Agenda

- Welcome
  - Number of participants, background, etc..
- Goal, Frequency
  - Similar to an academic lab.
  - Read and discuss papers, share resources
  - Network and collaborate
- Papers, presenter
  - Presenter every week, either to present or lead the discussion
  - Flexibility as long as it is related to 3D (neural fields, explicit representations, vision, robotics, ..)

Agenda

- Format
  - Very informal, slides or summary are preferred but not required.
  - Clear the following: Prerequisites – What – Why – How

- Conferences – CVPR?

Neural Fields in Visual Computing and Beyond

Yiheng Xie[1,2] Towaki Takikawa[3,4] Shunsuke Saito[5] Or Litany[4] Shiqin Yan[1] Numair Khan[1] Federico Tombari[6,7]
James Tompkin[1] Vincent Sitzmann[8†] Srinath Sridhar[1†]

[1]Brown University [2]Unity Technologies [3]University of Toronto [4]NVIDIA [5]Meta Reality Labs Research [6]Google [7]Technical University of Munich
[8]Massachusetts Institute of Technology †*Equal advising*

Presenter: Mauro Comi @mauro_ai

Neural Fields in Visual Computing and Beyond

Prerequisites

- Fundamental of Deep Learning and optimisation
- Encoder – Decoder architectures
- Knowledge of explicit representations (point cloud, mesh, etc..)

Neural Fields in Visual Computing and Beyond

What

- Describe neural fields techniques with consistent notation
- Describe neural fields applications

Neural Fields in Visual Computing and Beyond

Example: NeRF!

Neural Fields in Visual Computing and Beyond

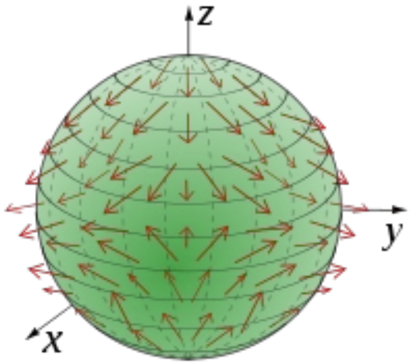
Why

- No standard terminology
- "Selective amnesia" a.k.a research repetition
- Provide an overview of the state of the field

Neural Fields in Visual Computing and Beyond

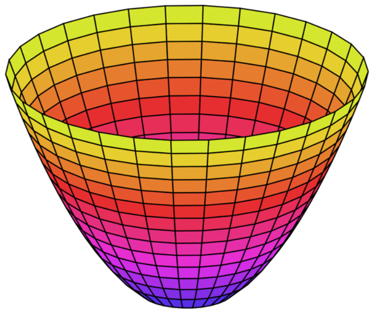
Definitions

- A **field** is a quantity defined for all spatial and/or temporal coordinates.



Vector field

Image



Explicit surface

- A **neural field** is a field that is parametrised by a neural network.

