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“Algebraic and Geometric Methods of Analysis”

Book of abstracts

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- 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 problems in mathematical analysis
- Geometric and topological methods in natural sciences
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Algorithms for solving an algebraic equation

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For finding global approximate solutions to an algebraic equation in n unknowns, the Hadamard open polygon for the case $n = 1$ and Hadamard polyhedron for the case $n = 2$ are used. The solutions thus found are transformed to the coordinate space by a translation (for $n = 1$) and by a change of coordinates that uses the curve uniformization (for $n = 2$). Next, algorithms for the local solution of the algebraic equation in the vicinity of its singular (critical) point for obtaining asymptotic expansions of one-dimensional and two-dimensional branches are presented for $n = 2$ and $n = 3$. Using the Newton polygon (for $n = 2$), the Newton polyhedron (for $n = 3$), and power transformations, this problem is reduced to situations similar to those occurring in the implicit function theorem. In particular, the local analysis of solutions to the equation in three unknowns leads to the uniformization problem of a plane curve and its transformation to the coordinate axis. Then, an asymptotic expansion of a part of the surface under examination can be obtained in the vicinity of this axis. Examples of such calculations are presented.

Для нахождения глобальных приближённых решений алгебраического уравнения с n неизвестными при $n = 1$ предлагается ломаная Адамара, а при $n = 2$ — многогранник Адамара. Найденные решения переводятся в координатное подпространство: для $n = 1$ — сдвигом, а для $n = 2$ — заменой координат, использующей униформизацию кривой. Затем излагаются алгоритмы локального решения алгебраического уравнения вблизи особой (критической) точки для $n = 2$ и $n = 3$ для получения асимптотических разложений одномерных и двумерных ветвей. С помощью многоугольника Ньютона (при $n = 2$), многогранника Ньютона (при $n = 3$) и степенных преобразований эта задача сводится к ситуациям, аналогичным теореме о неявной функции. В частности, при локальном анализе решений одного уравнения от трёх неизвестных приходим к задаче об униформизации плоской алгебраической кривой и преобразовании её в координатную ось. После этого вблизи этой оси можно получить асимптотическое разложение куска изучаемой поверхности. Приведены примеры таких вычислений.

References

[1] Alexander Bruno. Algorithms for solving an algebraic equation. *Programming and Computer Software*, 44(6) : 533–545, 2018. DOI: 10.1134/S0361768819100013 = Алгоритмы решения одного алгебраического уравнения. *Программирование*, 45(1) : 59–71, 2019. DOI: 10.1134/S0132347419010084

Зміст