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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Shape optimization in the batch crystallization of CAM

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The citric acid monohydrate (CAM) is an important organic substance but, until 1997, the scientific literature covered mostly the kinetics of nucleation [4] and the crystal growth [5] rather than its production via the crystallization by cooling in a stirred tank reactor (STR). The Department of Chemical Engineering at the University "La Sapienza" of Rome decided to fill that sci-tech gap through a meticulous investigation, with three STRs at the laboratories of San Pietro in Vincoli's district, on the crystallization in discontinuous (batch) of CAM from aqueous solutions. The author participated in that cutting edge experience, as experimenter and coder under the supervision of Prof. Barbara Mazzarotta, in the years 1997-1998 [1]. Our specific tasks were to spot the main operating conditions, to modify them until an *optimal* crystal size distribution (CSD), i.e., large-sized homogeneous crystals of CAM, and to write a QBasic program predicting the outcomes of any test in batch reactors [2]. Here we focus on the influence of the STRs' geometry, i.e., the role played by the tanks in crystallizing the CAM thanks to their differently shaped bottoms (flat, hemispherical, conical). All the data, collected and simulated, show that the round-bottomed crystallizer gives the best CSD, performing better than the conical-bottomed STR, and that we should discard the flat-bottomed STR for the poor quality of its crystalline product [3]. The homogenous distribution of large crystals from the round-bottomed STR is due to the *optimal* suspension state that such shape provides for the dispersed phase of CAM particles [6], as confirmed by the computational fluid-dynamics software `VisiMix`.

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Homotopies to Diffeomorphisms in Symplectic Field Theory

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Homotopies between non-compact Lagrangian submanifolds are considered, and using the Fukaya conjecture relative to the Witten deformation of higher product structures conforming a Fukaya category $\mathcal{W}(H)$, from the perspective of the Floer complexes, which determine diffeomorphisms $C_{-*}(\Omega_x) \to \mathcal{W}(H)$, whose space of paths go from $\gamma(x)$, to $\phi(x)$, foreseen in $HW^*(L_0, L_1) \cong H_{-*}(\mathcal{P}_{x_0,x_1})$. Then the field ramification of the space $C_{-*}(\Omega_x)$, is a connection obtained under the following commutative category scheme [1]:

$$\begin{array}{ccccc} mod(B) & & \xrightarrow{\mathcal{R}^{-1}} & & C \\ \nearrow \quad \downarrow & & & & \nearrow \; \downarrow \\ O_c(\phi) \in H(\mathrm{mod} f(C_{-*}(\Omega Z)) & & \longrightarrow H(\mathcal{M}) & & \mathcal{M} \\ \downarrow \qquad \nearrow \Omega Z & & \to & \downarrow \mathrm{embb} & \nearrow \\ C_{-*}(\Omega_x) & & \xrightarrow{Diff} & \mathcal{W}(H) \ni \phi & \end{array} \tag{1}$$

Note. Here $\mathcal{W}(H)$, represents the wrappings of the flow of geodesics, which physically represents that happen in the dual space obtained for the product of the diffeomorphism given in the Čech complex defined by $C = \oplus_I \Gamma(U_I)[-d]$, that is to say, of the "states" $\phi(x)$, which are connected by the paths of the cohomology of the paths in Z, from $\phi(x_0)$, to $\phi(x_1)$. the other conjecture that must be planted is that as consequence of the derived categories scheme(1) is:

Conjecture 1. *Direction is time and translation is space in the space-time.*

Keywords: Čech Complex, Diffeomorphisms, Floer Cohomology, Fukaya Category, Homotopy, Lagrangian submanifolds.

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