

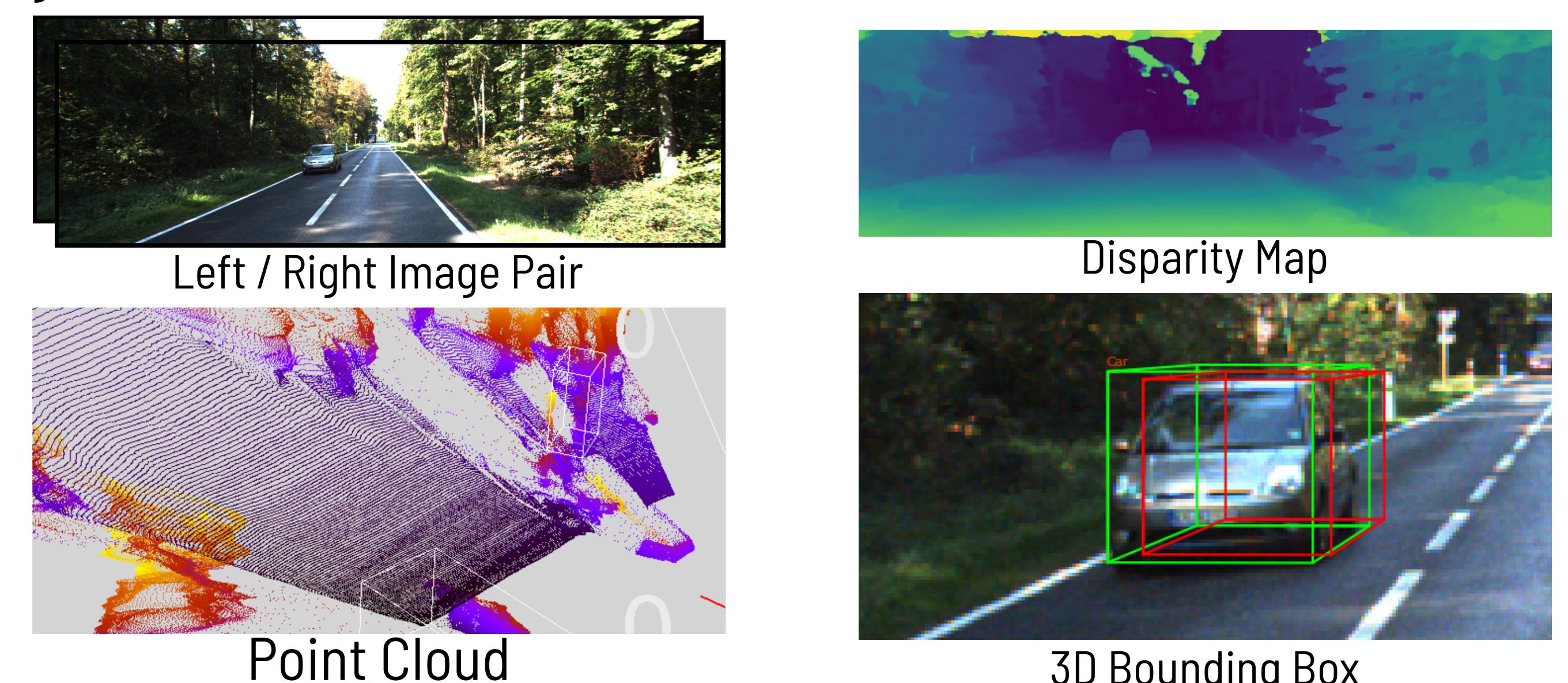
SMART3D

The SMART3D project seeks to find and develop competitive alternatives to LiDAR sensors, primarily through the investigation of PMD sensors and stereo camera sensors.

