}^{\infty} \varphi_i(t, x) M_i(t, x, V). \quad (4)$$

where $M_i(t, x, V)$ are the exact solutions of the equation (1)-(3)

$$D(M_i) = Q(M_i, M_i) = 0$$

and the coefficient functions $\varphi_i(t, x)$ are nonnegative smooth functions on \mathbb{R}^4 and $\varphi_i(t, x) \neq 0$.

As a value of the deviation between the parts of equation (1) we will consider a uniform-integral error of the form

$$\Delta = \Delta(\beta_i) = \sup_{(t,x) \in \mathbb{R}^4} \int_{\mathbb{R}^3} |D(f) - Q(f, f)| dV. \quad (5)$$

In the paper [2], several cases of coefficient functions $\varphi_i(t, x)$ were obtained for which the deviation (5) can be done arbitrarily small. This is possible thanks to a special selection of hydrodynamic flow parameters.

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Semi-Fredholm theory in unital C^* -algebras

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The Fredholm and semi-Fredholm theory on Hilbert and Banach spaces started by studying the integral equations introduced in the pioneering work by Fredholm in 1903 in [5]. After that, the abstract theory of Fredholm and semi-Fredholm operators on Hilbert and Banach spaces was further developed in numerous papers and books such as [1], [2] and [14]. In addition to classical semi-Fredholm theory on Hilbert and Banach spaces, several generalizations of this theory have been considered. Breuer for example started the development of Fredholm theory in von-Neumann algebras as a generalization of the classical Fredholm theory for operators on Hilbert spaces. In [3] and [4] he introduced the notion of a Fredholm operator in a von Neumann algebra and established its main properties. On the other hand, Fredholm theory on Hilbert C^* -modules as another generalization of the classical Fredholm theory on Hilbert spaces was started by Mishchenko and Fomenko. In [13] they introduced the notion of a Fredholm operator on the standard Hilbert C^* -module and proved a generalization in this setting of some of the main results from the classical Fredholm theory. In [6], [7], [8], [9] and [10] we went further in this direction and defined semi-Fredholm and semi-Weyl operators on Hilbert C^* -modules. We investigated and proved several properties of these new semi-Fredholm operators on Hilbert C^* -modules as a generalization of the results from the classical semi-Fredholm theory on Hilbert and Banach spaces. The interest

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