AI Use Cases for Radar Data: ACD, RD and Point Clouds

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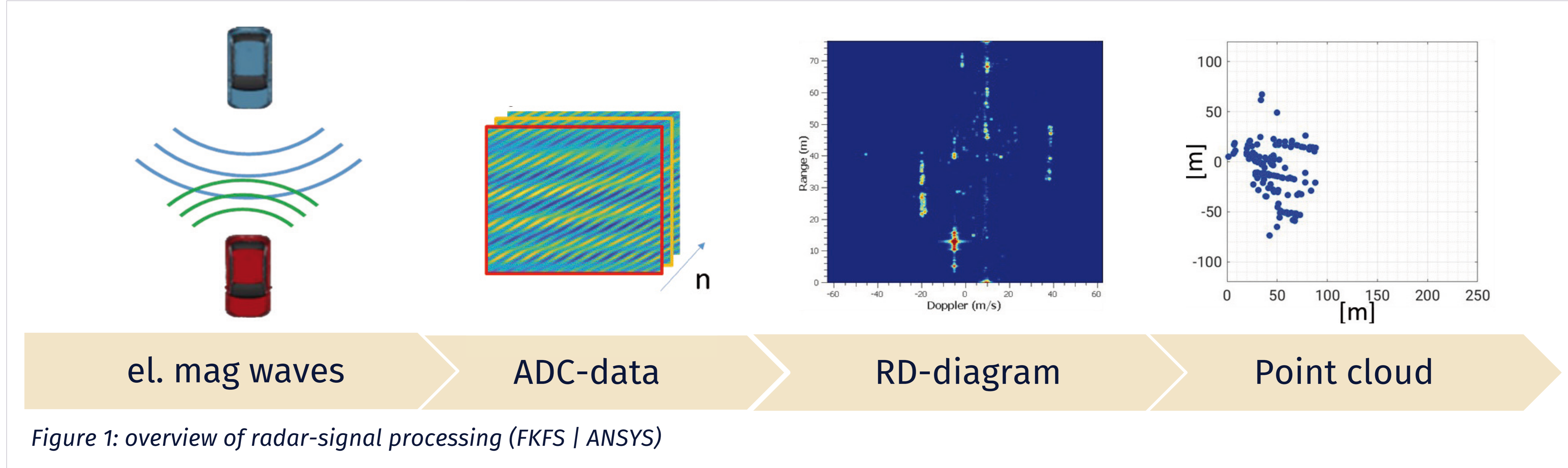