3D Point Cloud Matching

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Introduction

Motivation and Context

What is “3D Point Cloud” ?

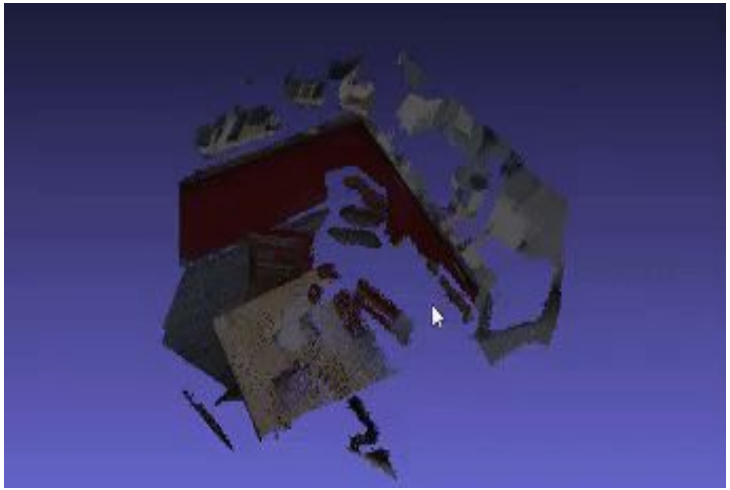


Fig 1. Representation of 3D Point Cloud

What is “3D Point Cloud Matching”?

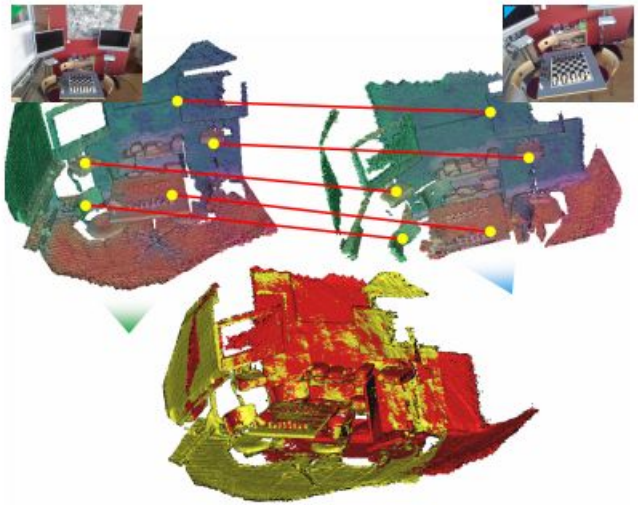


Fig 2. Image extracted from [Deng, H., Birdal, T., et al. 2018]

Introduction

Motivation and Context

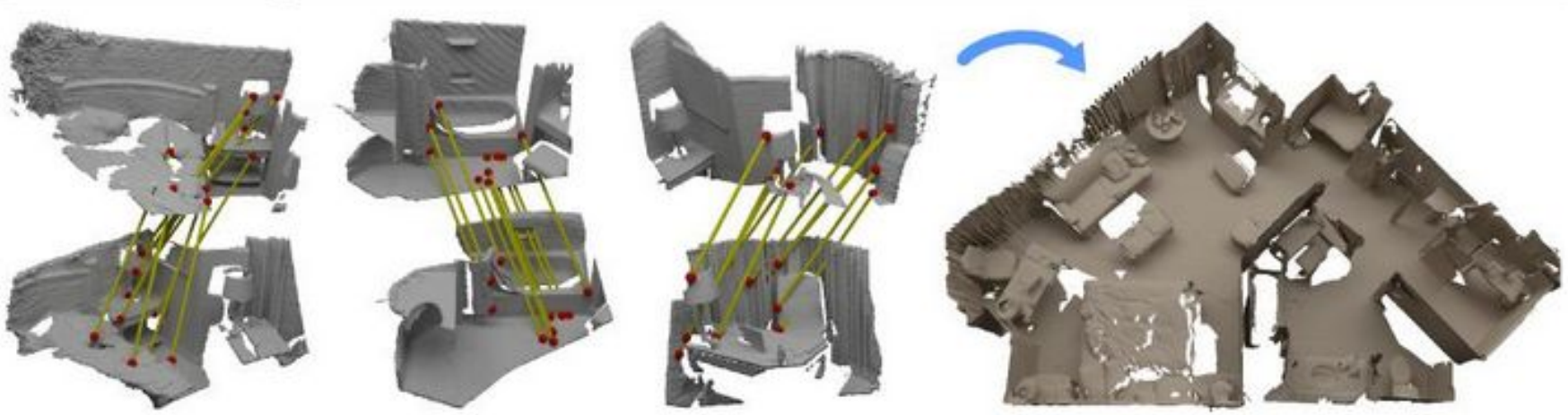
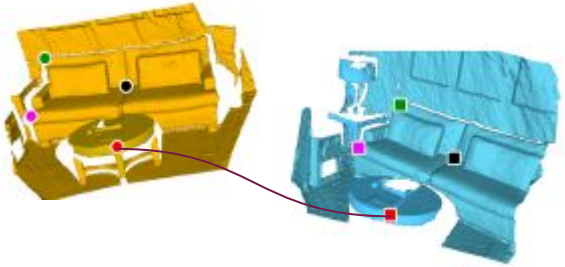