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Typical pipeline

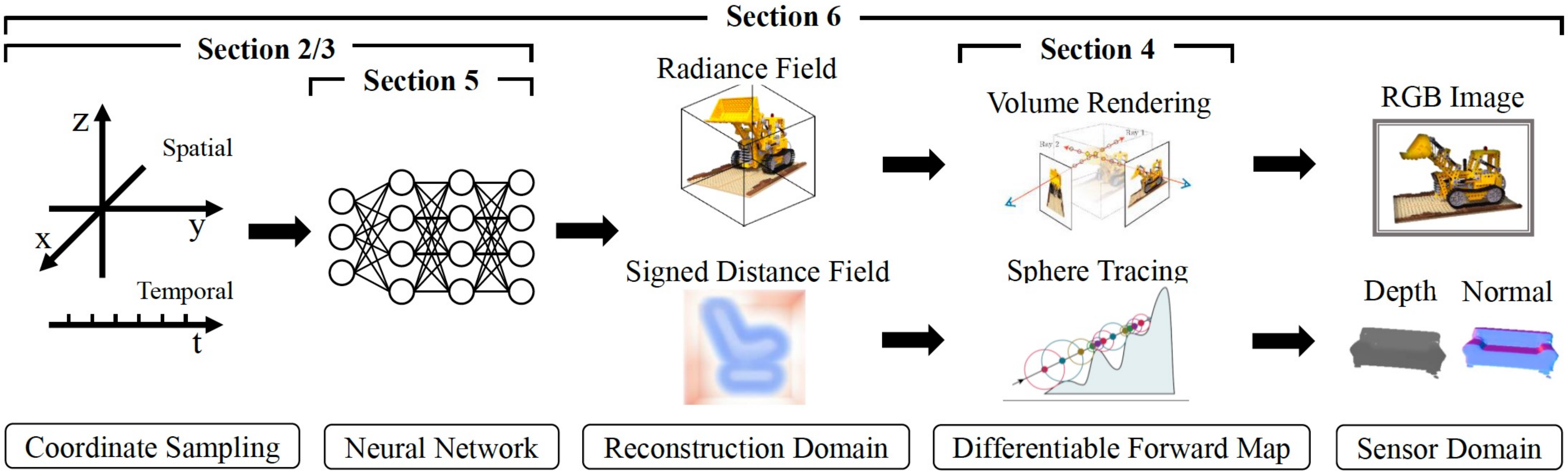

Figure 3: **A typical feed-forward neural field algorithm.** Spatiotemporal coordinates are fed into a neural network which predicts values in the reconstruct a domain. Then, this domain is mapped to the sensor domain where sensor measurements are available as supervision.

Neural Fields in Visual Computing and Beyond

Classes of techniques

Class and Section	Problems Addressed
Prior Learning and Conditioning (Section 2)	Inverse problems, ill-posed problems, edit ability, symmetries.
Hybrid Representations (Section 3)	Computation & memory efficiency, representation capacity, edit ability.
Forward Maps (Section 4)	Inverse problems.
Network Architecture (Section 5)	Spectral bias, integration and derivatives.
Manipulating Neural Fields (Section 6)	Edit ability, constraints, regularization.

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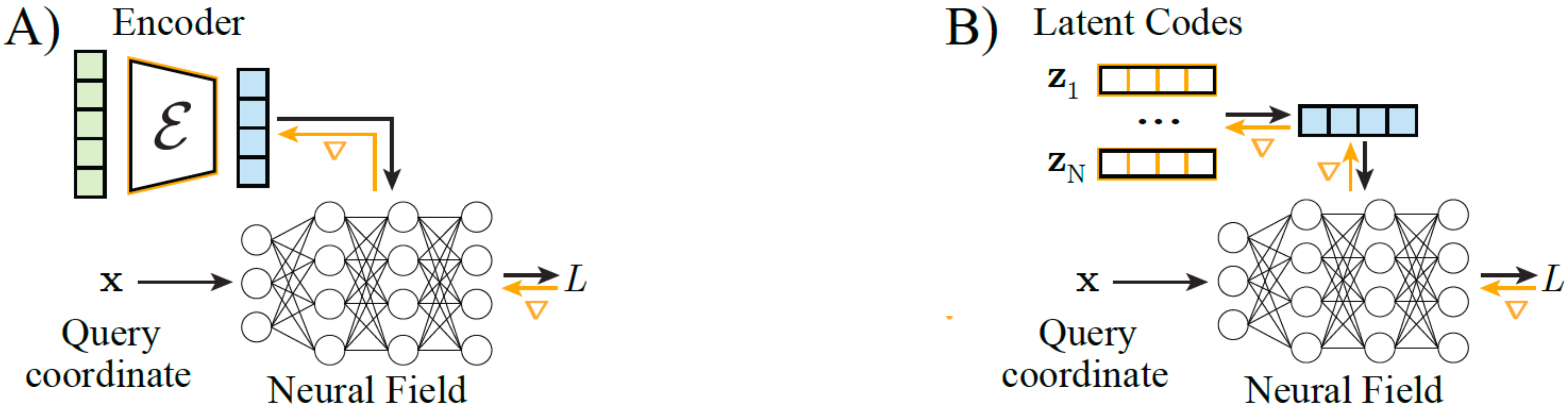
Prior learning and conditioning

