Motivation
Matching geometry in 3D scans is hard:
- sensor noise
- low resolution
- viewpoint differences
- partial surfaces

Hand-crafted geometric features:
✓ work well for 3D models with complete surfaces
✗ sensitive to noise and resolution
✗ unstable for partial scans
✗ difficult to generalize to new datasets

Learning a data-driven 3D descriptor?
It is difficult to collect sufficient training data - manually labeling correspondences in 3D scans is not only time consuming, but also prone to errors.

Our solution:
We present 3DMatch, a data-driven local 3D descriptor for matching geometric features in noisy and partial 3D scanning data. We amass training data by leveraging the free, long-range correspondence labels found in completed RGB-D scene reconstruction datasets.

Feature Visualization
Keypoint Matching
Geometric Registration

When combined with RANSAC, 3DMatch is able to outperform many other state-of-the-art geometric registration algorithms.

Geometric Registration

(Left) two scans (A and B) from different view angles. (Right) each row shows a local 3D patch from A, and three nearest neighbor local 3D patches from B using 3DMatch.

Supersizing Training Data
We make use of multiple RGB-D reconstruction datasets to train 3DMatch for our experiments. Each dataset contains depth scans of different environments with local geometries at varying scales, registered together by different reconstruction algorithms. These datasets provide a diverse surface correspondence training set with varying levels of sensor noise, viewpoint variance, and occlusion patterns.

3DMatch for Mesh Correspondence

3DMatch for Object Pose Estimation

3DMatch for 3D Reconstructions

3DMatch for 6D pose estimation by aligning object models (a) to noisy and partial 3D scans (b, c). (Right) predicted object poses using 3DMatch + RANSAC on the Shelf & Tote Benchmark.

Without any finetuning, 3DMatch can generalize to find geometrically similar correspondences on complete 3D meshes of the same object category (top and middle rows), and across different object categories (bottom row).