**Docket #:** S17-380

# End-to-end Semantic Segmentation of 3D Point Clouds by Convolutional Neural Networks, Trilinear interpolation, and Conditional Random Fields

Stanford inventors have developed a deep learning framework that is able to label individual points from 3D Point Clouds that are acquired by various sensors (RGBD sensors, LIDAR sensors, etc.). This framework obtains a point-level fine-grained labeling of 3D Scenes. When evaluated on current datasets of laser scanners city scans, autonomous vehicles LIDAR scans, Matterport and KINECT RGBD scans of indoor spaces, this innovation shows performance on par or better than the current state of the art. This technology has a variety of applications such as autonomous vehicles, robotics navigation and manipulation in indoor and outdoor spaces for human assistance, 3D geospatial analytics, and Virtual Reality.

## Applications

- **Indoor and outdoor robotics for human assistance**
  - Extract room, buildings, road and cities plans which allow safe navigation of robots in indoor and outdoor environments
  - Semantic labeling of objects allows robots to manipulate identified objects and provide assistance to humans with tasks involving scene object manipulation
- **Autonomous vehicles**
  - Identification of the road, pedestrians and other cars enables safe navigation

- **3D Geospatial analytics**
  - Enables large scale analysis of city scans to inform policies related to landscape architecture, transportation and urban planning
- **Virtual reality**
  - Transport people to virtual spaces that are similar to real labeled spaces

## Advantages

- End-to-end framework
- Leverage each point's contextual information to obtain a more accurate labeling
- Uses a Conditional Random Field to ensure consistency of labels between neighboring points
- The use of Trillinear interpolation allows to leverage the contextual information provided by voxel level 3D convolution while still obtaining a fine-grained point-level label

## Patents

- Published Application: 20190108639
- Issued: 11,004,202 (USA)

## Innovators

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