Summary: We discuss an approach to the problem of calculating the local topological index of vector fields
given on complex spaces or varieties with singularities developed by the author over the past few years.
Our method is based on the study of the homology of a contravariant version of the classical Poincaré-de
Rham complex. This idea allows not only simplifying the calculations, but also clarifying the meaning
of the basic constructions underlying many papers on the subject. In particular, in the graded case, the
index can be expressed explicitly in terms of the elementary symmetric polynomials. We also considered
some useful applications in physics, mechanics, control theory, the theory of bifurcations, etc.

MSC:

32S65  Singularities of holomorphic vector fields and foliations
58K45  Singularities of vector fields, topological aspects
35N05  Overdetermined systems of PDEs with constant coefficients
81T13  Yang-Mills and other gauge theories in quantum field theory
81R15  Operator algebra methods applied to problems in quantum theory

Keywords:
singularities; vector fields; logarithmic differential forms; index theory; bifurcations; deformations; non-
linear analysis

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