DAROD: A DEEP AUTOMOTIVE RADAR OBJECT DETECTOR ON RANGE-DOPPLER MAPS

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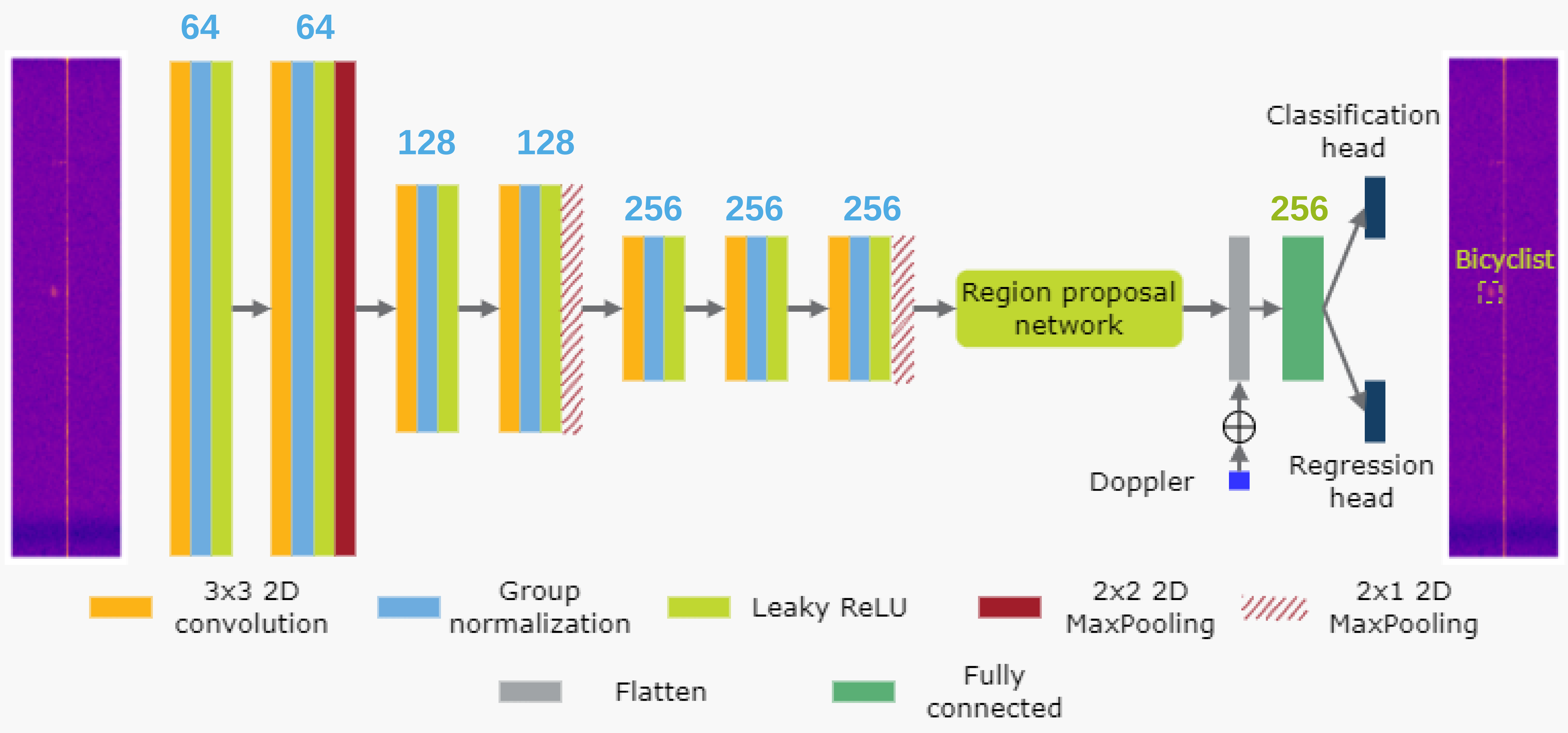
1. INTRODUCTION

- Radar sensors seem particularly suited for critical and real-time automotive applications, because they are not hampered by light or weather conditions.
- Range-azimuth-doppler (RAD) tensors provide the most informative data but they are cumbersome to compute.
- We hypothesise the range-doppler (RD) spectrum contains enough information for both detection and classification tasks in automotive radar while being low computationally expensive.
- We propose an adaptation of the Faster R-CNN [1] object detector, with a lightweight backbone for feature extraction.
- We evaluate our model on CARRADA [2] and RADDet [3] datasets.

2. MODEL ARCHITECTURE

- We adapt Faster R-CNN object detector for radar data and we propose a lightweight backbone derived from the VGG architecture with only 7 convolutional layers.
- The stride in the Doppler dimension (2) is lower than the stride in the range Dimension (8), to preserve Doppler information throughout the network.
- RD spectra are not translation invariant so we add the velocity as an additional feature.