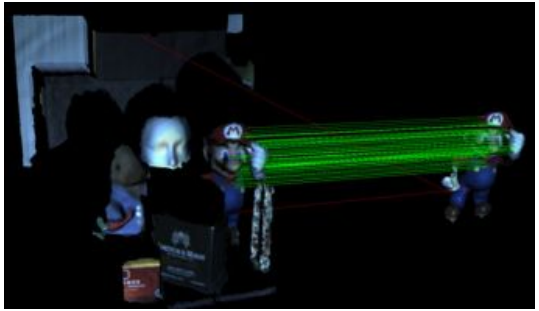
Fig 3. Geometric Registration Benchmark [Zeng, A., Song, S., et al. 2017]

Introduction

Problem Statement

- Perspective
- Illumination
- Oclusion
- Resolution
- Distortion





Dataset

- **3DMatch:** 54 scenes
  Each scene is a folder containing one or more RGB-D video sequences. The folder contents are as follows:
  camera-intrinsics.txt - a text file with depth camera intrinsics (3x3 matrix in homogeneous coordinates)
  seq-XX
    - **frame-XXXXXX.color.png** - a 24-bit PNG RGB color image.
    - **frame-XXXXXX.depth.png** - a 16-bit PNG depth image, aligned to its corresponding color image. Depth is saved in millimeters (mm). Invalid depth is set to 0.
    - **frame-XXXXXX.pose.txt** - a text file with the camera pose of the frame (camera-to-world, 4x4 matrix in homogeneous coordinates and in meters)

Approach

- Convolutional Neural Network Siamese

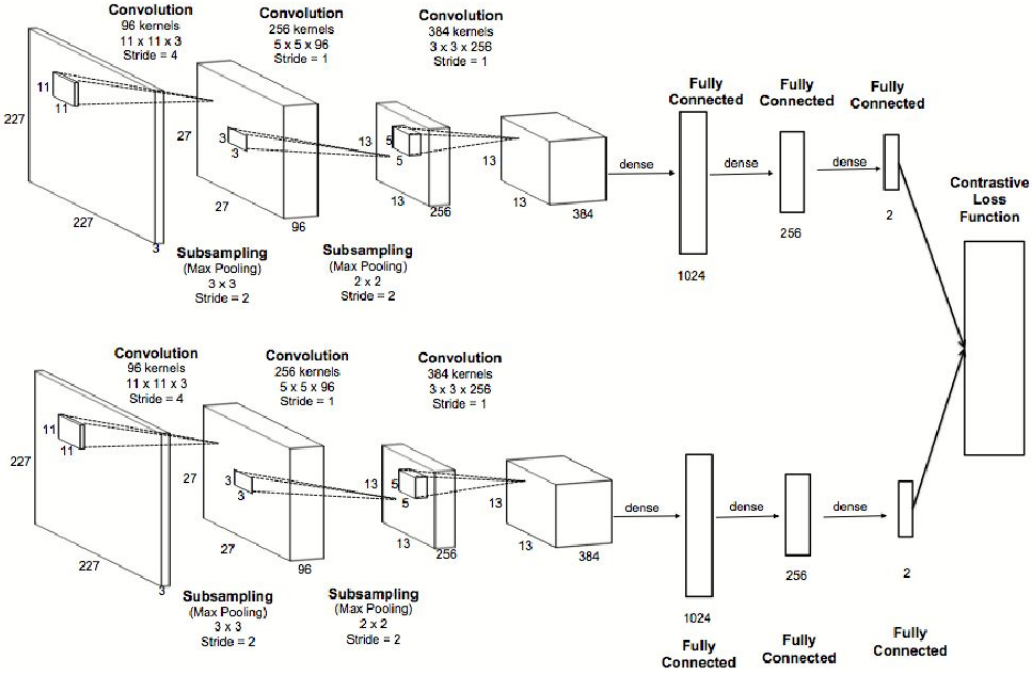
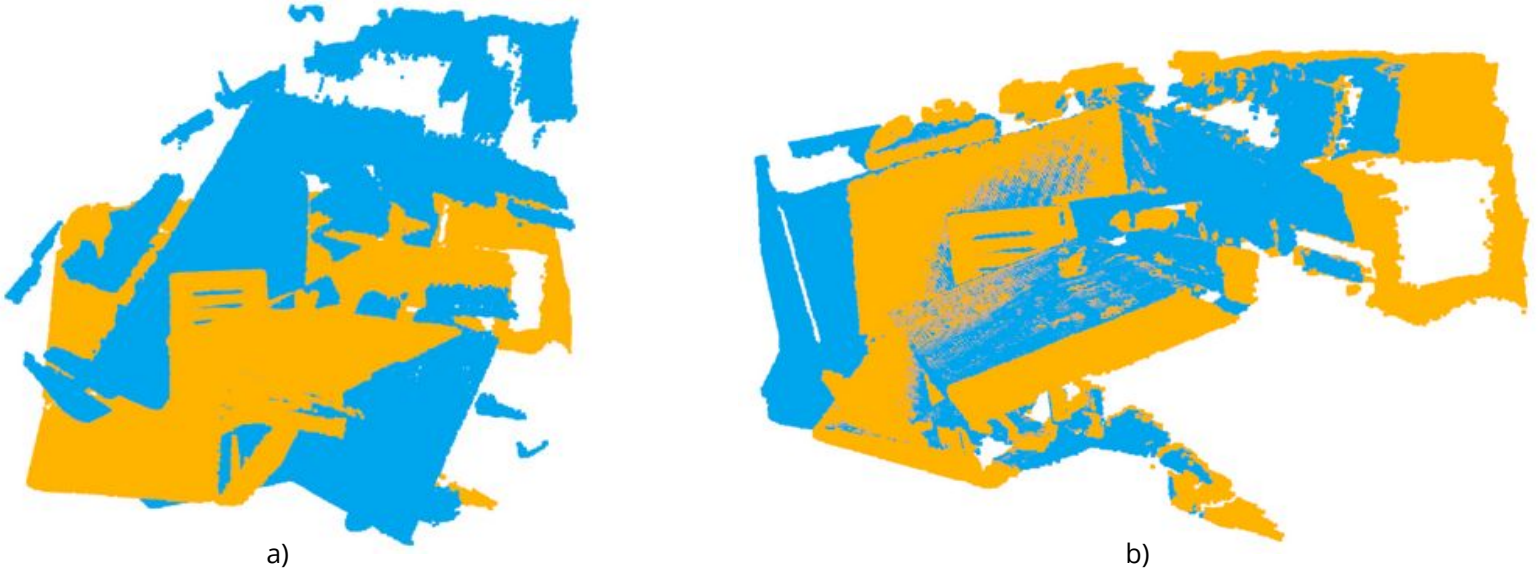


