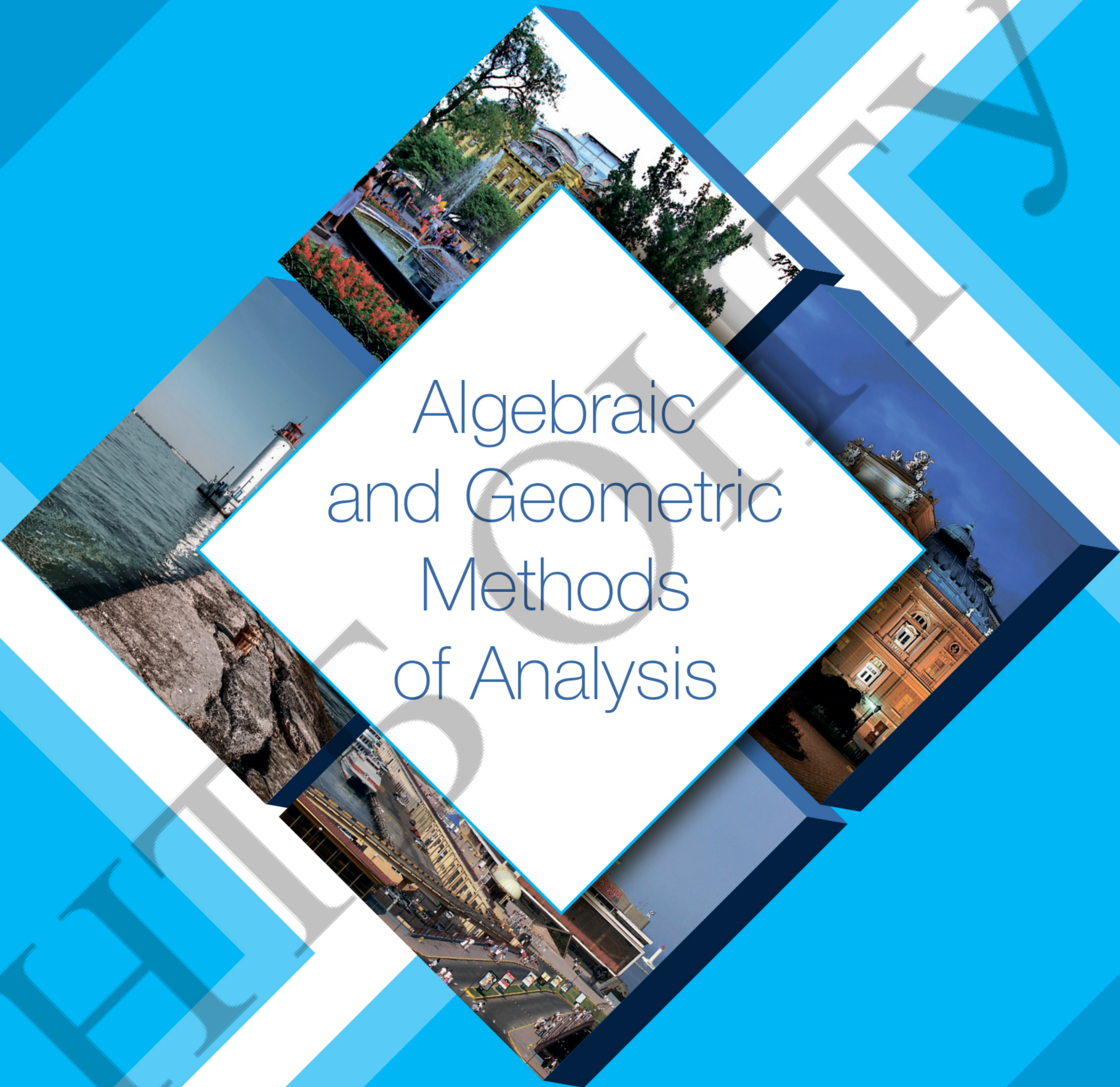
International
Scientific Conference



Algebraic and Geometric Methods of Analysis

27-30 May 2024

Odesa, Ukraine

The purpose of this conference is to bring together researchers in geometry, topology, algebra, analysis and dynamical systems and to provide for them a forum to present their recent work to colleagues from different nationalities. This way we aim to stimulate discussion about the latest findings in geometrical and topological methods in analysis and to increase international collaboration.

