Deep Learning Point Clouds and Deep Meshes

Summary

Deep Learning for Point Cloud Data

Main Topics

- Point Cloud Data
  - Raw Sensor (LIDAR, RGB-D) / Simple / Convert to Regular (Voxels, Multiview, Implicit)
- Deep Learning for Point Clouds
  - Analysis (Classification, Part & Scene Segmentation) / Synthesis (From Single Image)
- PointNet
  - Permutation Invariance (Aggregate Symmetric Operator) / Rigid Transformation Invariance
- PointNet++ (PointNet at Local Regions)
  - Hierarchical Feature Learning / Local Translation and Permutation Invariance / Varying Sampling Density
- Point Cloud Synthesis
  - Supervision from "Synthesize for Learning Learning" / Two-Branch Architecture (Deconvolution + Fully Connected)
- Distance Metrics
  - Learn Mean Shape / Earth Moving vs. Chamfer
- New: Point Transformer

Deep Meshes

Main Topics

- Overview
  - Mesh Representation / Pixel2Mesh / Mesh R-CNN / Non-Euclidean / Spectral Domain
- Mesh Representation
  - Non Trivial for Neural Nets (Not Regular) / Mesh = Point Set + Connectivity Graph / How? (Convolution, Pooling)
- Pixel2Mesh (Image of Object -> Mesh)
  - Iterative Refinement / Graph Convolution / Vertex Aligned Features / Chamfer Loss
- Mesh R-CNN (Image of Scene -> Segmentation and Mesh of Objects)
  - Hybrid 3D Shape Representation / Voxel (Topolgy) / Mesh Deformation (Geometry)
  - Box+Mask Branch / Voxel Branch / Mesh Refinement Branch (Align, Graph Conv, Refine)
- Going Non-Euclidean
  - Spectral Convolution / Laplacian Eigenfunctions / Not Shif Invariant (depend on basis)
- Meshes in Spectral Domain (Eigenfunctions from Laplacian-Beltrami Op.)
  - Spectral Convolution / Spectral Kernels / Spatial Acrivation
  - Intrinsic Shape = Invariant to Embedding (rotation, translation, pose)
  - Spherical CNN (special case) / SO(3) Equivariant Representation