Fig 4. Siamese Network [Qiang Zhang]

Example Result



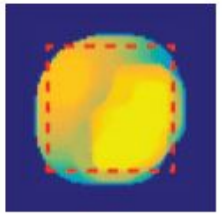
a) b)

Fig 5. a) Representation of two Point Clouds and b)Representation of Matching 3D

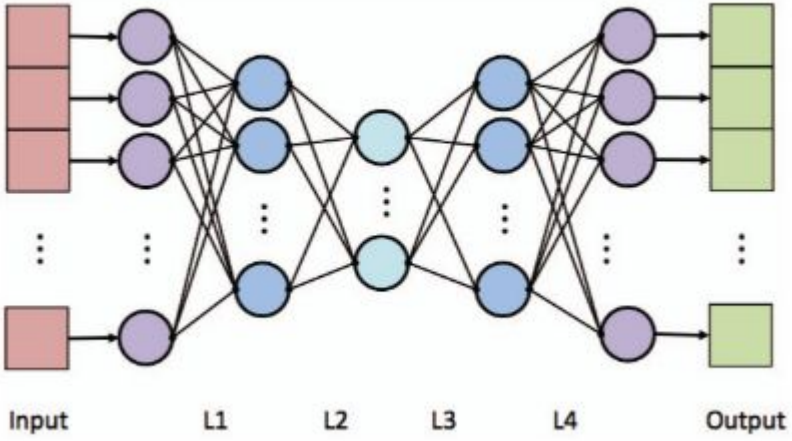
Model 2D using Autoencoders

3D Point Cloud Registration for Localization using a Deep Neural Network Auto-Encoder

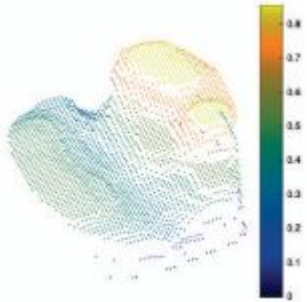
a)



b)



c)



d)

Fig 6.Pipeline [Deng, H., Birdal, T., et al. (2017]