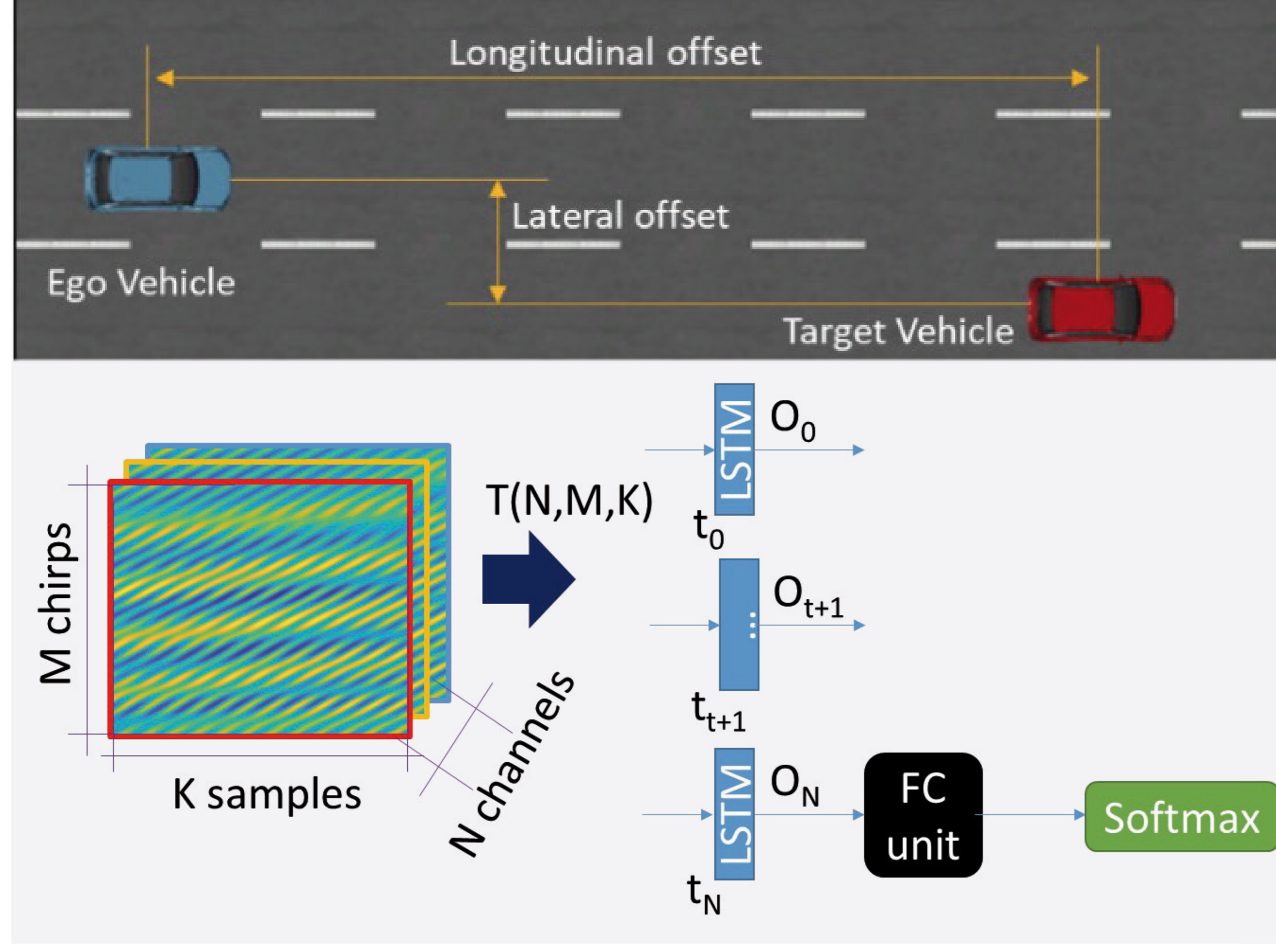For more information contact:
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Introduction

