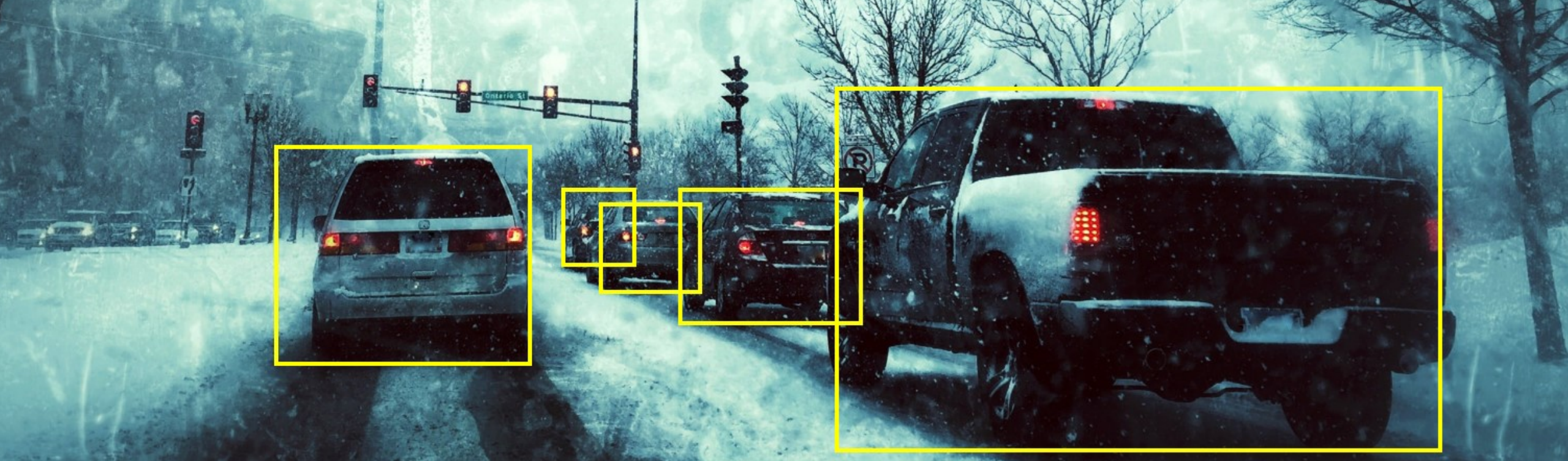




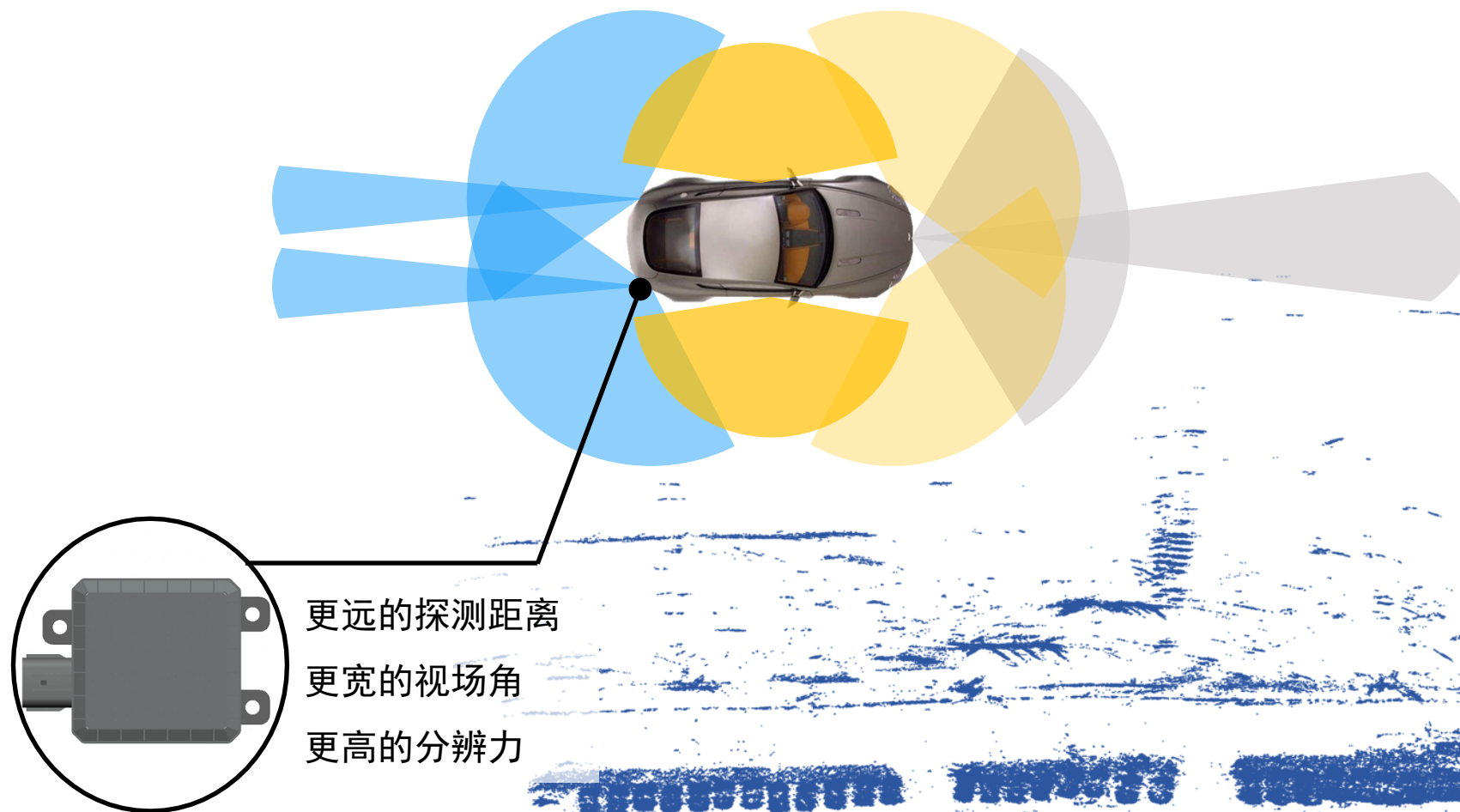
新一代自动驾驶

毫米波雷达关键技术

买剑春
雷达系统工程师