Models supervised

3DMatch: Learning Local Geometric Descriptors from RGB-D Reconstructions

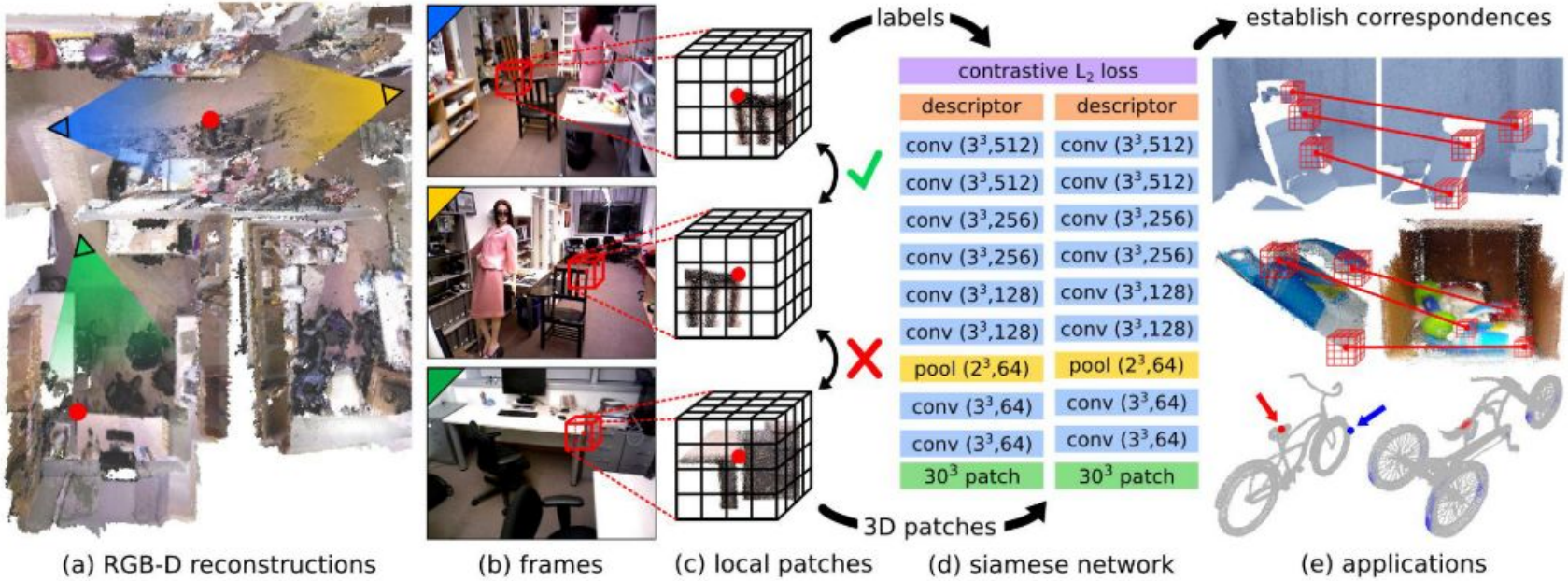


Fig 7.Inputs and Architecture of 3DMatch [Zeng, A., Song, S., et al. 2017]

Model supervised

PPFNet: Global Context Aware Local Features for Robust 3D Point Matching

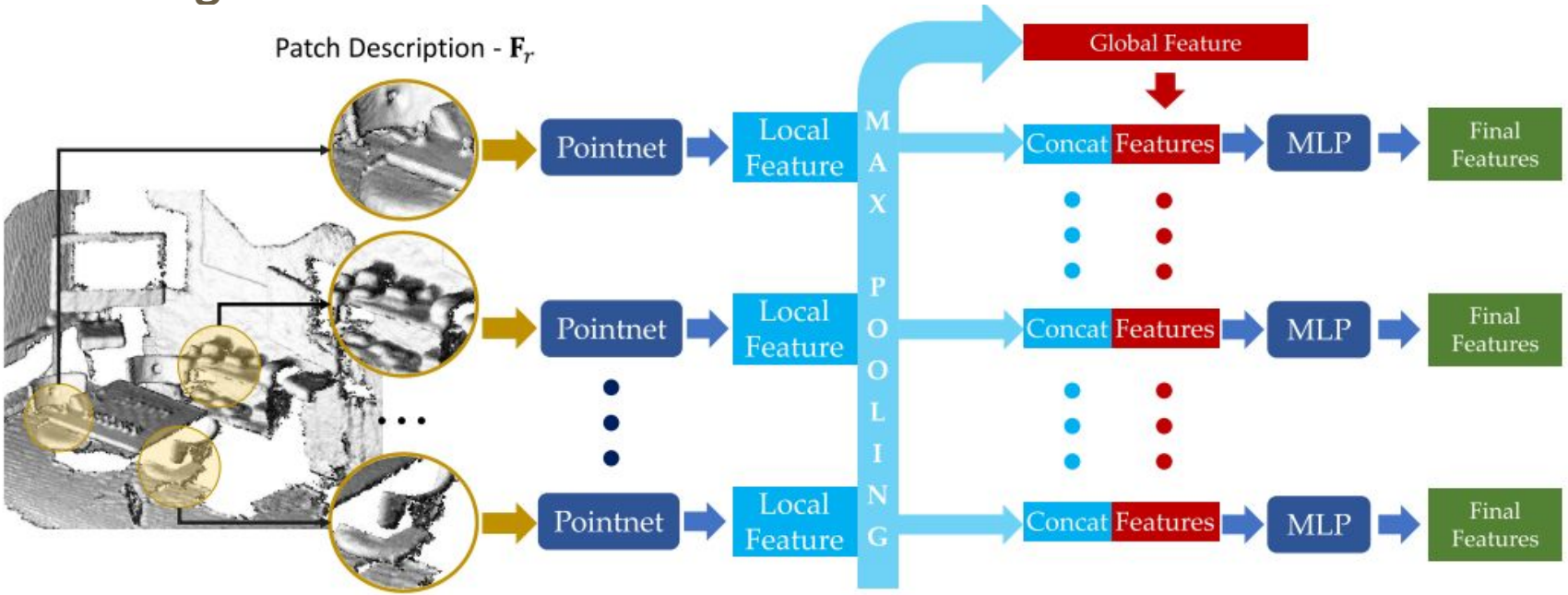


Fig 8. Input features [Deng, H., Birdal, T., et al. 2018b]