- AI approaches highly depend on the used data (type)
- In common use cases radar data can be either „raw" as ADC data, or processed to a *range-Doppler diagram* (RD) or point clouds.

| el. mag waves | ADC-data | RD-diagram | Point cloud |

Figure 1: overview of radar-signal processing (FKFS | ANSYS)

Scenarios & Synthetic Data

ADC-Data [1]

- Use case: **Distance prediction**
- ML Approach: Recurrent Neural Networks (RNN)

Figure 2: scene and RNN-structure for distance prediction (© FKFS)

	RNN
input	3D matrix: T(Batch_size,Inputs,Steps)= T(N, M, K)
structure	Long short-term memory (LSTM) → fully connected unit (FC) → softmax function

Range-Doppler [2]

- Use case: **Object classification and localization**
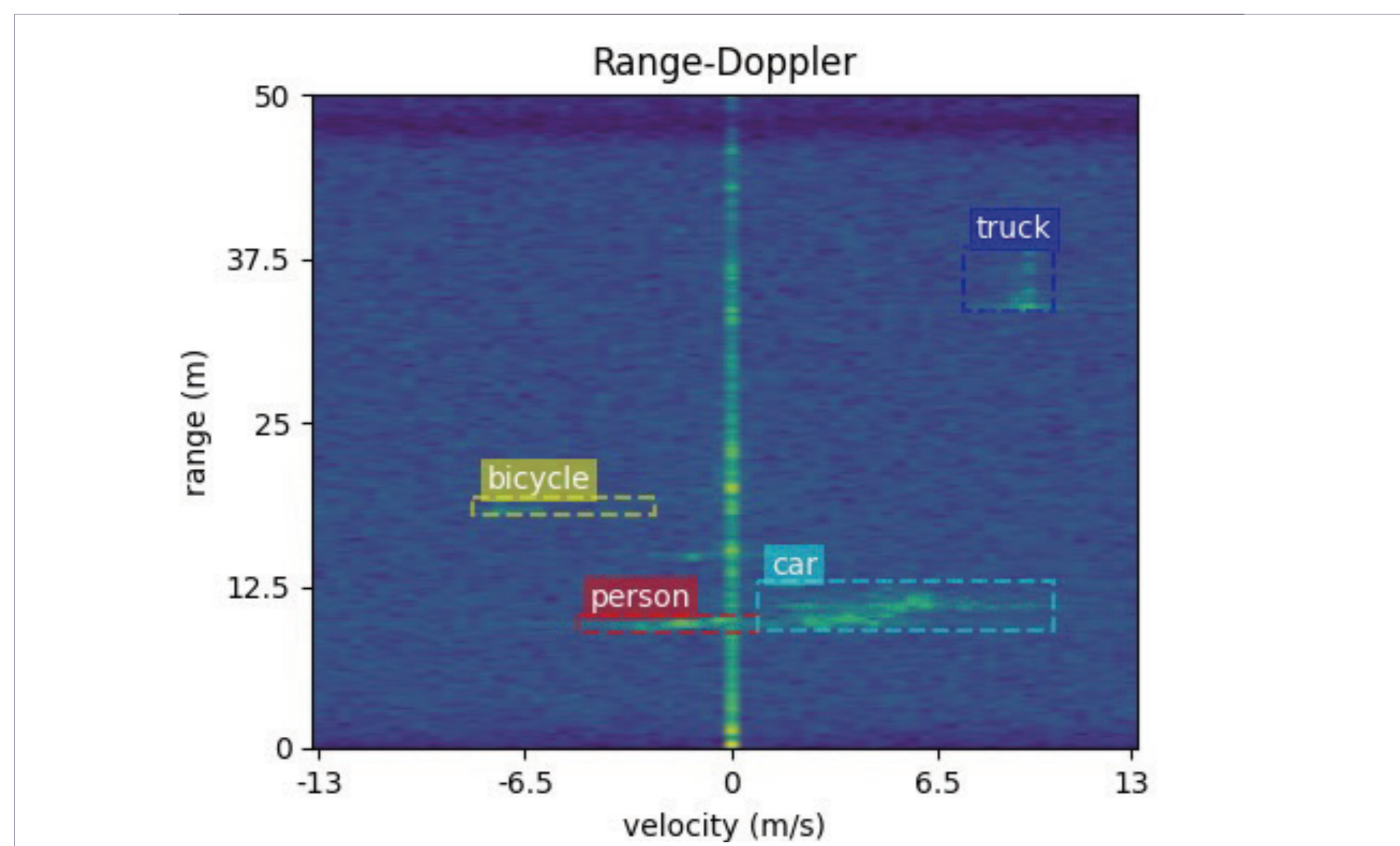- ML Approach: RadarResNet (based on YOLO)

Figure 3: annotated range-Doppler diagram (©[2])

Point clouds [3]

