

## BACKGROUND

### RF Sensing

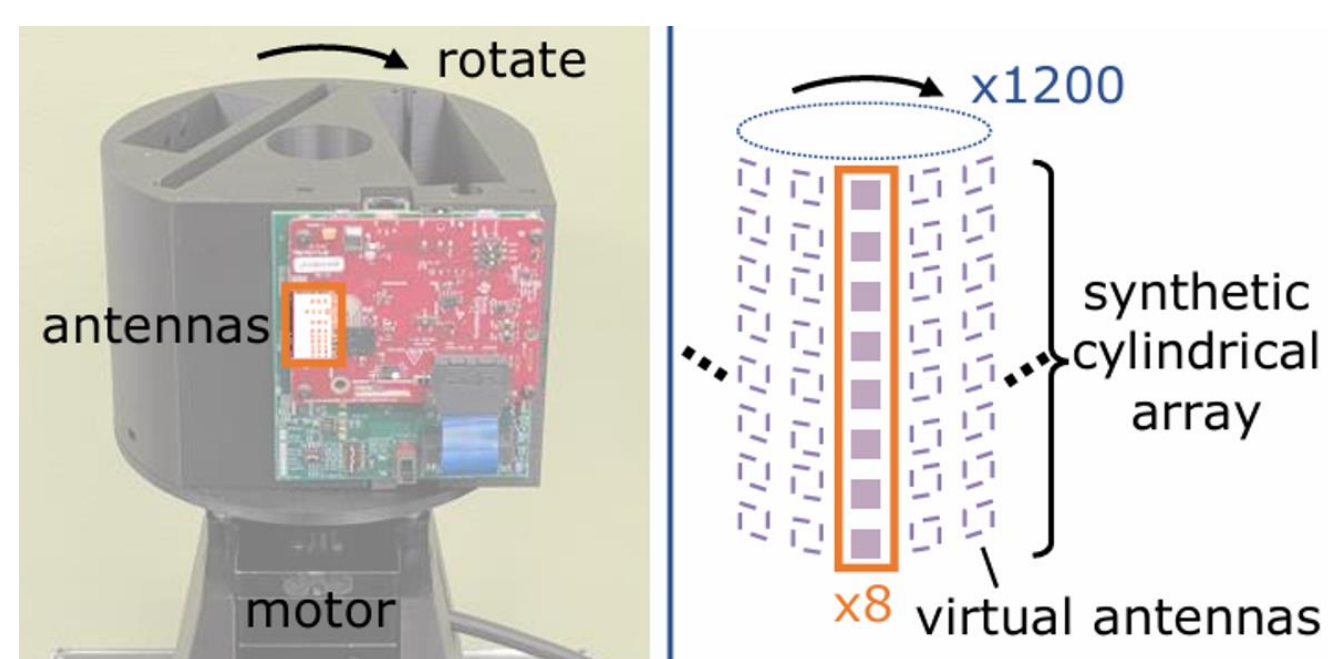
Resilient to dust, smoke, adverse lighting