Model supervised

PPFNet: Global Context Aware Local Features for Robust 3D Point Matching

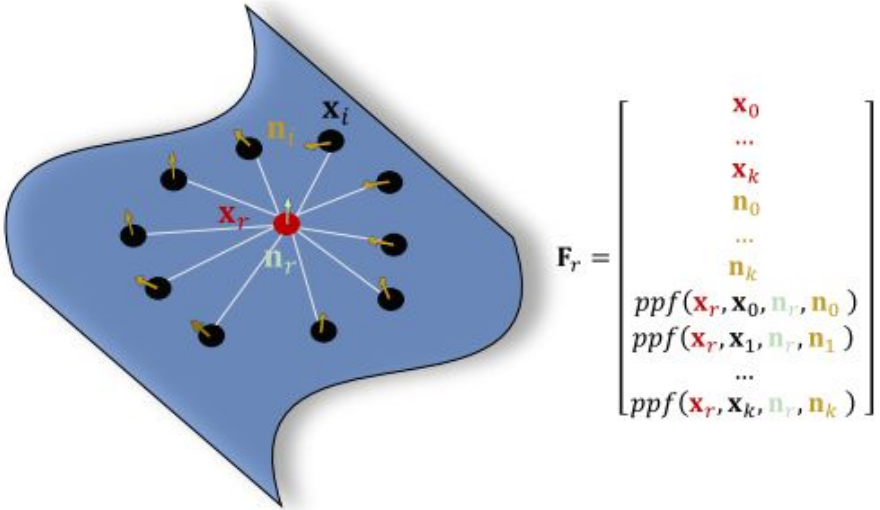


Fig 9. Pair Point Feature [Deng, H., Birdal, T., et al. 2018b]

Model supervised

PPFNet: Global Context Aware Local Features for Robust 3D Point Matching

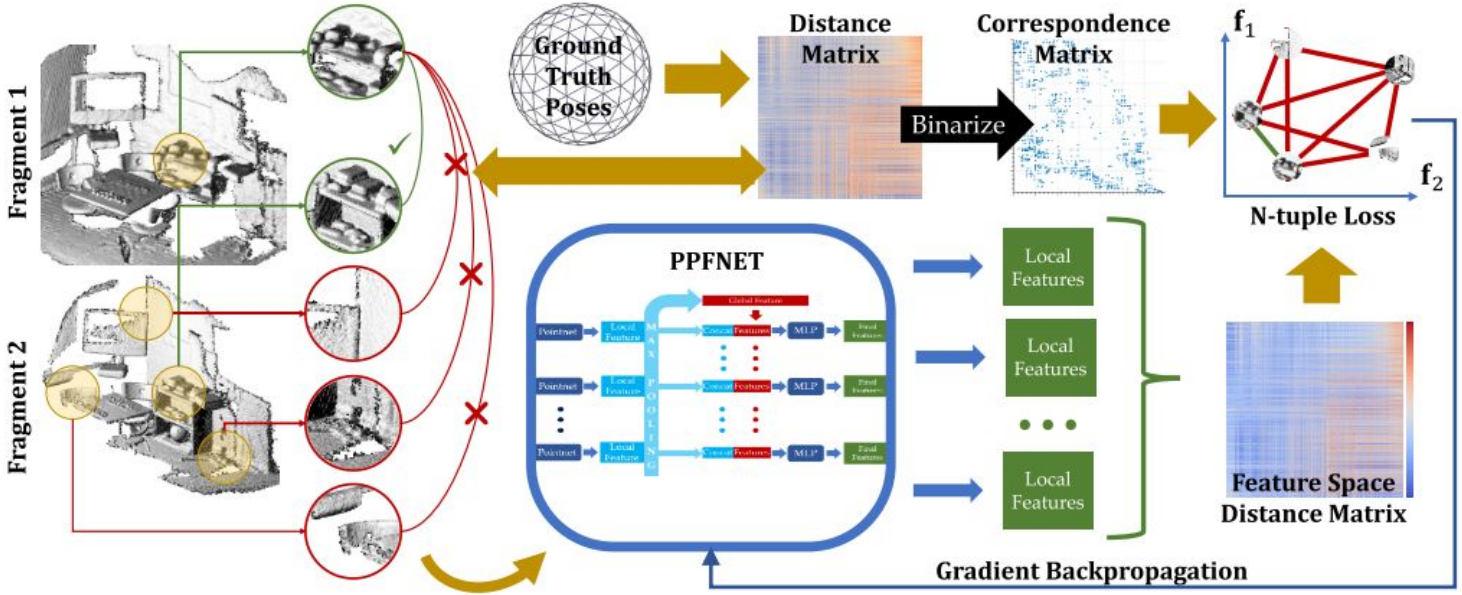


Fig 9. Architecture [Deng, H., Birdal, T., et al. 2018b]