- Example: 3D shape reconstruction using partial point clouds



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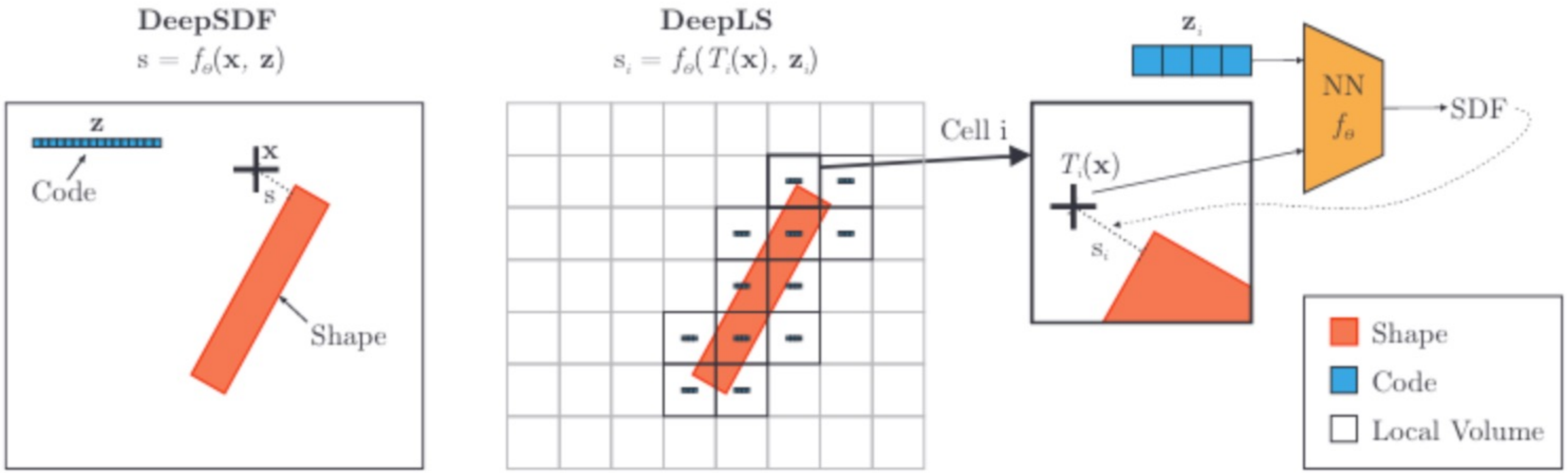
DeepSDF



Chabra, Rohan, et al. "Deep local shapes: Learning local sdf priors for detailed 3d reconstruction."

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DeepSDF

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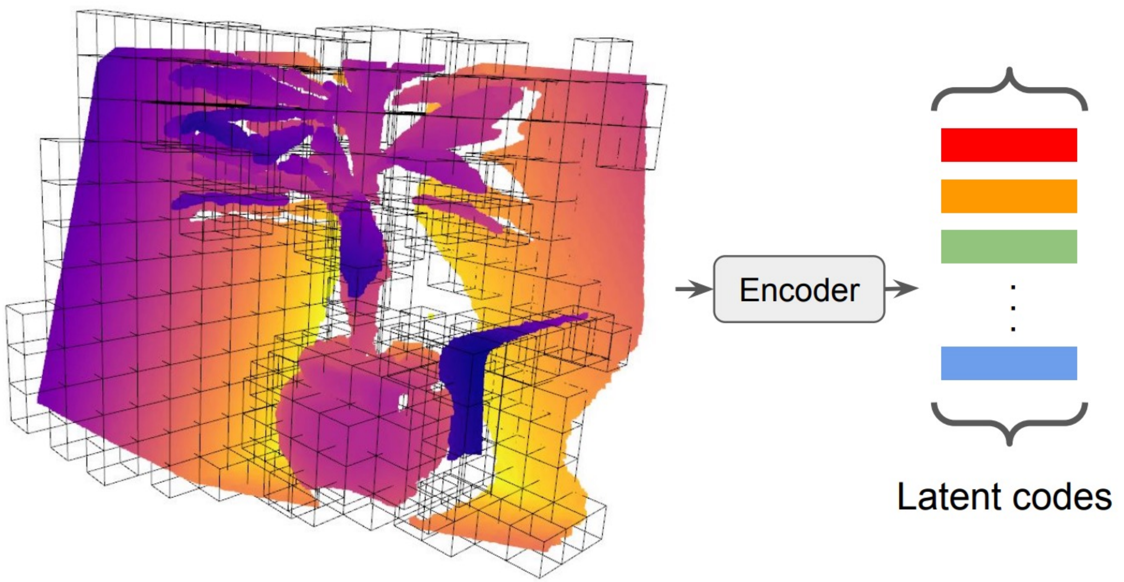
Hybrid representations