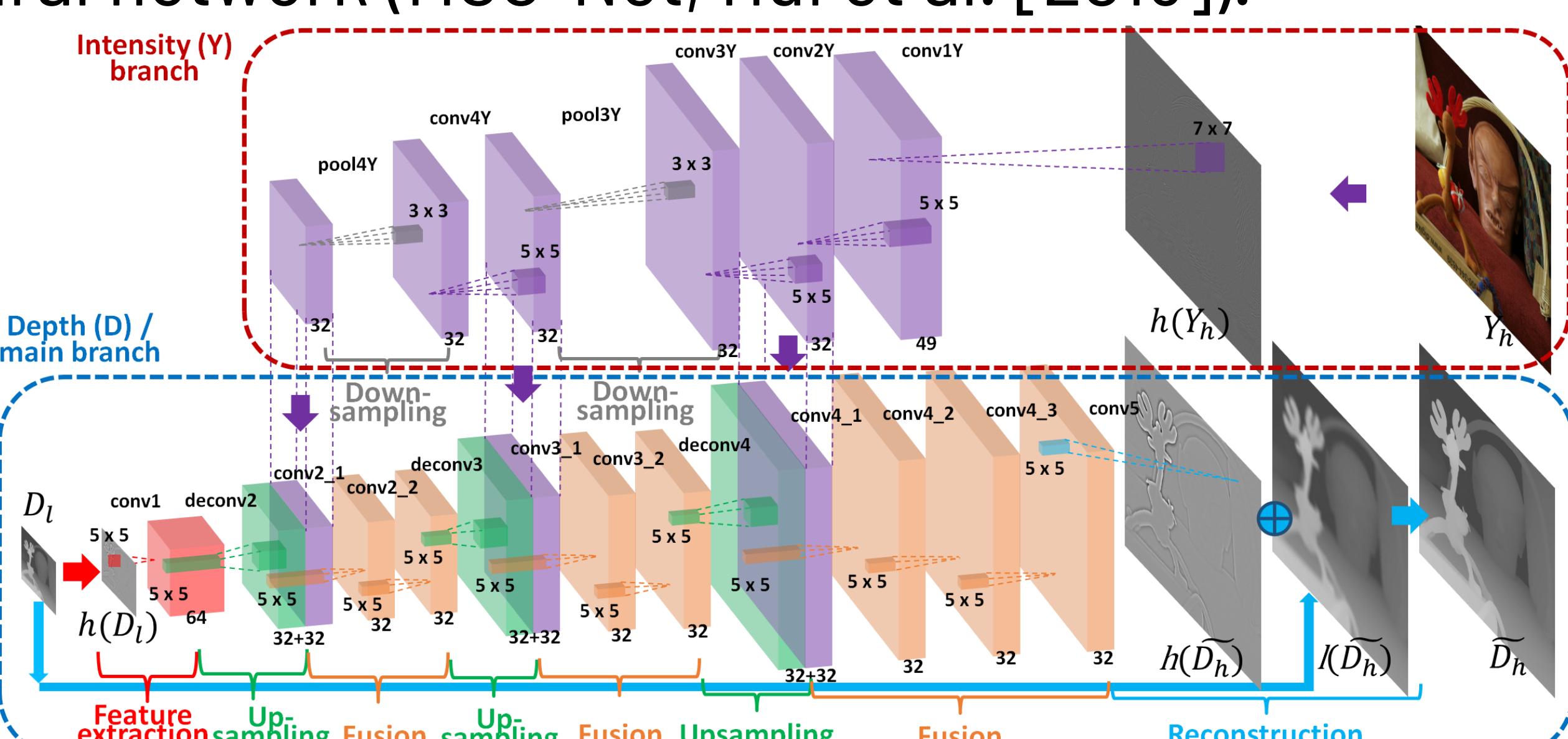
PMD (Photonic Mixing Device) sensors are short-medium range active sensors which typically have low resolution. However, a neural network may be used to implement image upscaling, which takes a low-resolution dpeth map and a high-resolution photo and estimates a higher resolution depth image from the two. The first phase of the experiment was carried out by obtaining a low-res PMD sensor(provided by the ifm) as well as a high-res color camera sensor. A high-quality LiDAR system also provided a ground truth depth map for each scene. In total, this setup was used to capture multiple scenes, enabling training and testing of a "super-resolution" neural network (MSG-Net, Hui et al. [2016]).