Model supervised

PPFNet: Global Context Aware Local Features for Robust 3D Point Matching

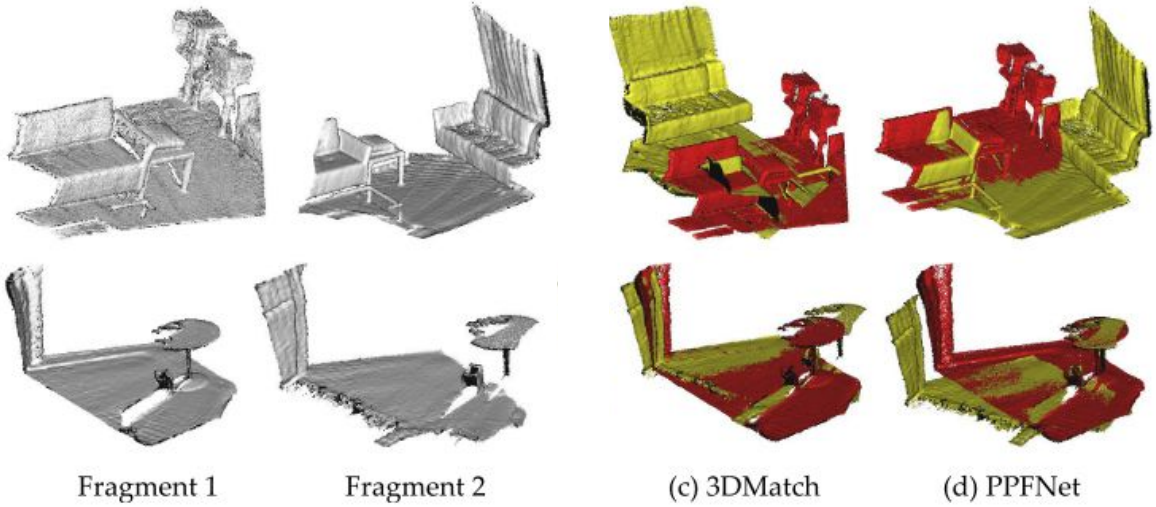


Fig 10. Comparative between 3DMatch and PPFNet [Deng, H., Birdal, T., et al. 2018b]

Model unsupervised

PPF-FoldNet: Unsupervised Learning of Rotation Invariant 3D Local Descriptors

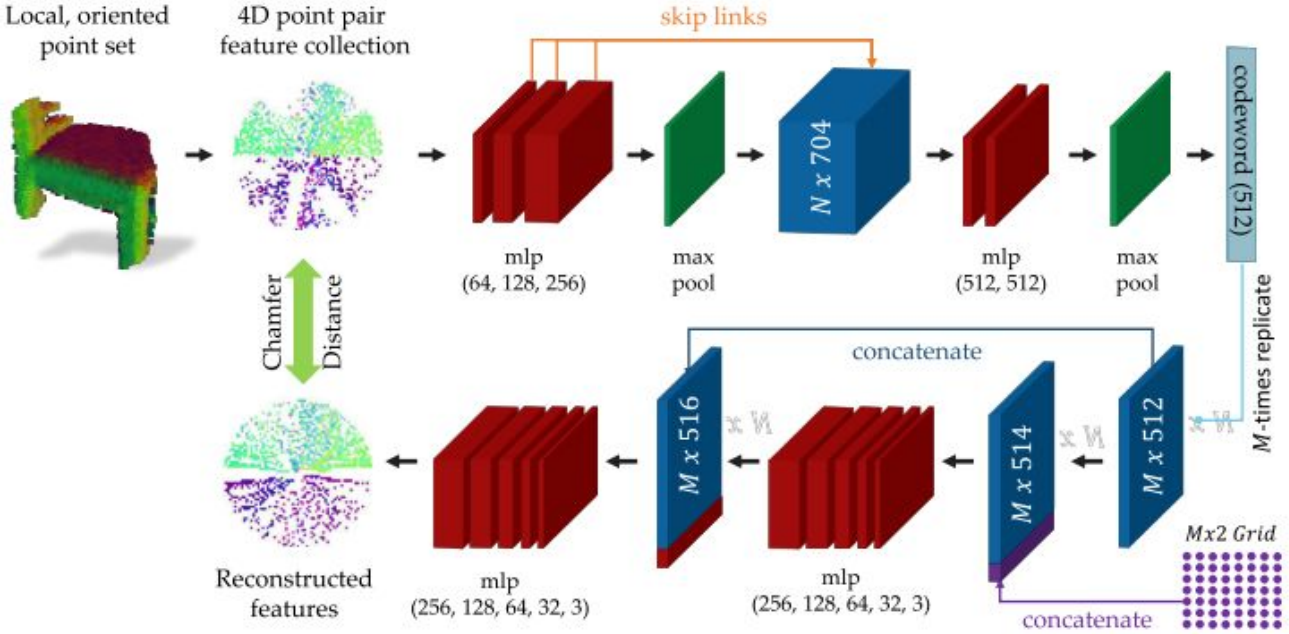


Fig 10. Architecture of PPF-FoldNet [Deng, H., Birdal, T., et al. 2018a]