- Decompose spatial domain and store neural fields parameters in a data structure *g*. Given a coordinate, query *g* to retrieve the corresponding neural field.
- Local shape embedding?



Li, Kejie, et al. "Bnv-fusion: dense 3D reconstruction using bi-level neural volume fusion."

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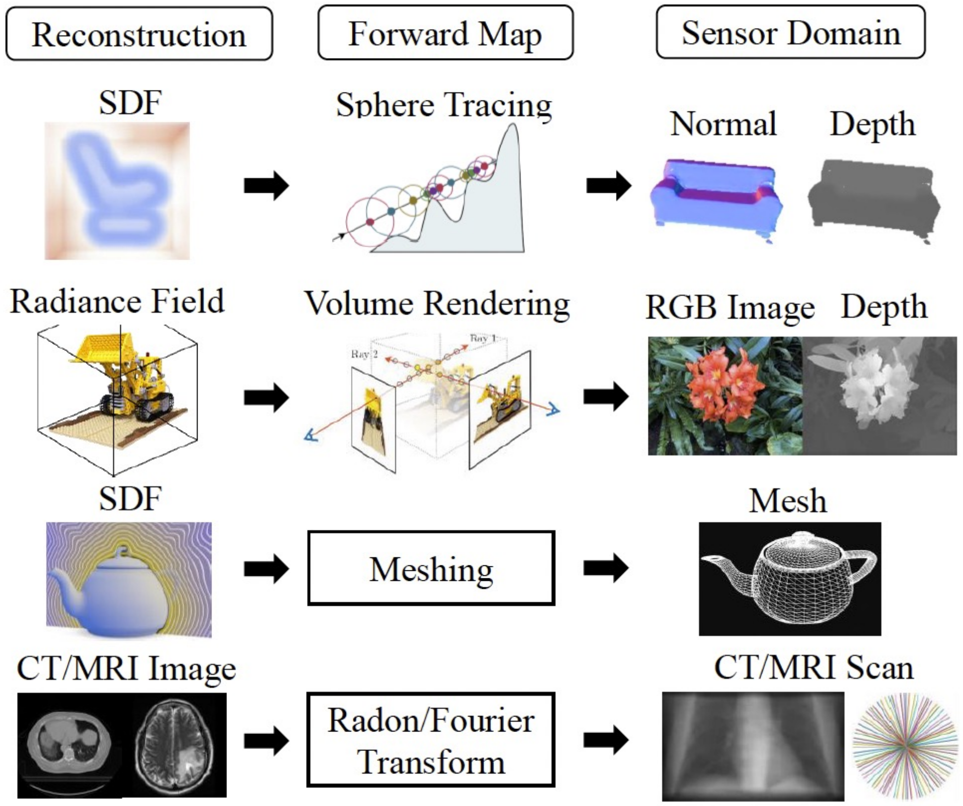
Forward maps

- Neural field TO sensor domain



- Rendering (3D to image)
- PINN (Eikonal equaiton?)

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Network architecture

- Neural networks are biased to fit function with low frequency

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Network architecture

- Solutions:
  - Positional encoding
  - Activation functions (SIREN)