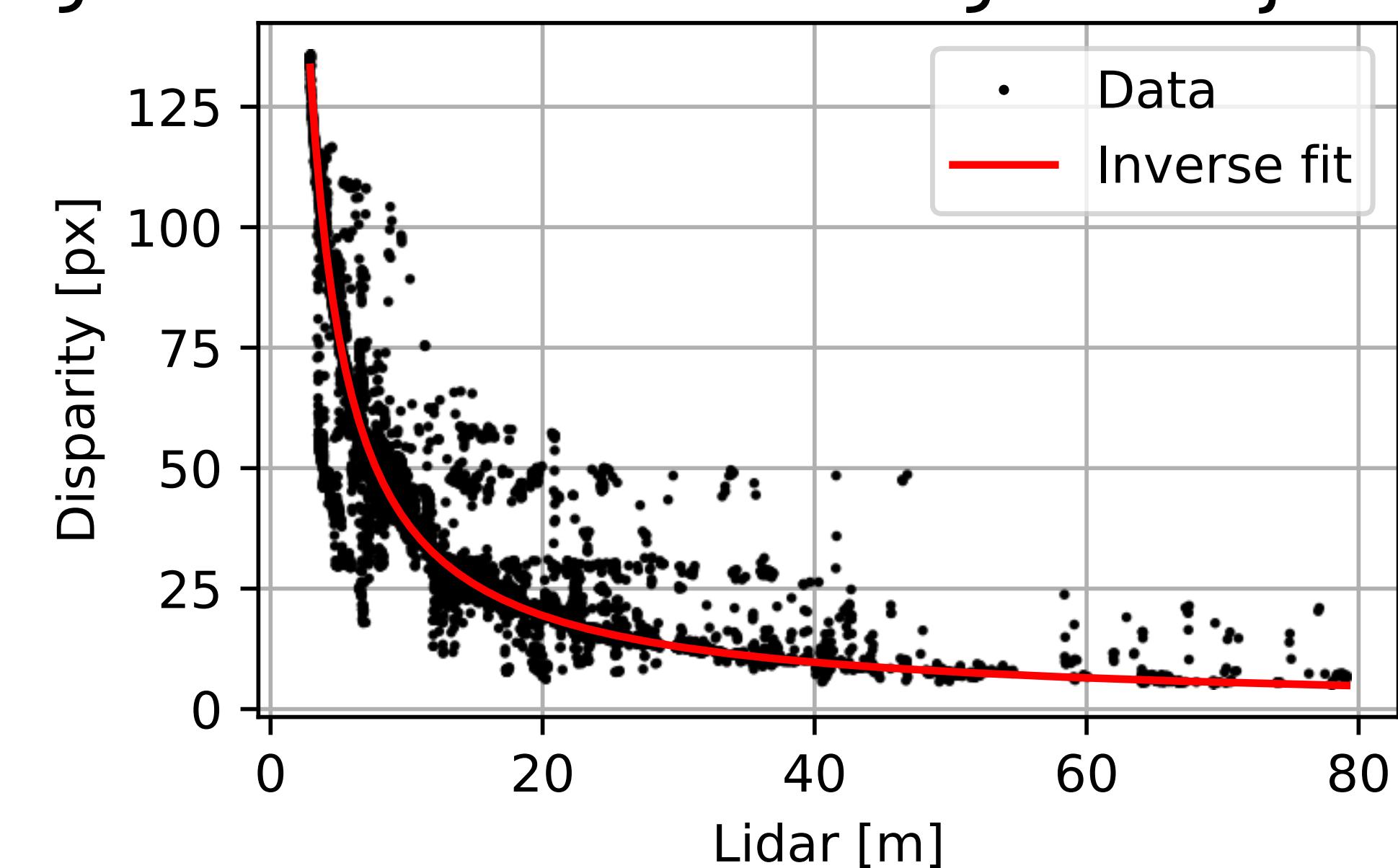
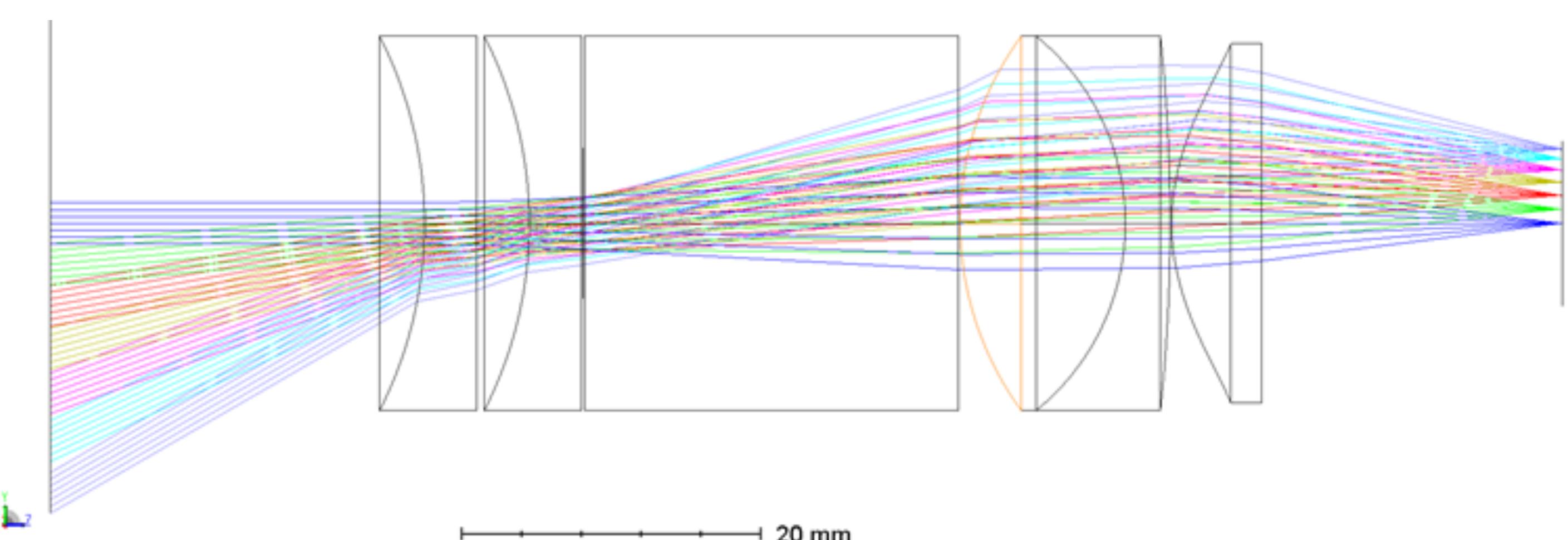
Stereo camera sensors are short-to-medium range passive sensors that rely on parallax to estimate distance, much like the human eye. With the correct application of neural network and related training, a pair of images can transform into a set of estimated object locations.



A pair of images is taken from an offline dataset, transformed into a disparity map estimation, via AI, which is then reconstructed into a point cloud. This point cloud is then fed into another network capable of estimating 3D coordinates of that given object.



In addition to the network, a classical approach to upsampling was taken, achieving similar results. The greatest challenge, however, was finding a suitable dataset to work with. Ultimately, the requirements of building, cleaning up, and then using a dataset from the ground up were not given priority, and a shift to using a different depth map generator was taken.



There is an inverse relationship between stereo camera disparity and reference lidar distance. The quality of this relationship directly affects the accuracy and reliability of a stereo-based system.

