Radar Sensor Simulation

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KI DATA TOOLING – The Data Kit for Automotive AI

Scenarios & Synthetic Data

Radar Sensor Simulation

The radar sensor generates point-clouds in x,y,z and velocity distinguishing static obstacles and dynamic objects.

Figure 1: Test Measurement at test site in Renningen with radar reference targets ©BOSCH

Based on 3D scenarios defined in glTF format 3D path tracing generates the impulse response of the scenes which is transferred to a radar point cloud by a sensor specific plugin.

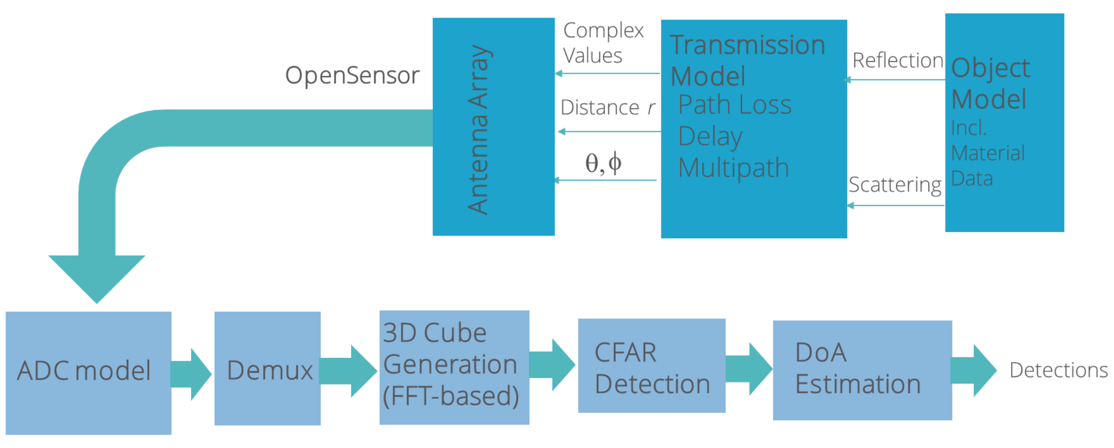

Figure 2: Block diagram of integrated radar plugin ©BIT-TS

Each processing step such as complex ADC data, range-Doppler maps or point clouds can be provided. All blocks can be parametrized to match the individual sensor.
The effect of the IF filter as well as the used reference objects clearly show off in the range profile:

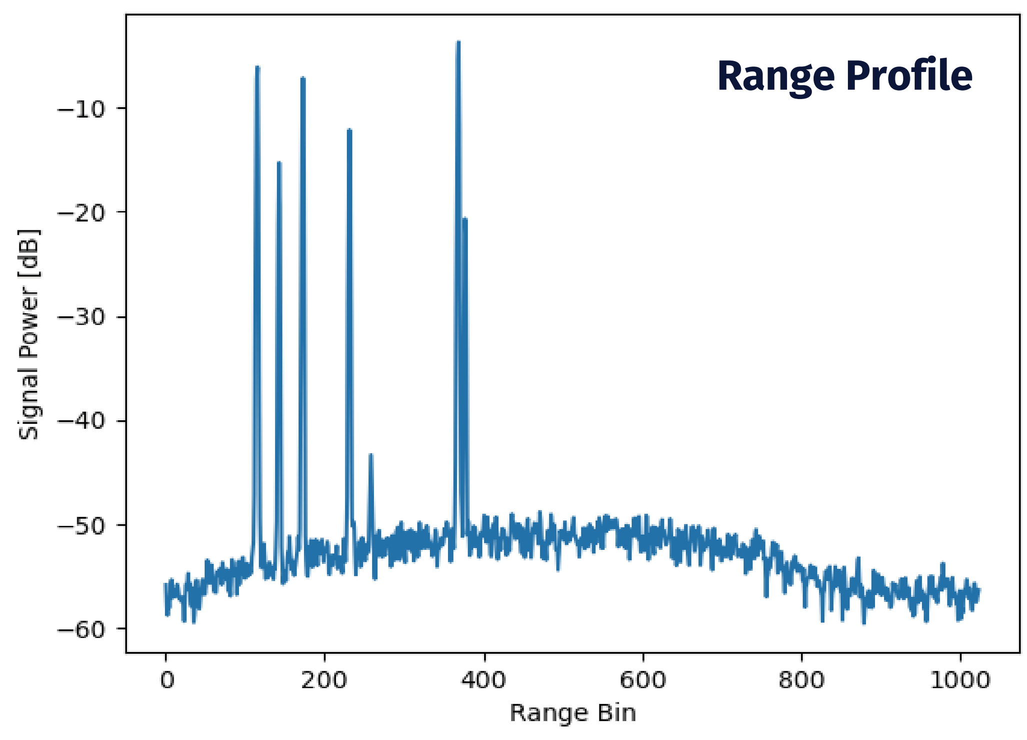

Figure 3: Range Profile of ADC raw data of a single simulated radar channel ©BIT-TS

Extrapolating the complex receiver data based on the velocity vector of each point-of-reflection, complex range-Doppler-maps are generated allowing target detection with 3D position, RCS and radial velocity.

