Motivation

- Our world is full of 3D objects in motion
- To act and reason autonomously, machines need an adequate model of time-varying 3D geometry
- Inferring such a model from sparse sensory inputs requires knowledge of the world
- Can we find a 4D representation which can be learned from observations?

Learning-based 3D Reconstruction

- Successful because rich prior knowledge can be used, e.g. to resolve ambiguities
- But in the real world, objects are in motion

Our Representation

Represent motion by a temporally and spatially continuous vector field $v_0 : \mathbb{R}^3 \times [0, T] \rightarrow \mathbb{R}^3$

Represent 3D shape at time 0 as the continuous decision boundary of a binary classifier $f_0 : \mathbb{R}^3 \rightarrow [0, 1]$

+ Spatially and temporally continuous
+ Implicit correspondences over time
+ Fast inference

Experiments

- Representation Power
- 4D Point Cloud Completion
- Shape Interpolation

How can we extend the 3D models to 4D?

- Naïvely discretizing the temporal domain leads to
  - Sparsity in time
  - No correspondences
  - Slow inference

velocity field $v_0$