The conference continues the traditional annual conference «Geometry in Odesa» holding from 2004, and hosted by Odesa National University of Technology (Odesa National Academy of Food Technologies till 2021). From 2017 the conference was renamed to «Algebraic and geometric methods of analysis» (AGMA).

The Conference languages: Ukrainian and English.

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

Organizers

- Ministry of Education and Science of Ukraine
- Odesa National University of Technology, Ukraine
- Institute of Mathematics of the National Academy of Sciences of Ukraine
- Taras Shevchenko National University of Kyiv
- Kyiv Mathematical Society

Scientific Committee

- **Vladimir Balan** (*Bucharest, Romania*)
- **Taras Banakh** (*Lviv, Ukraine*)
- **Dmytro Bolotov** (*Kharkiv, Ukraine*)
- **Vyacheslav Boyko** (*Kyiv, Ukraine*)
- **Yulia Fedchenko** (*Odesa, Ukraine*)
- **Oleg Gutik** (*Lviv, Ukraine*)
- **Olena Karlova** (*Chernivtsi, Ukraine*)
- **Volodymyr Kiosak** (*Odesa, Ukraine*)
- **Nadiia Konovenko** (*Odesa, Ukraine*)
- **Volodymyr Lyubashenko** (*Kyiv, Ukraine*)
- **Sergiy Maksymenko** (*Kyiv, Ukraine*)
- **Koji Matsumoto** (*Yamagata, Japan*)
- **Piotr Mormul** (*Warsaw, Poland*)
- **Maryna Nesterenko** (*Kyiv, Ukraine*)
- **Roman Popovych** (*Kyiv, Ukraine*)
- **Alexandr Prishlyak** (*Kyiv, Ukraine*)
- **Aleksandr Savchenko** (*Kherson, Ukraine*)

Organizing commitee

- **Nadiia Konovenko** (*Odesa, Ukraine*)
- **Yuliya Fedchenko** (*Odesa, Ukraine*)
- **Mykola Lysynskiy** (*Kyiv, Ukraine*)
- **Bohdan Mazhar** (*Kyiv, Ukraine*)
- **Sergiy Maksymenko** (*Kyiv, Ukraine*)
- **Alexandr Prishlyak** (*Kyiv, Ukraine*)

Dynamics of influenza with the rates of vaccination and treatment

Canan Vural
(Istanbul University, Faculty of Science, Department of Mathematics, Istanbul, Turkey)
E-mail: canan.vural@istanbul.edu.tr

Elif Demir
(Yildiz Technical University, Faculty of Science and Arts, Department of Mathematics, Istanbul, Turkey)
E-mail: edbilek@yildiz.edu.tr

Influenza is one of the most common diseases worldwide. In this work, we investigate the dynamics of influenza effected by vaccination and treatment with an SIR model that includes Caputo type fractional derivative. These dynamics are explained with this model by using Fractional Backward Euler Method [1].

Remark 1. This is a joint work with Elif Demir. This work is supported by the Scientific and Technological Research Council of Turkey (TUBITAK) Grant No: BIDEB2210A and Yildiz Technical University Scientific Research Projects Coordination Department with Project Number FYL-2023-5925.

References

[1] P. Tomášek, On Euler methods for Caputo fractional differential equations. *Archivum Mathematicum*, 59 : 287–294, 2023.

Topology of the Hilbert Schemes of monomial plane curve singularities

Masahiro Watari
(University of Kuala Lumpur, Malaysia France Institute, Japanese Collaboration Program Section 14, Jalan Damai, Seksyen 14, 43650
Bandar Baru Bangi, Selengor, Malaysia)
E-mail: masahiro@unikl.edu.my

Let X be a singular irreducible plane curve over $\mathbb{C}$. For a singular point o of X, we refer to the pair (X, o) as a plane curve singularity. Let $\mathcal{O}_{X,o}$ (resp. Γ) be the local ting of (X, o) (resp. the semi-group associated with (X, o)). We denote by $\mathrm{Hilb}^r(X, o)$ the punctual Hilbert scheme of degree r for a given singularity (X, o). Piontkowski [1] studied the topology of the Jacobian factor $J_{X,o}$ for a plane curve singularity (X, o) with $\Gamma = \langle p, q\rangle$ $(\gcd(p, q) = 1)$. He showed the existence of an affine cell decomposition of the Jocobi factor $J_{X,o}$ and the Euler number of J_X and the Betti numbers of J_X are described. In this talk, we generalize Piontkowski's results to the cases of the punctual Hilbert schemes of (X, o).

