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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Planar and non-planar degenerations with related fundamental groups

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We study planar and non-planar degenerations that are related to algebraic surfaces. It is interesting to see the differences in results and research methods between both cases. We have studied already planar degenerations with an R_k singularity, non-planar degenerations of degree 4, 6, and 8. The fundamental groups of the Galois covers of the related surfaces were investigated, because those groups are invariants of classification of algebraic surfaces in the moduli space.

Theorem 1. *The fundamental groups of surfaces that degenerate to one R_k singularity are all trivial, for any k.*

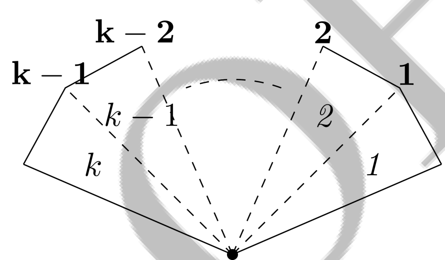

Figure 1.1. R_k singularity

Theorem 2. *The fundamental groups of Galois covers related to non-planar degenerations are trivial (for a degree 4 degeneration), $\mathbb{Z}_2^4$ (for a degree 6 degeneration), and a metabelian group of order 2^{23} (for a degree 8 degeneration).*

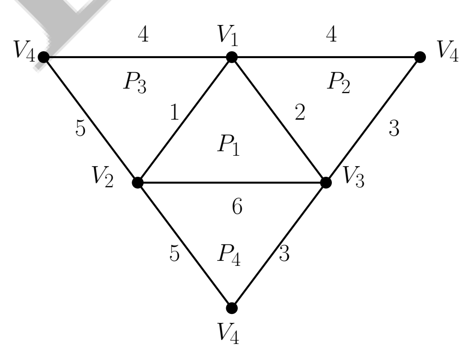

Figure 2.2. Degree 4 non-planar degeneration

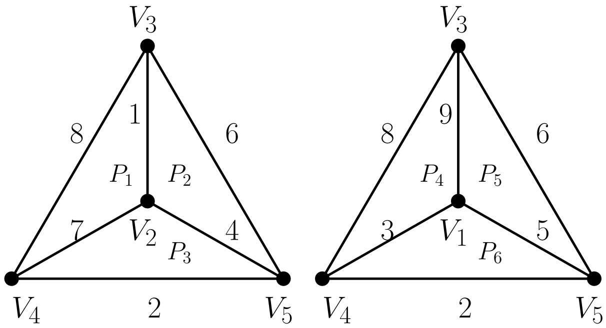

FIGURE 2.3. Degree 6 non-planar degeneration

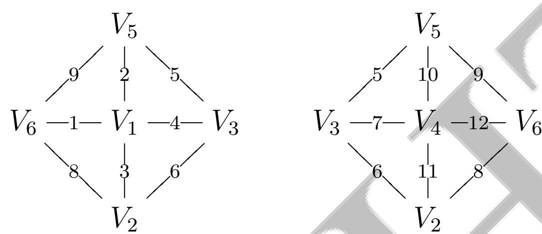

FIGURE 2.4. Degree 8 non-planar degeneration

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Surfaces with zero mean curvature vector in 4-dimensional spaces

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Let (N, h) be an oriented Riemannian 4-manifold. Let $\bigwedge^2 TN$ be the 2-fold exterior power of the tangent bundle TN of N. Then $\bigwedge^2 TN$ is a vector bundle of rank 6 over N and Hodge's $*$-operator gives a bundle decomposition $\bigwedge^2 TN = \bigwedge^2_+ TN \oplus \bigwedge^2_- TN$ by two subbundles $\bigwedge^2_\pm TN$ of rank 3. The twistor spaces associated with N are the sphere bundles in $\bigwedge^2_\pm TN$ and denoted by $U\big(\bigwedge^2_\pm TN\big)$. We can refer to [5] for twistor spaces. Let M be a Riemann surface and $F : M \longrightarrow N$ a conformal and minimal immersion. Let F^*TN be the pull-back bundle on M by F. Then F gives its twistor lifts, which are sections of $U\big(\bigwedge^2_\pm F^*TN\big)$. Let

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