- Use case: **Point cloud segmentation**
- ML Approach: Kernel Point Convolution based LSTM Networks
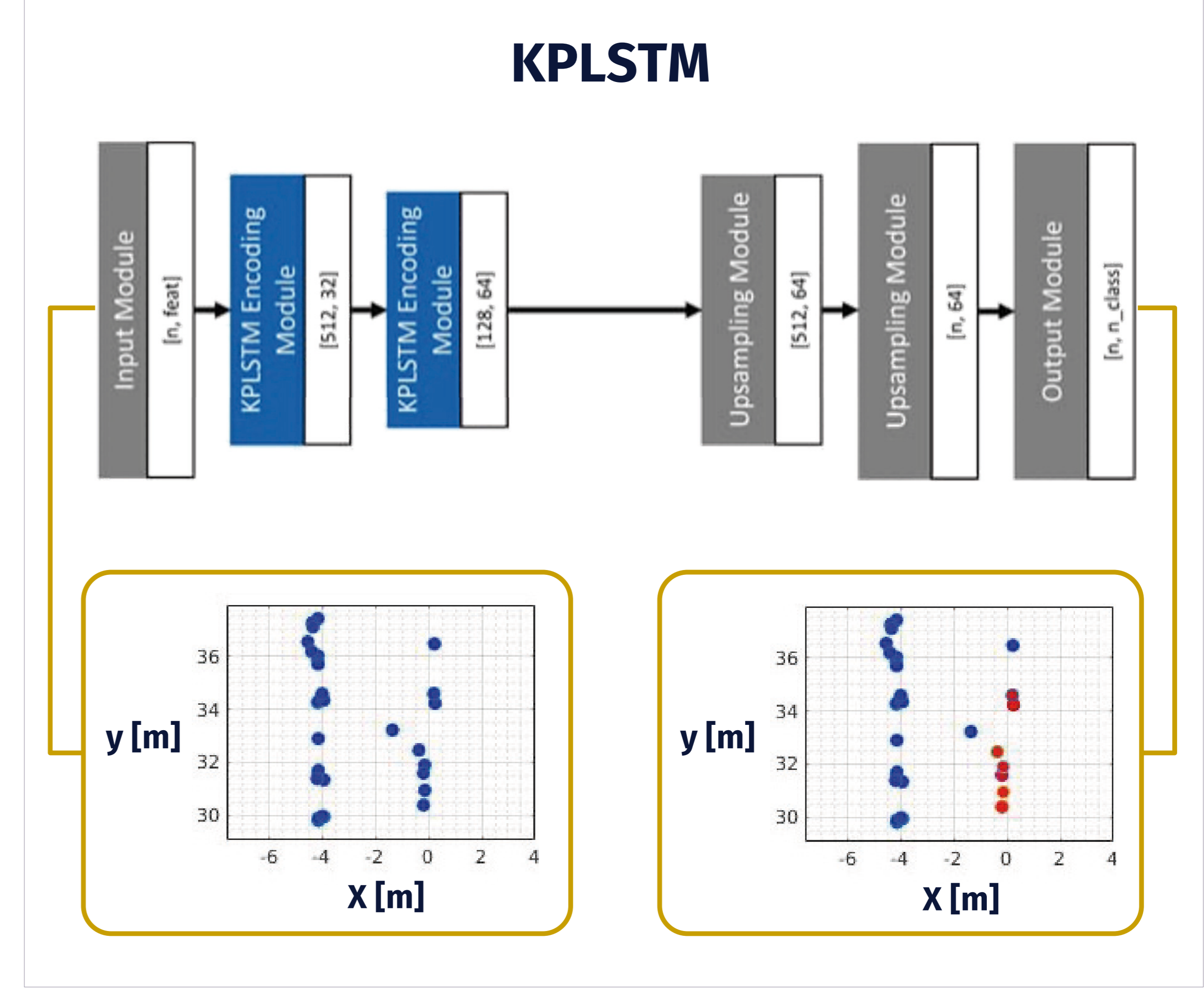

Figure 4: KPLSTM structure and segmented radar point-cloud (©[3])

Conclusion

- Some radar data like ADC and RD cannot be intuitively interpreted. AI methods are a powerful tool for the interpretation of radar data of every type.

- Each radar data type has its own approaches and tasks.

References:

[1] Lang, L.; Saad, K.; Salles, D.; Reuss, H.-C., „Automotive Radar Antenna Configurations and their Impact on Machine Learning Approaches: A Case Study", Driving Simulation Converence (DSC22), Straßburg
[2] Zhang, A.; Nowruzi, F. E.; Laganière, R., "RADDet: Range-Azimuth-Doppler based Radar Object Detection for Dynamic Road Users." 2021 18th Conference on Robots and Vision (CRV) (2021): 95-102.
[3] Nobis, F.; Fent, F.; Betz, J.; Lienkamp, M.; "Kernel Point Convolution LSTM Networks for Radar Point Cloud Segmentation", Applied Sciences 11 (2021), no. 6: 2599. https://doi.org/10.3390/app11062599
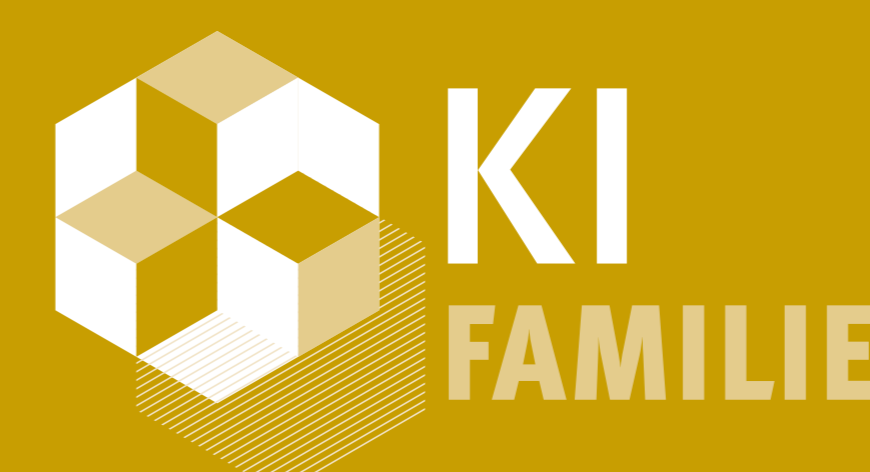
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