HAWKEYE
隼眼科技

新一代自动驾驶中的雷达传感器

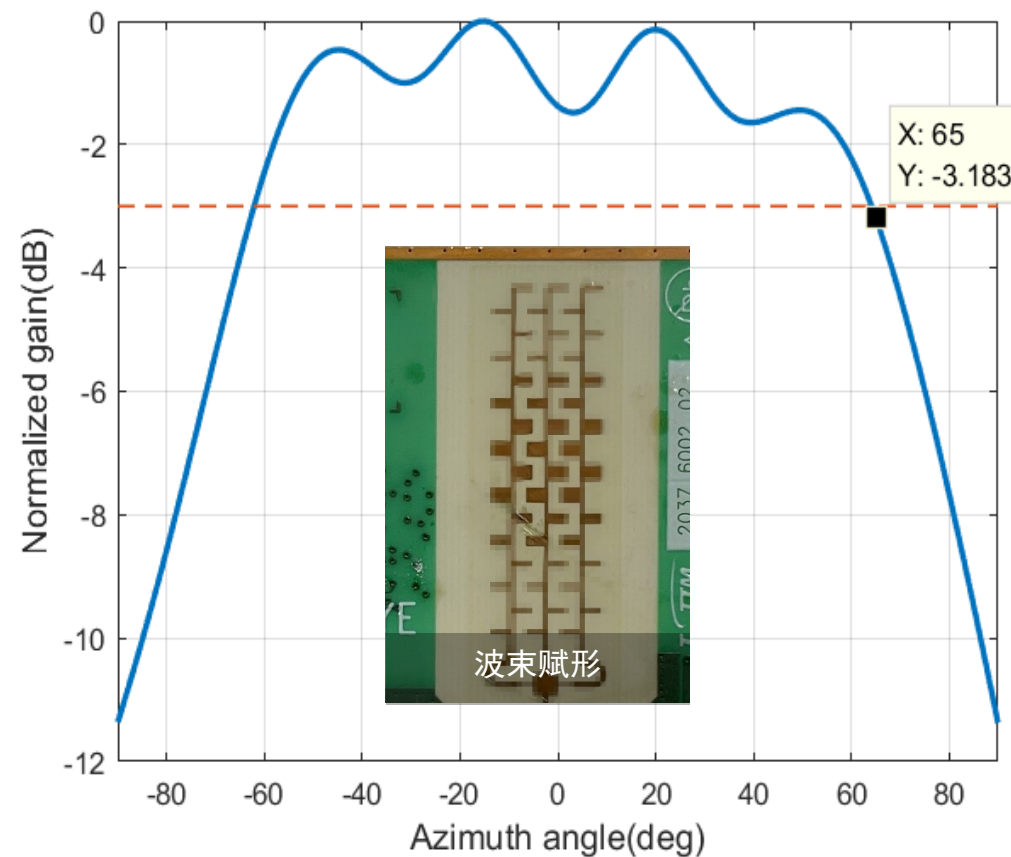
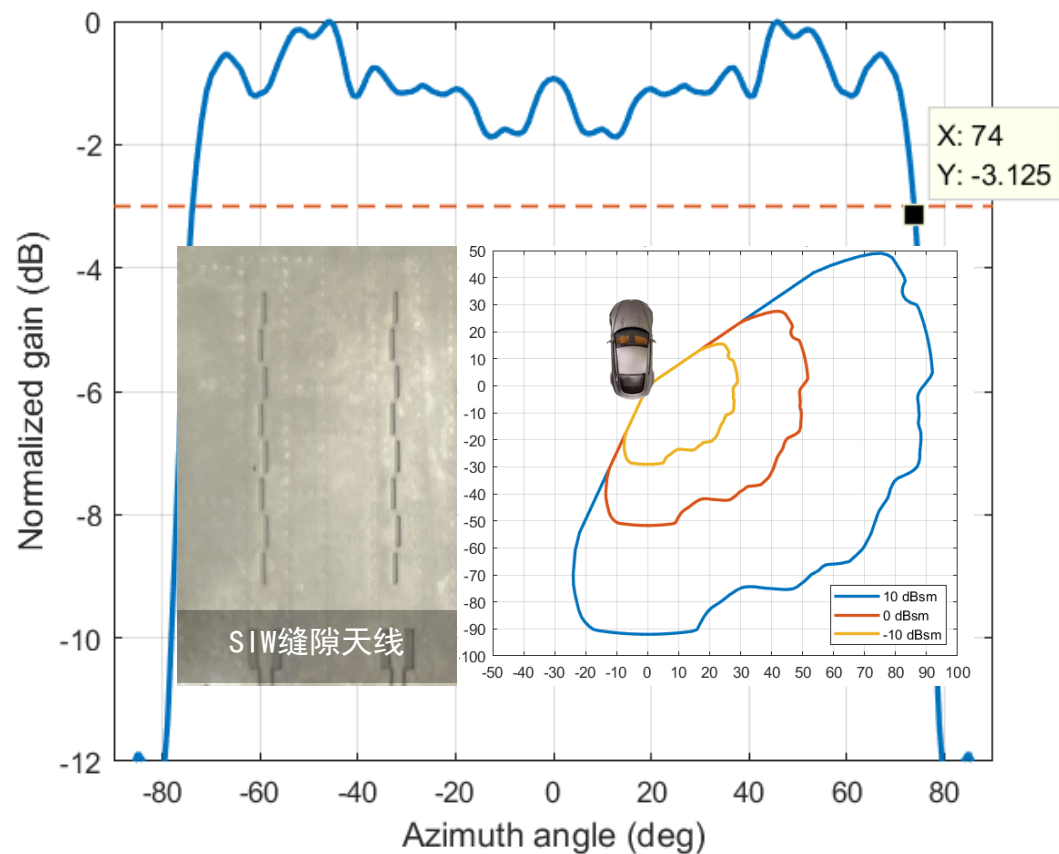