Low resolution

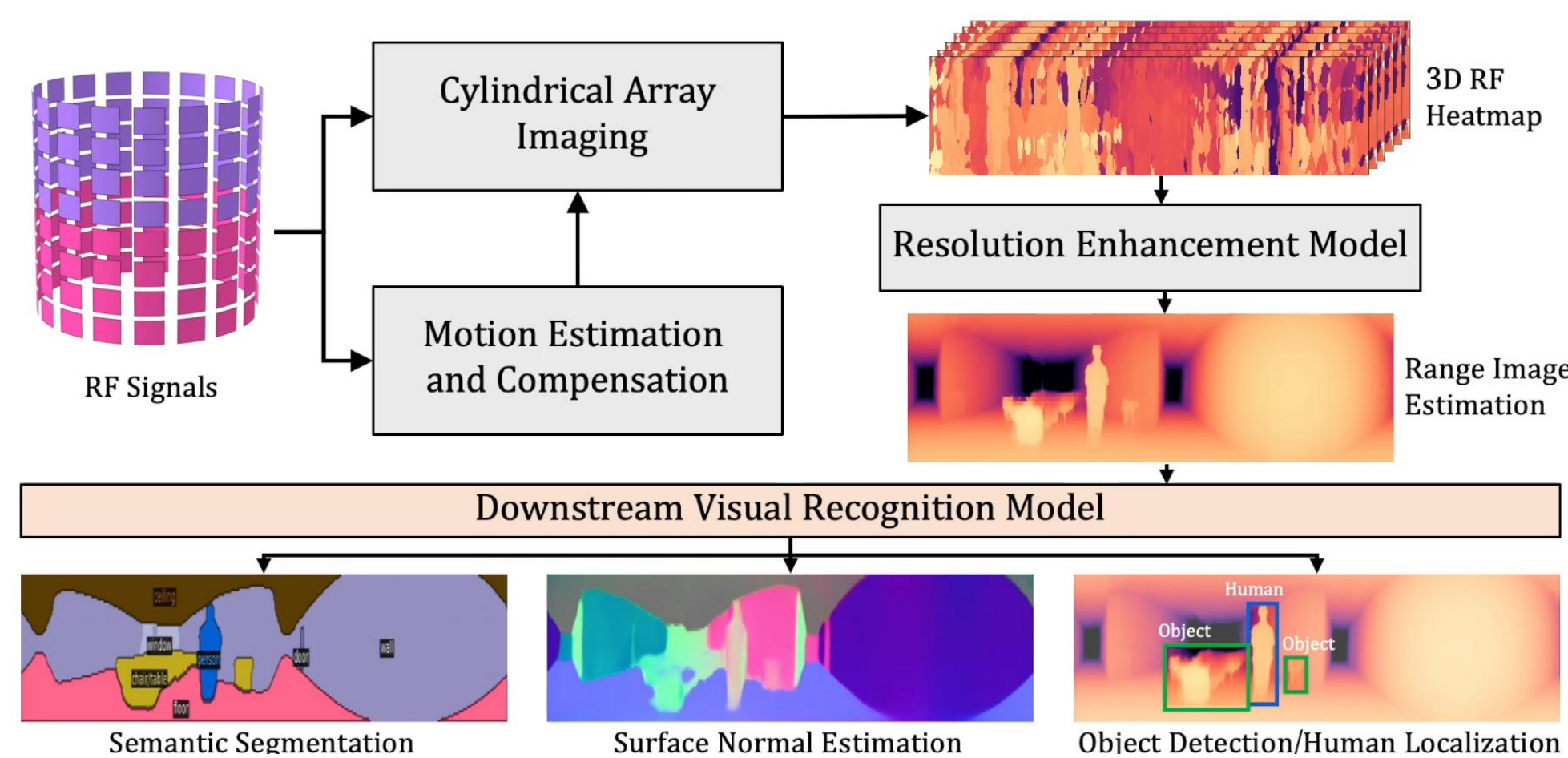
- |  |                                      |
|--|--------------------------------------|
| Learning based solutions                       | SAR based solutions                  |
| - Rely on category specific priors             | - Large cumbersome setup             |
| - Not applicable as a general sensing solution | - Long scanning times                |
|  | - Does not work with external motion |