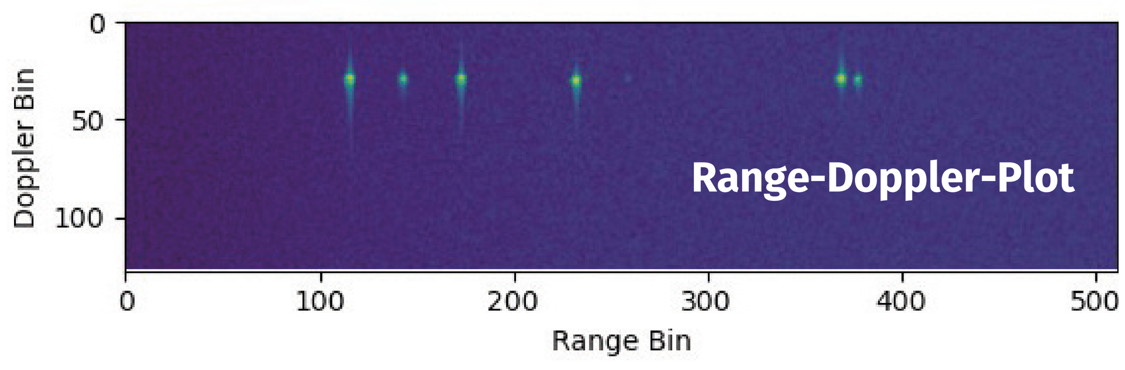

Figure 4: Range-Doppler representation of single receiver signal ©BIT-TS

Point Cloud Comparison

The simple corner reflector scenario was used for comparing the point clouds (PCD):

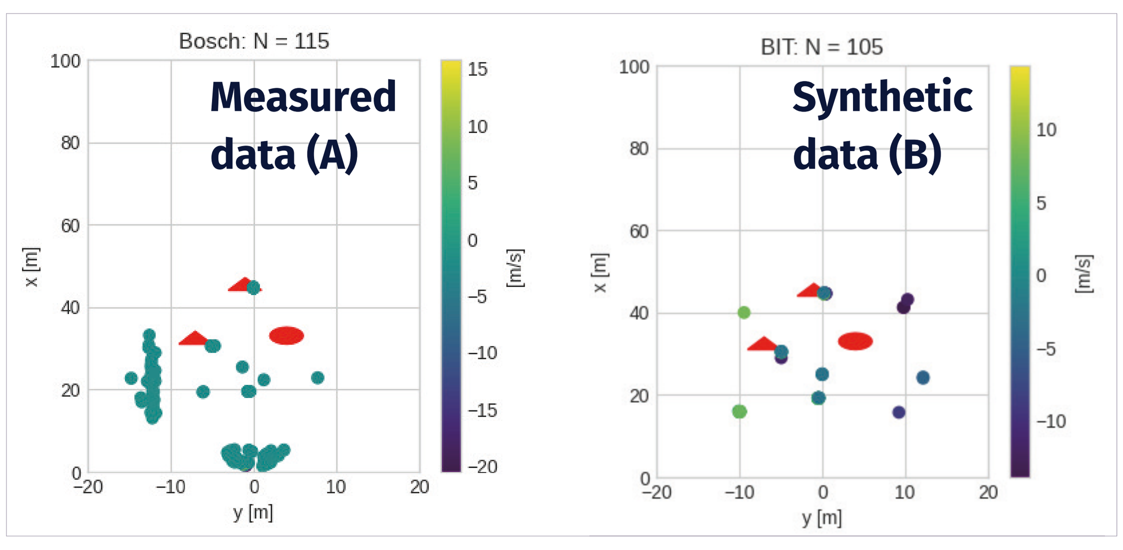

Figure 5: Comparison of measurement and simulated point clouds from test measurement in Renningen ©FKSF

Using the **Hausdorff** or **Chamfer distance**:

Hausdorff distance: Compute the max. distance of points in **A** between points in **B**.
Pro: Comparison of PCDs with different cardinality (number of points)
Con: Does **not** take „inner structure“ of PCD into account; outlier strong impact on result.

