Deep Learning-based approaches

The below papers include various deep learning-based approaches to 3D object detection and tracking.

Fast and Furious: Real Time End-to-End 3D Detection, Tracking and Motion Forecasting with a Single Convolutional Net by W. Luo, *et. al.*

> ***Abstract:*** *In this paper we propose a novel deep neural network that is able to jointly reason about 3D detection, tracking and motion forecasting given data captured by a 3D sensor. By jointly reasoning about these tasks, our holistic approach is more robust to occlusion as well as sparse data at range. Our approach performs 3D convolutions across space and time over a bird's eye view representation of the 3D world, which is very efficient in terms of both memory and computation. Our experiments on a new very large scale dataset captured in several north american cities, show that we can outperform the state-of-the-art by a large margin. Importantly, by sharing computation we can perform all tasks in as little as 30 ms.*

VoxelNet: End-to-End Learning for Point Cloud Based 3D Object Detection by Y. Zhou and O. Tuzel

> ***Abstract:*** *Accurate detection of objects in 3D point clouds is a central problem in many applications, such as autonomous navigation, housekeeping robots, and augmented/virtual reality. To interface a highly sparse LiDAR point cloud with a region proposal network (RPN), most existing efforts have focused on hand-crafted feature representations, for example, a bird's eye view projection. In this work, we remove the need of manual feature engineering for 3D point clouds and propose VoxelNet, a generic 3D detection network that unifies feature extraction and bounding box prediction into a single stage, end-to-end trainable deep network. [...] Experiments on the KITTI car detection benchmark show that VoxelNet outperforms the state-of-the-art LiDAR based 3D detection methods by a large margin. Furthermore, our network learns an effective discriminative representation of objects with various geometries, leading to encouraging results in 3D detection of pedestrians and cyclists, based on only LiDAR.*

Other papers on Tracking Multiple Objects and Sensor Fusion

The below papers and resources concern tracking multiple objects, using Kalman Filters as well as other techniques! We have not included the abstracts here for brevity, but you should check those out first to see which of these you want to take a look at.

> *Multiple Object Tracking using Kalman Filter and Optical Flow by S. Shantaiya, et. al.*

> *Kalman Filter Based Multiple Objects Detection-Tracking Algorithm Robust to Occlusion by J-M Jeong, et. al.*

> *Tracking Multiple Moving Objects Using Unscented Kalman Filtering Techniques by X. Chen, et. al.*

> *LIDAR-based 3D Object Perception by M. Himmelsbach, et. al*

> *Fast multiple objects detection and tracking fusing color camera and 3D LIDAR for intelligent vehicles by S. Hwang, et. al.*

> *3D-LIDAR Multi Object Tracking for Autonomous Driving by A.S. Rachman (long read)*