# Research Profile - Zheng "Leslie" Chen

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# Numerical Simulations for Nonsmooth Problems

- **Goal:** Resolve accuracy issues in functions with singularities.
- **Projects:**
  - Innovative reconstruction methods to recover high accuracy.
  - Singularity-enriched basis for LDG methods to capture the singular solutions.
  - Neural network-based approach for singularity detection.

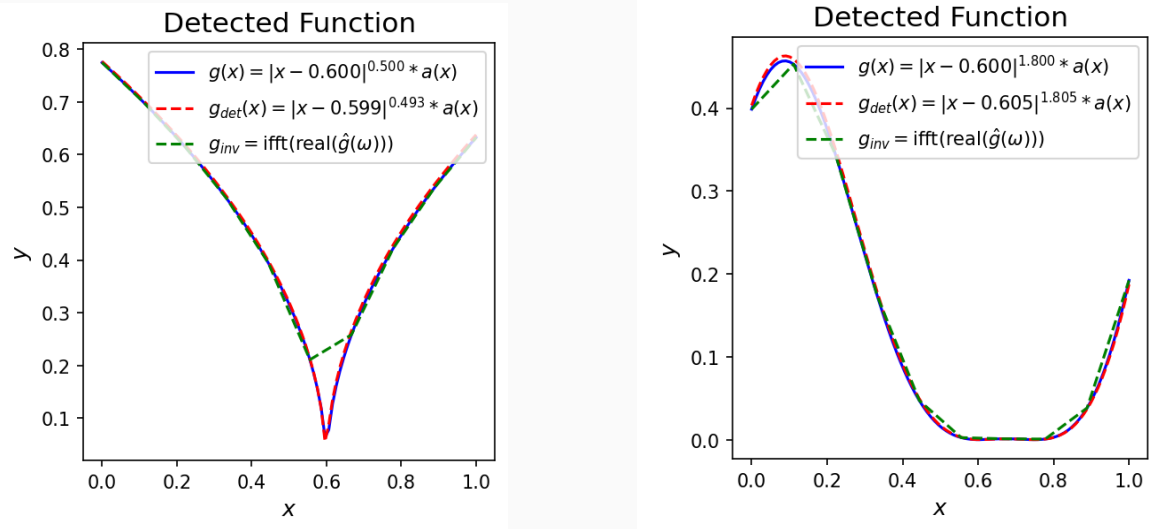
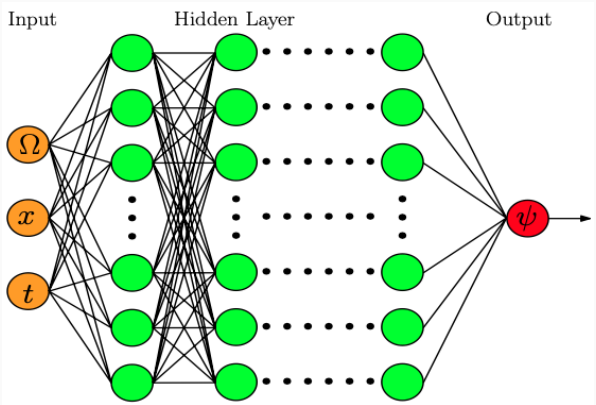



**Figure 1:** Comparison of example singular functions, detected functions, and their inverse DFTs.

# Numerical Methods for Kinetic Models

- **Focus:** Develop efficient and accurate methods for kinetic models.
- **Projects:**
  - Stochastic Galerkin framework for kinetic models with uncertainties.
  - Fast solvers for kinetic models.
  - Application of deep neural networks.



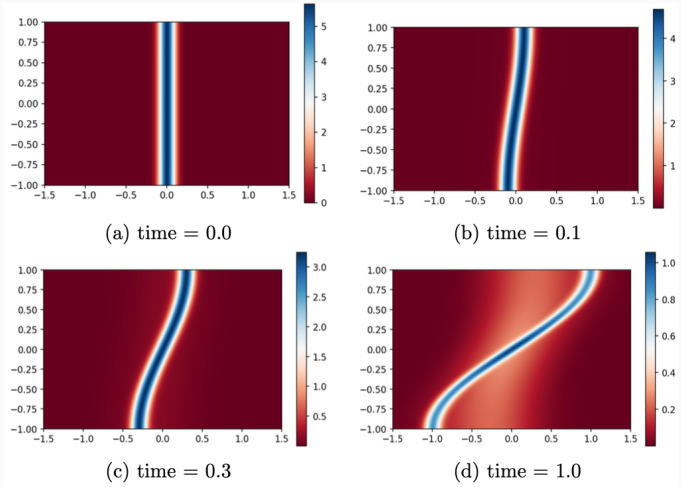




**Figure 2:** Solving linear transport equations by a deep neural network approach.

# High-Order Numerical Methods

- **Dedication:** Innovate high-order numerical schemes for other model PDEs.
- **Projects:**
  - Ongoing work on interpolation methods for parametric differential equations.
  - Third-order Maximum-Principle-Satisfying direct discontinuous Galerkin (DDG) methods for time-dependent convection-diffusion equations on unstructured triangular meshes