Model unsupervised

PPF-FoldNet: Unsupervised Learning of Rotation Invariant 3D Local Descriptors

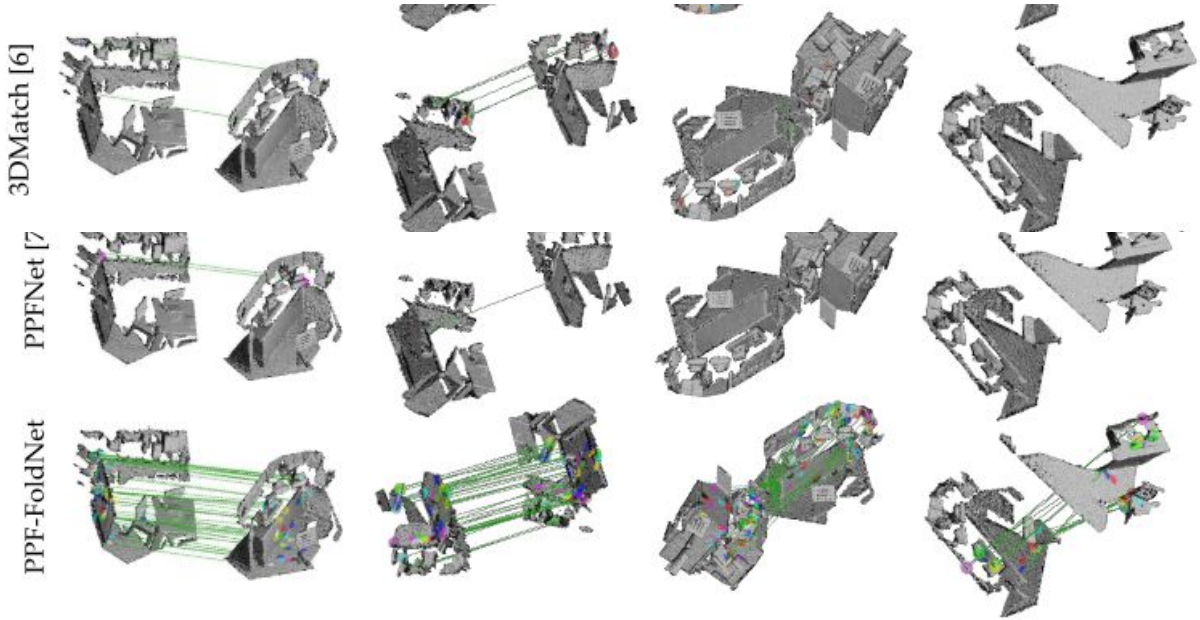


Fig 10. Comparative 3DMatch, PPFNet and PPF-FoldNet [Deng, H., Birdal, T., et al. 2018a]

Model supervised

The Perfect Match: 3D Point Cloud Matching with Smoothed Densities

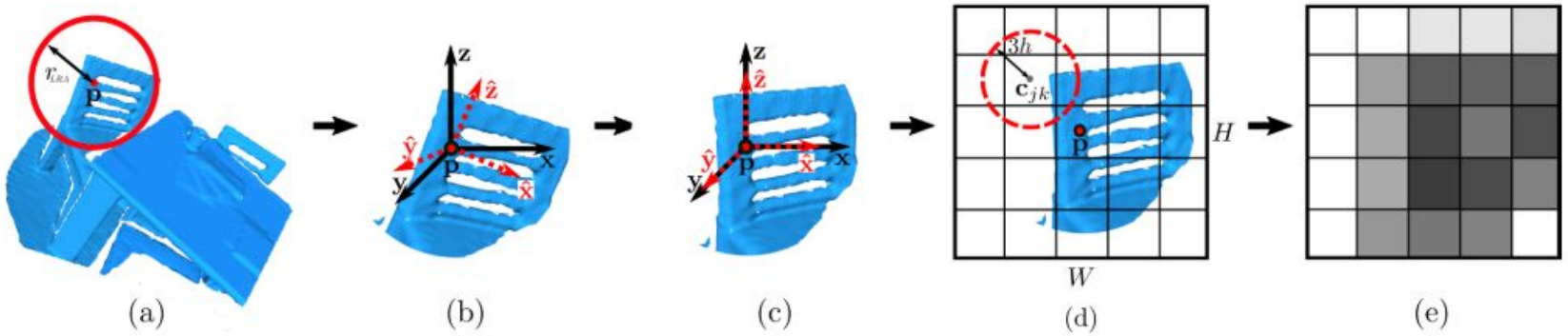


Fig 11. Input Parameterization [Gojcic, Z., Zhou, C., et al. 2018]