## OUR APPROACH

### Hardware Design: Rotating mmWave Radar



### System Overview

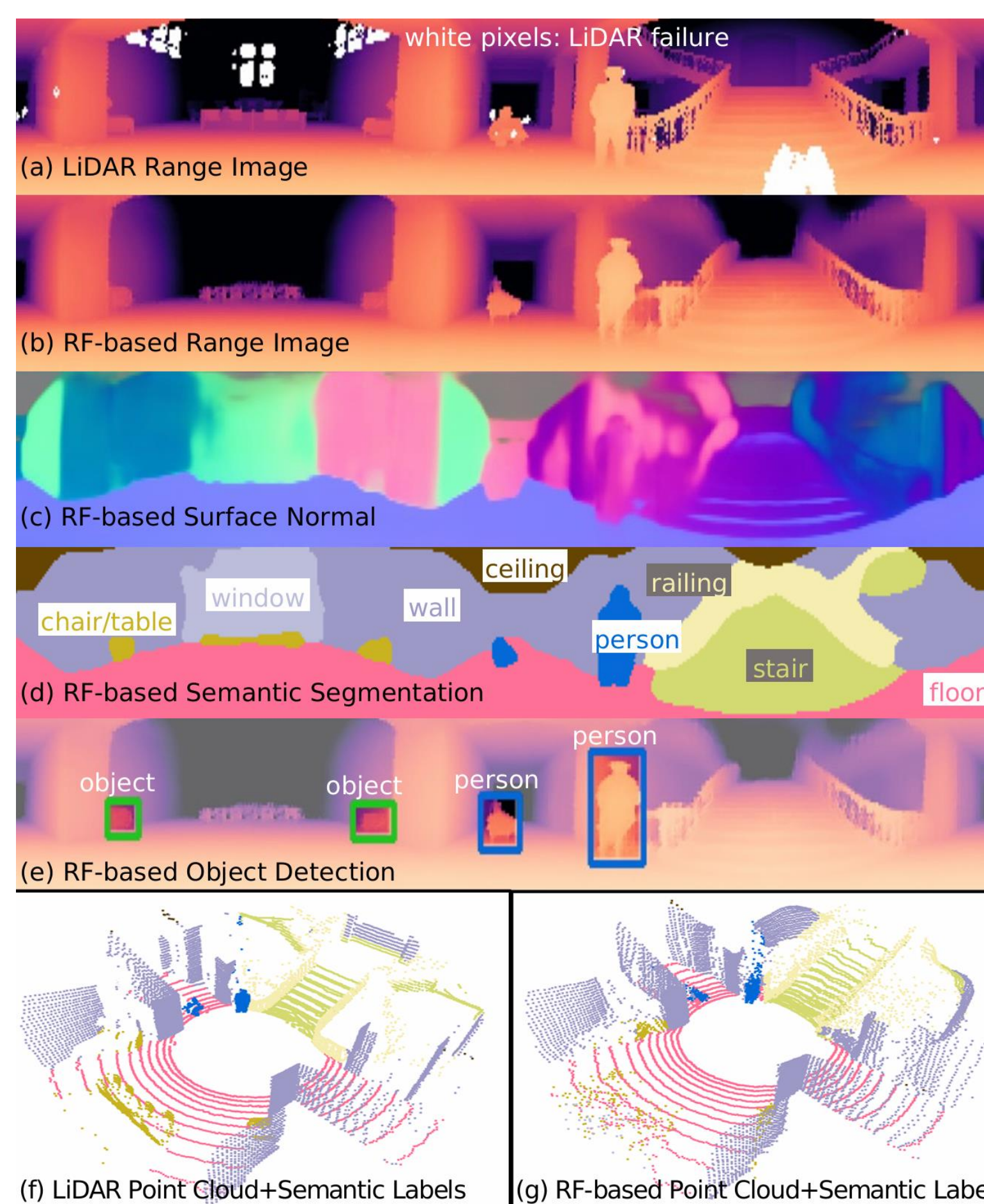


Achieve LiDAR comparable range images and visual recognition

## CONTRIBUTIONS

- Novel design that integrates a off the shelf mmWave radar with a motor
- New motion estimation algorithm for coherent combination of radar signals
- Innovative neural network for efficient 3D imaging using 2D convolutions

