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Algebraic and Geometric Methods of Analysis

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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

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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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Characterizing Linear Mappings Through Unital Algebra

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In this paper, we characterize two linear mappings satisfying

$$x, y \in A, x \circ y^* = 0 \Rightarrow 0 = \delta(x) \circ y^* + x \circ \tau(y)^*$$

for all $x, y \in A$, where A be an algebra over a real or complex field K from a unital algebra into its unital bimodule. The structure of linear mappings behaving like Jordan derivations at commutative zero products has been studied extensively. We refer the reader to [1] and [2] for more details.
As is well known, the problem of linear mappings preserving fixed products is a very interesting item in the field of operator algebra. Derivations that can be completely determined by the local action on some subsets of algebra have attracted attention of many researchers. Historically, the study of derivation was initiated during the 1950s and 1960s. Derivations of rings got a tremendous development in 1957, when [3] established two very striking results in the case of prime rings.
We denote by $F(A)$ the subalgebra of A generated by all idempotents in A. Let A be an algebra. An A-bimodule M is said to have the property $\diamond$, if there is an ideal $J \subseteq F(A)$ of A such that $\{m \in M : xmx = 0$ for every $x \in J\} = 0$.

Theorem 1. *Let A be a unital algebra and M be a unital A-bimodule with the property $\diamond$. Suppose that δ is a linear mapping from A into M satisfying*

$$x, y \in A, x \circ y = 0 \Rightarrow \delta(x) \circ y - x \circ \delta(y) = 0$$

and each element of A has a weak inverse. Then A has zero ideal.

Theorem 2. *Let A be a unital algebra and M be a unital A-bimodule with the property $\diamond$. Suppose that δ and τ are linear mappings from A into M satisfying $x, y \in A, x \circ y = 0 \Rightarrow \delta(x) \circ y + x \circ \tau(y) = 0$ and $[A, (\delta - \tau)] = 0$. Then there exists a Jordan derivation $\triangle$ from A into M such that $\triangle(x) = 0$ for every x in A.*

Corollary 3. *Let A be a unital $*$-algebra and M be a unital $*$-A-bimodule with the property $\diamond$. If δ and τ are linear mappings from A into M satisfying*

$$x, y \in A, x \circ y^* = 0 \Rightarrow \delta(x) \circ y^* + x \circ \tau(y)^* = 0,$$

and A is a separating point of M. Then there exist Jordan derivations $\triangle$ and Γ from A into M and $\delta(A) = 0$.

References

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Edge resolvability and topological characteristics of zero-divisor graphs

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Definition 1. (Zero- Divisor Graph) Zero-divisor graph is a geometric representation of a commutative ring. Zero-divisor graph of ring R is denoted by $\Gamma(R) = (V(\Gamma), E(\Gamma))$, defined by a graph whose vertices are all elements of the zero-divisor set of a ring R, and two distinct vertices z_1 and z_2 are adjacent if and only if $z_1.z_2 = 0$.

Definition 2. (Metric Dimension) Let $G = (V(G), E(G))$ be a graph, and $S \subset V(G)$ be an ordered subset of the principal nodes set, defined as $s = \{\aleph_1, \aleph_2, \aleph_3, ..., \aleph_k\}$. Let $\aleph$ be any principal node in $V(G)$. The identification of a principal node $\aleph$ with respect to S is a k-ordered distance set $\big(d(\aleph, \aleph_1), d(\aleph, \aleph_2), ..., d(\aleph, \aleph_k)\big)$. If each principal node for $V(G)$ has a unique identification according to ordered subset S, then this subset is called resolving set of graph G. The minimum number of elements in the subset S is called the metric dimension of G.

Definition 3. [1] (Edge Metric Dimension) If in a simple and connected graph G, the distinct edges of G have distinct representation with respect to an ordered subset R of vertices of G, then S is known as edge resolving set of G. The minimal edge resolving set of G is called edge metric basis, and its cardinality is called edge metric dimension of G. The edge metric dimension of graph G is denoted by $edim(G)$.

These are some important findings

Theorem 4. [2] *For a graph G, we have*

$$edim(G) = \begin{cases} 1, & \text{iff } G = P_n, \text{ (Path graph)} \\ n-1, & \text{iff } G = K_n, \text{ (Complete graph)} \\ 2, & \text{if } G = C_n, \text{ (Cycle graph)} \\ n-2, & \text{if } G \cong K_{1,n} \text{ (except } K_{1,1}), \text{ or a bipartite graph} \end{cases}$$

Theorem 5. [3] *The diameter of $\Gamma(R) \leq 3$, where R is a commutative ring.*

Theorem 6. *The edge metric dimension of the zero-divisor graph of R is finite iff R is finite, where $R - \{0\}$ is a commutative ring but not an integral domain.*

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