

报告题目与摘要

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Nakano positivity may not imply Hodge-Riemann property

Let M be a (k, k) matrix whose entries are constant $(1,1)$ -forms on $\mathbb{C}^n$. Let $\Omega = \det M$. Dinh-Nguyen asked whether the Griffiths positivity of M implies the Hard Lefschetz or the Hodge-Riemann properties of Ω .

I will present the counterexamples found by AI, the proof under additional conditions, and Mathematics behind.

When $k = 0, 1$, this is trivially true.

When M is diagonal, Dinh-Nguyen proved it is true.

When $n \geq 4$ and $2 \leq k \leq n - 2$, AI constructed counterexamples.

Assume that all entries of M can be simultaneously diagonalized (SD condition), Chen proved that when $n = 4, 5$ and $k = 2$ it is true.

When $n \geq 6$ and $2 \leq k \leq n - 4$, AI constructed counterexamples under SD condition.

When $k = n - 2 \geq 2$ or $k = n - 3 \geq 2$, we prove that DN question has affirmative answer under SD condition.

The proof uses dually Lorentzian polynomials and generalized Alexandrov-Fenchel inequality.

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多智能体协作驱动数学研究：范式、应用与实践

基础数学研究正面临新的智能化机遇：多智能体系统可以通过分工协作、互相验证与迭代改进，处理远超单一模型能力的数学推理任务。本报告在梳理 AI for Math 背景与多智能体基础概念之后，结合典型工作，讨论多智能体在定理证明、形式化、数学猜想生成与反例搜索等基础数学场景中的应用方式与优势。随后，我们将汇报团队在相关方向上的实践探索，包括智能体角色设计、研究过程可视化与人机交互机制，并分析当前方法的有效性与局限性。最后，报告呼吁以 AI-Native 的思维重构基础数学研究流程，让多智能体成为数学家探索未知结构的新工具与新伙伴。

刘济豪 北京大学

The Yau-Tian-Donaldson Conjecture for constant scalar curvature metrics

In this talk I will discuss my recent construction of a smooth projective polarized fivefold which is K-polystable but does not admit any cscK metrics, hence disproves the Yau-Tian-Donaldson Conjecture for constant scalar curvature metrics (Donaldson 2002 paper's version/wikipedia version). The talk will be half mathematics (a sketch of the disproof will be provided) and half on the use of AI, particularly the Danus system, for providing the disproof. The talk is based on an AI-generated, human-verified work of the speaker whose verification was assisted by Bin Dong and Guoxiong Gao (from the AI side) and Chi Li, Gang Tian, and Kewei Zhang (from the math side).

许超 电子科技大学

数学 Harness 的设计与实验

数学 Harness 的目标，是在有限预算内，将自然语言数学问题转化为正确且可独立检查的证明或反例。它的核心任务是在 exploration 与 verification 之间分配计算：前者寻找证明路线，后者判断哪些结论可以进入可信状态。

本报告分析多个 Harness 在相同数学问题上的运行。实验显示，推理部分往往只占总支出的少数，大量预算用于重复处理上下文、协调和可见输出。与此同时，增加推理或编排步骤也未必提高求解能力。这些现象表明，现有 Harness 在计算分配和验证机制上仍有很大改进空间。

沿着 The Bitter Lesson，本报告讨论一种面向持续模型升级的设计哲学：少把人工设计的数学技巧固化为复杂流程，多建设能够随模型和算力扩展的通用探索与验证机制。评价 Harness 时，需同时衡量能力与计算成本，判断复杂机制是否真正带来更多正确结果，而不只是更多调用和 token 消耗。

于飞 浙江大学

Non-asphericity and Higher Homotopy of Strata of Differentials and Stability Spaces

We study the topology of strata of differentials and related spaces of Bridgeland stability conditions. In genus one, we show that when the number of zeros or poles is at least four, every connected component of the stratum of differentials with prescribed zero and pole orders is not an orbifold $K(\pi, 1)$. Our method also detects explicit nontrivial higher homotopy groups of these strata. For quadratic differentials, this provides infinitely many counterexamples to a conjecture attributed to Kontsevich, as well as to a folklore conjecture concerning the contractibility of spaces of Bridgeland stability conditions.

I will also discuss some recent developments in higher genus.

This is joint work with Dawei Chen, Jingyin Huang, and Yu Qiu, with AI assistance.