Model architecture

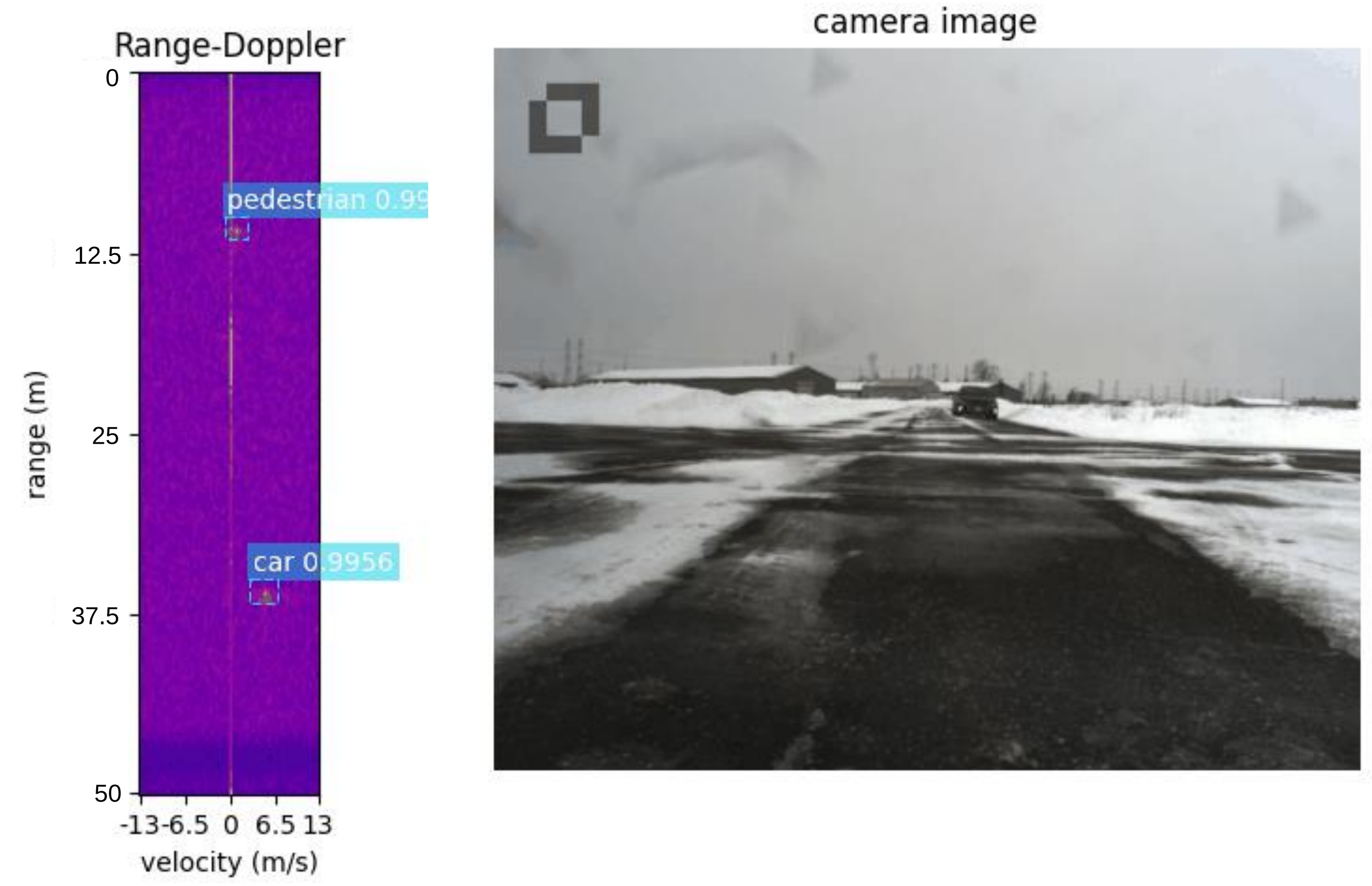
3. RESULTS

MAP@0.5	CARRADA	RADDET	# PARAMETERS	# GFLOPS (PER FRAME)	#GMACS (PER FRAME)	INFERENCE TIME
DAROD (ours)	<u>55.83</u>	<u>46.57</u>	3.4M	<u>12.6</u>	<u>6.3</u>	**25.31ms**
RADDet [2]	18.57	22.87	7.8M	**9.6**	**4.8**	74.03ms
Faster R-CNN (pretained) [3]	**61.56**	**49.55**	41.3M	122	61	<u>37.19ms</u>
Faster R-CNN (scratch) [3]	52.93	**40.84**	41.3M	122	61	<u>37.19ms</u>

- DAROD outperforms the RADDet method on both datasets.
- DAROD remains competitive with Faster R-CNN which have large number of parameters comparing to DAROD.
- Radar based approaches are far more efficient than Faster R-CNN that uses up-sampling and deeper backbones.
- The pretraining of Faster R-CNN backbone on the ImageNet dataset helps to improve the detection performance.

4. CONCLUSION

- We don't need to use very deep convolutional neural network to extract meaningful information from radar data.
- A simple and light backbone performs well for object detection and classification tasks comparing to deeper image-based backbones which reach better results but at higher cost.
- Our model doesn't yet consider the angle and the temporal information but achieve good results without it.



ACKNOWLEDGMENTS

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