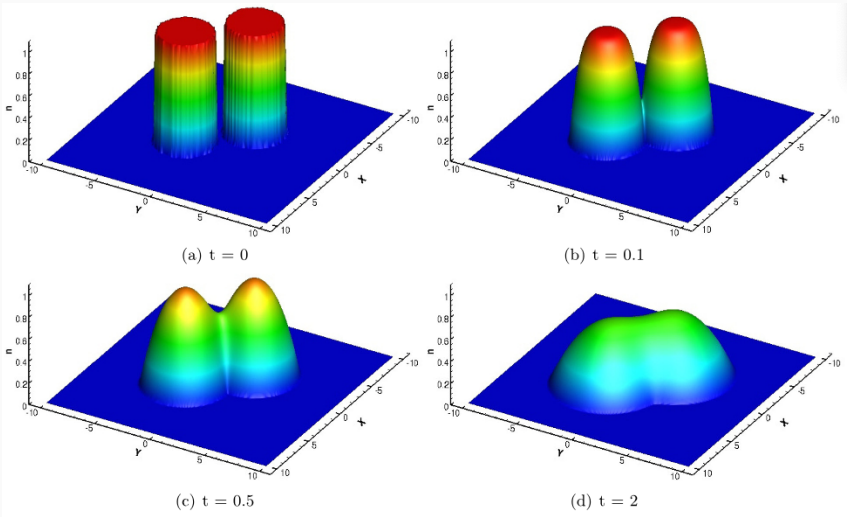



**Figure 3:** Nonlinear porous medium problem

# Mathematical Applications Across Diverse Disciplines

- **Dedication:** Apply mathematical tools to various scientific fields.
- **Collaborations:**
  - Accounting: Impact of generalist CEOs on 10-K report readability.
  - Civil Engineering: Machine learning for material behavior analysis.

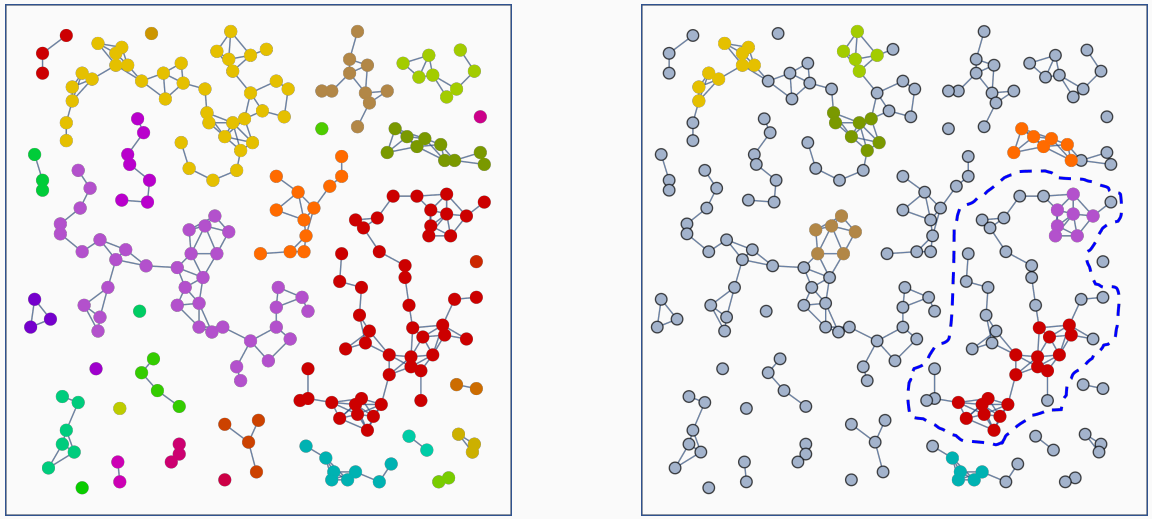


**Figure 4:** Use graph theory feature to characterize the material microscopic texture.