Model supervised

The Perfect Match: 3D Point Cloud Matching with Smoothed

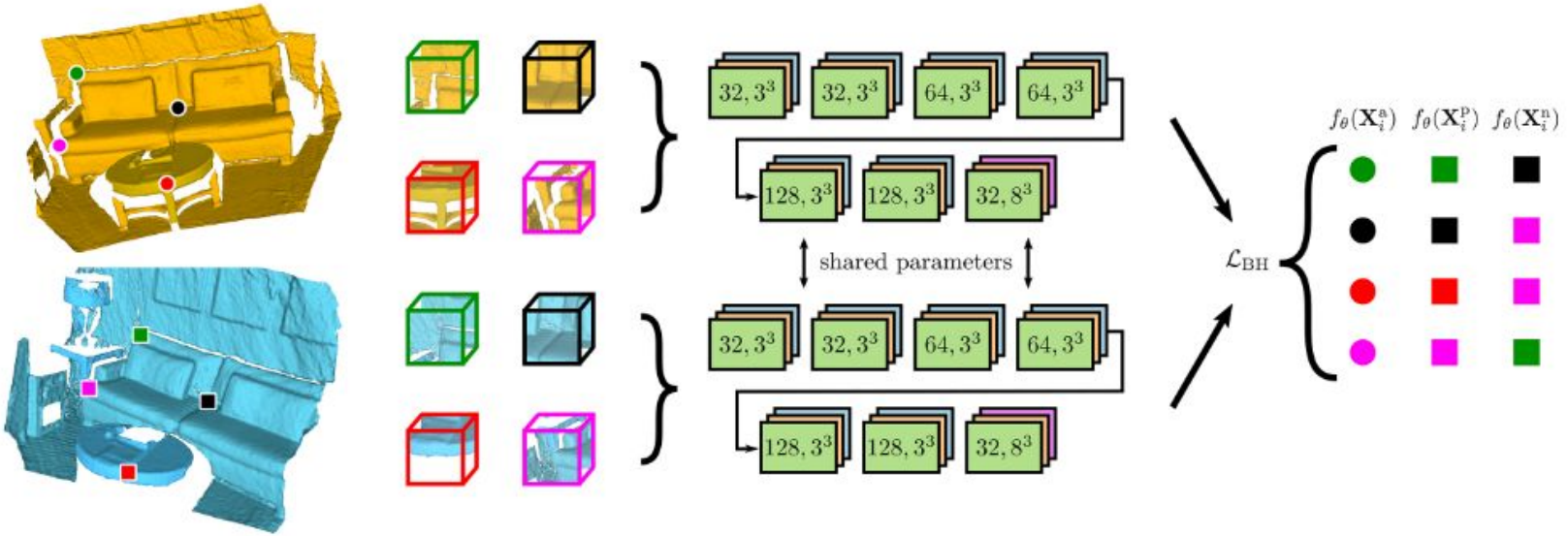


Fig 12. Architecture [Gojcic, Z., Zhou, C., et al. 2018]

Model supervised

The Perfect Match: 3D Point Cloud Matching with Smoothed Densities

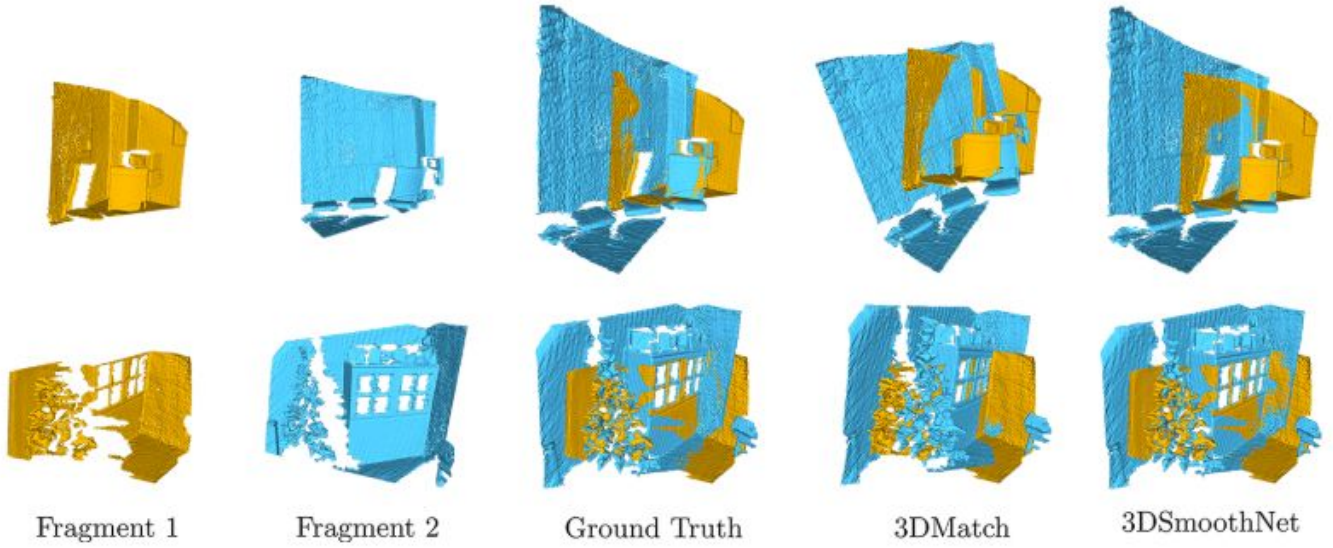


Fig 13. Comparative between 3DMatch and 3DSmoothNet [Gojcic, Z., Zhou, C., et al. 2018]

Conclusions

- Muchos de los modelos proponen su data de validación con respecto a sus propios descriptores.
- No existe un modelo que trate directamente a la nube de puntos y realice un correcto matching.
- Los modelos usan directamente data monocrómatica a excepción del 3DMatch que usa imágenes RGB-D
- El DataSet 3DMatch es un conjunto de imágenes más no de nube de puntos

Thanks :)
Questions?

Bibliography

Deng, H., Birdal, T., et al. (2018a). PPF-FoldNet: Unsupervised Learning of Rotation Invariant 3D Local Descriptors.Proceedings of the European Conference on Computer Vision (ECCV), pages 602–618.

Deng, H., Birdal, T., et al. (2018b). PPFNet: Global Context Aware Local Features for Robust 3D Point Matching. Proceedings of the 31th IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2018), pages 195–205

Gojcic, Z., Zhou, C., et al. (2018). The Perfect Match: 3D Point Cloud Matching with Smoothed Densities

Zeng, A., Song, S., et al. (2017). 3DMatch: Learning local geometric descriptors from RGB-D reconstructions. Proceedings of the 30th IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2017), pages 199–208.