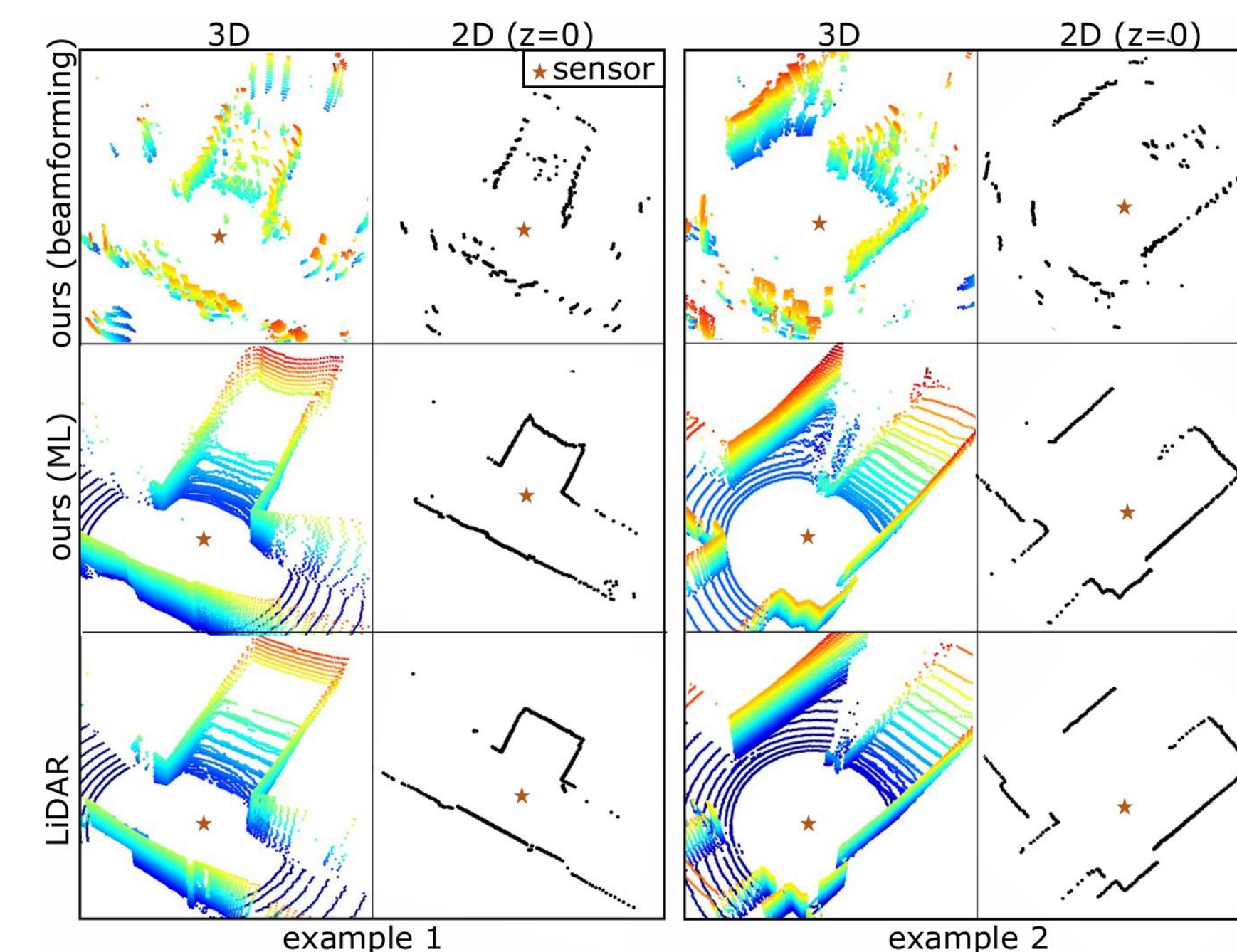
## RESULTS



### Visual Recognition Performance

Range Absolute Error		Surface Normal Error	
mean	median	mean	median
15.76 cm	3.39 cm	8.83°	2.17°
Semantic Segmentation		Object Detection	
mIoU	pAcc	AP30	AP50
48.00	86.33	52.34	38.30

## Point Cloud Visualization



## Performance Through Smoke



## CONCLUSIONS

- First RF imaging system with resolution comparable to LiDAR
- Enabling first visual recognition at RF
- We release code and dataset to facilitate future research in this direction

## ACKNOWLEDGEMENTS

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