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Infinite dimensional irreducible Lie algebras containing transformations of finite rank

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ABSTRACT

Let F be a field of characteristic zero and let V be an infinite dimensional vector space over F. A linear transformation x of V is called *finitary* if $\dim xV < \infty$.

We describe irreducible Lie subalgebras of $gl(V)$ containing nonzero finitary transformations. It turns out that any such algebra is a semidirect product of a finite dimensional Lie algebra and a "dense" Lie subalgebra of $gl(W)$ for some vector space W.

The proof is based on author's recent classification of finitary simple Lie algebras over fields of zero characteristic [1].

This result is a Lie algebra analog of classical Nathan Jacobson's [2, Ch.IX] description of the structure of irreducible associative rings containing finitary transformations, and Helmut Wielandt's [3] theorem saying that each primitive permutation group on an infinite set Ω which contains a nonidentity finitary permutation contains the (finitary) alternating group $\mathrm{Alt}(\Omega)$.

References

[1] A.A. Baranov, Finitary simple Lie algebras, *J. Algebra* 219 (1999), 299-329.

[2] N. Jacobson, Lectures in abstract algebra, II. Linear algebra, Van Nostrad, N.-Y., 1951.

[3] H. Wielandt, "Unendliche Permutationsgruppen", Lecture Notes, Universitat Tubingen, 1959.

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