

# Neural Implicit Flow (NIF)

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# Problem Statement

- Spatio-temporal data modeled by PDEs is computationally challenging.
  - Examples: turbulence modeling, sparse sensing, surrogate modeling
- Current reduction methods (SVD, CAE) fail with variable geometry or adaptive meshing.
- Need for a scalable, mesh-agnostic approach for real-time engineering applications.

# New Approach: Neural Implicit Flow (NIF)

- Combines two neural networks:
  - **ShapeNet**: Encodes spatial complexity mesh-agnostically.
  - **ParameterNet**: Models temporal and parametric dependencies.
- Provides efficient, nonlinear dimensionality reduction and interpretable representations.

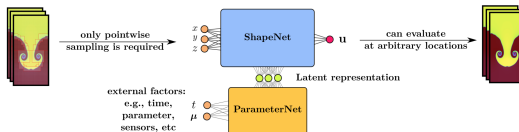


Figure: NIF Hypernetwork Architecture

# Key Results

- 40% better generalization performance compared to conventional methods.
- Scalable to adaptive mesh and complex spatio-temporal datasets.