Publication in Mathematics

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Preprints

Mixed characteristic Geometric Casselman Shalika Formula, arXiv:2408.07953, **submitted**. In this joint work with Ashwin Iyengar (American Mathematical Society) and Konrad Zou (Bonn University), we prove the geometric Casselma–Shalika formula in the setting of Witt vector Grassmanian.

Integral aspects of Fourier Duality, arXiv:2407.06184, **submitted**. In this joint work, we prove several results regarding integral versions of Fourier duality for abelian schemes, using Pappas' work on integral Grothendieck–Riemann–Roch.

In progress

Relative Langlands on the Fargues Fontaine, the Iwasawa Tate case, joint with Yuta Takaya (Tokyo University). We explicitly compare the period and L-sheaves under the relative Langlands conjectures of Ben-Zvi-Sakellaridis-Venkatesh.

Mixed characteristic Iwahori-Whittaker equivalence, joint with Konrad Zou (Bonn University), this is an application of the previous paper on Casselman-Shalika Formula, where we also prove basic properties of categorical actions in the l-adic setting.

Geometric categorical deformations, examples, joint with Anish Chedalavada (Johns Hopkins University). We are attempting to work on Lurie's 2010 ICM address on deformations of quantum groups.

Stacky approach to motivic periods, We give a "stacky interpretation" of periods defined by F. Brown and P. Deligne.

Projects in AI

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This section highlights exploratory projects and work notes that reflect my developing interests in AI and machine learning. These efforts include experimental and theoretical explorations, focusing on areas such as ethical AI, multilingual natural language processing, and the intersection of AI and mathematics.

Past Projects

Spoken MASSIVE Joint with Chutong Meng (George Mason University), this project studies synthetic data in spoken language understanding (SLU). We created the first multilingual SLU dataset by synthesizing data from MASSIVE and trained SLU models for evaluation.

Emotion Fine-Tuning An experimental project with Prof. Levine (Cornell University), exploring the role of emotion in AI behavior. The study investigates whether emotional feedback can rival reinforcement learning from human feedback (RLHF) in improving model performance.

Mitigating Social Biases in Language Models with Adversarial Debate Joint work with Cole Molloy and Lois Wang (Johns Hopkins University). We structured in-context adversarial debates between language models to mitigate biases in pretrained models.

Some Thoughts on AI and Mathematical Research (2023) Written with Sina Hazratpour (Johns Hopkins University), this article surveys the impact of large language models in the theorem-proving community.

In Progress

Polytope Decomposition of Weight Spaces for Associative Memory Networks Joint with Chris Hillar (Redwood Research, Berkeley), this study investigates the relationship between polytopal decomposition, scaling, and memory capacity in associative memory networks.

Dense Associative Memories Beyond Storage Capacity Joint with Muhan Gao (Johns Hopkins University), this project empirically studies dense associative memory networks as developed by Krotov and Hopfield in language modeling tasks, particularly in scenarios where stored memories exceed theoretical capacity limits.