In this talk, we always consider the plane curve singularity whose local ring $\mathcal{O}_{X,o}$ is $\mathbb{C}[[t^p, t^q]]$ where $\gcd(p, q) = 1$. Then such a singularity has $\Gamma = \langle p, q\rangle$ as its semi-group. Let $\mathrm{Mod}(\Gamma)$ be the set of all Γ-semi-modules. Defining $\mathrm{codim}\Delta := \#(S \setminus \Delta)$, we set $\mathrm{Mod}^r(\Gamma) := \{\Delta \in \mathrm{Mod}(\Gamma) | \, \mathrm{codim}\Delta = r\}$.

It is known that the components of $\mathrm{Hilb}^r(X,o)$ is parametrized by the elements of $\mathrm{Mod}^r(\Gamma)$.

$$\mathrm{Hilb}^r(X,o) = \bigcup_{\Delta \in \mathrm{Mod}^r(\Gamma)} H(\Delta) \tag{1}$$

The component $H(\Delta)$ in (1) is called the Δ-subset of $\mathrm{Hilb}^r(X,o)$.

Theorem 1. *Let (X,o) be a plane curve singularity whose local ring $\mathcal{O}_{X,o}$ is $\mathbb{C}[[t^p,t^q]]$ where $\gcd(p,q)=1$. Each Δ-subset $H(\Delta)$ in (1) is isomorphic to an affine space whose dimension is given by*

$$\sum_{i=1}^{p-1} \#[\{(\Gamma - \min\Delta) \cap [a_i, a_i+q]\} \setminus \Delta^{(0)}]. \tag{2}$$

Here $\Delta^{(0)}$ is the 0-nomalization of Δ and $\{a_0,\dots,a_{p-1}\}$ is the p-basis of $\Delta^{(0)}$.

The following fact follows from Theorem 1

Corollary 2. *Let (X,o) be a plane curve singularity with $\mathcal{O}_{X,o} = \mathbb{C}[[t^p,t^q]]$ $(\gcd(p,q)=1)$. The Euler number of $\mathrm{Hilb}^r(X,o)$ is equal to $\#\mathrm{Mod}^r(\Gamma)$.*

We denote by $e(\mathrm{Hilb}^r(X,o))$ the Euler number of $\mathrm{Hilb}^r(X,o)$.

Example 3. The Euler numbers of the punctual Hilbert schemes for the A_{2l}-singularity are given in the following table:

r	$0 \le r \le 2l$	$r \ge 2l+1$
$e(\mathrm{Hilb}^r(X,o))$	$[r/2]+1$	$l+1$

Here the notaion $[a]$ $(a \in \mathbb{R})$ is the biggest integer that is smaller than a.

Setting $\mathrm{codim}\, H(\Delta) := \dim \mathrm{Hilb}^r(X,o) - \dim\, H(\Delta)$, we define

$$\mathcal{H}_{r,d} := \{H(\Delta) \,|\, \Delta \in \mathrm{Mod}^r(\Gamma) \text{ and } \dim H(\Delta) = d\},$$
$$\mathcal{H}_r^d := \{H(\Delta) \,|\, \Delta \in \mathrm{Mod}^r(\Gamma) \text{ and } \mathrm{codim}\, H(\Delta) = d\}.$$

Theorem 4. *Let (X,o) be a plane curve singularity with the local ring $\mathbb{C}[[t^p,t^q]]$ $(\gcd(p,q)=1)$. Then the odd (co-) homology groups of $\mathrm{Hilb}^r(X,o)$ are zero. The even (co-) homology groups of $\mathrm{Hilb}^r(X,o)$ are free abelian groups with Betti numbers*

$$h_{2d}(\mathrm{Hilb}^r(X,o)) = \#\mathcal{H}_{r,d} \text{ and } h^{2d}(\mathrm{Hilb}^r(X,o)) = \#\mathcal{H}_r^d.$$

Example 5. The even (co-) homology groups of $\mathrm{Hilb}^r(X,o)$ for the A_{2l}-singularity are given in the following table:

r	$0 \le r \le 2l$	$r \ge 2l+1$
d	$0 \le d \le r$	$0 \le d \le l$
$h_{2d}(\mathrm{Hilb}^r(X,o))$	1	1
$h^{2d}(\mathrm{Hilb}^r(X,o))$	1	1

References

[1] J. Piontkowski, Topology of the compactified Jacobians of singular curves. Math. Z. **255** (2007), 195–226.