Chamfer distance: Sum up all min. distances of from each point in **A** to **B**.
Pro: Comparison of PCDs with different cardinality; takes „inner structure“ of PCD into account
Con: Outlier strong impact on result.

Effect-based Comparison

A complex scene of an intersection in Aschaffenburg was rendered for RGB, lidar and radar sensors. Walking Pedestrians are well suited to evaluate the micro-Doppler in the radar detections. Based on sensor parameters provided by Bosch the rendering was performed by BIT and dSPACE.

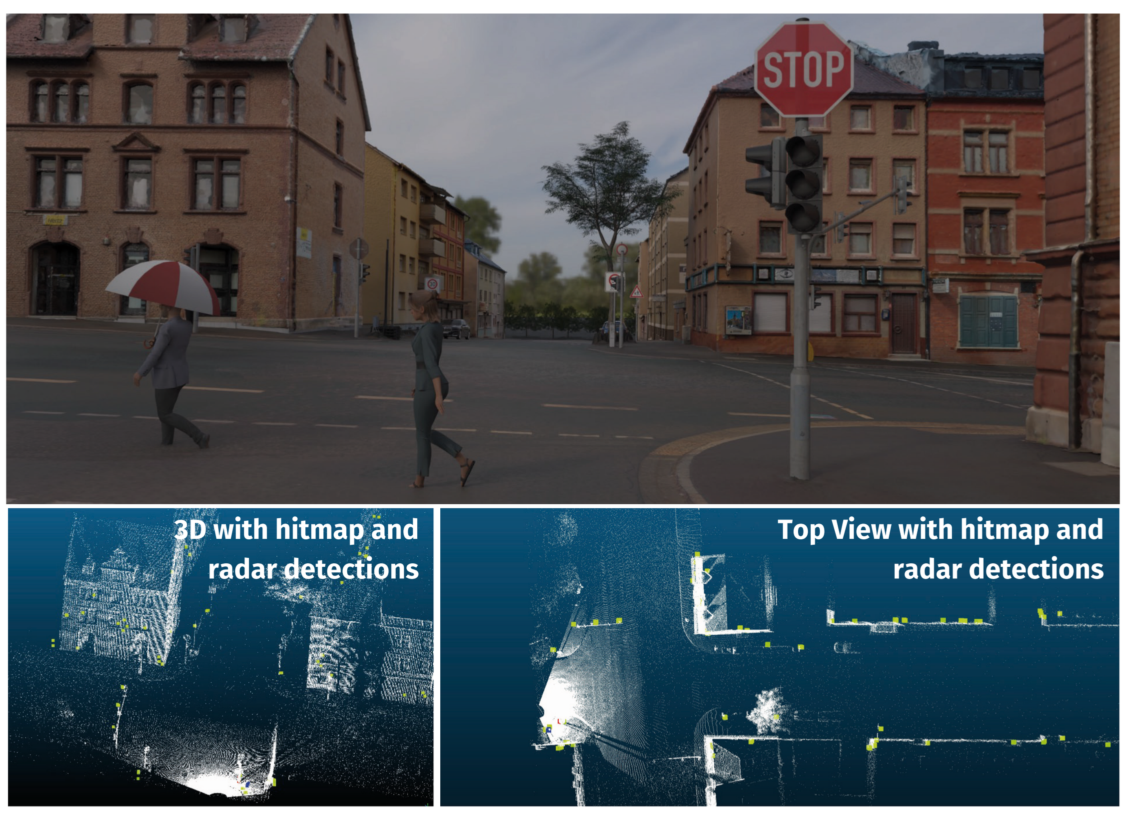

Figure 6: Rendering of Urban intersection scene including RGB (above) and radar point-clouds with path-tacer hitmaps (below) ©BIT-TS

Effect	BIT	dSPACE
Realistic object detection	partly	partly
Realistic Doppler signature	partly	partly
Radial component of velocity	partly	partly
Realistic number of locations	partly	partly
Data format consistent	yes	yes

Status 11/2023, BIT data in 4th and dSPACE data in 2nd iteration. Further improvements expected.

Table 1: Feature Based Evaluation on radar point clouds by two different providers ©BOSCH

Partners

BMW GROUP, BOSCH, Continental, Valeo, ZF, Ansys, AVL, dSPACE, DLR, FKFS, FZI, Bergische Universität Wuppertal, TH Aschaffenburg, Technische Universität Braunschweig, Technische Universität München, Universität Kassel, Universität Passau

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