更远的探测距离
更宽的视场角
更高的分辨力

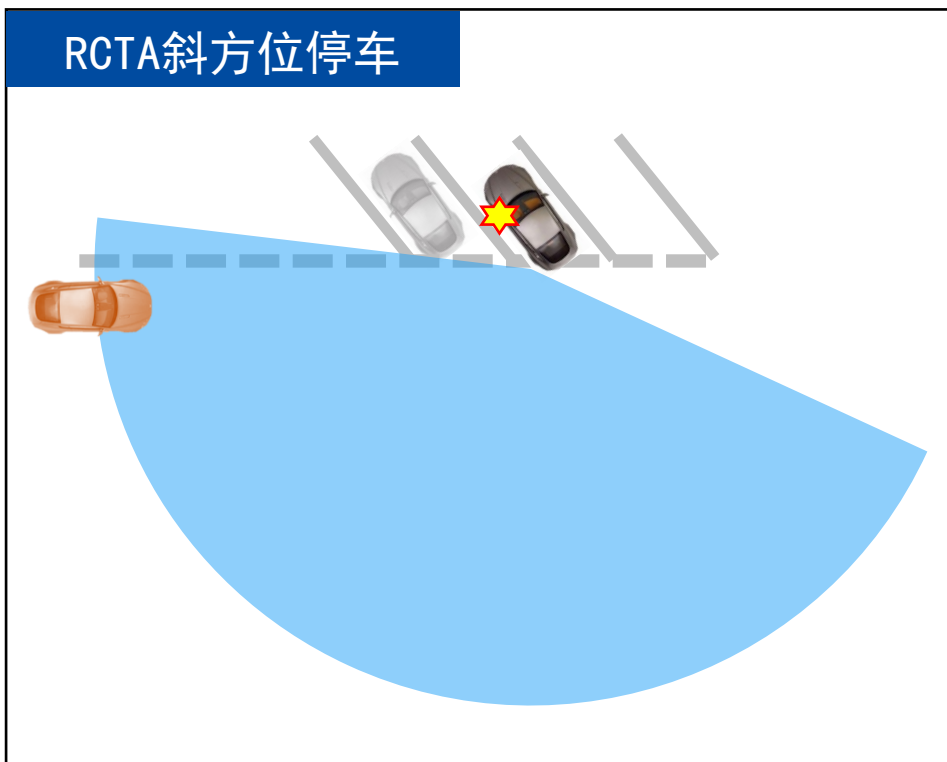
- | | |
|------------|-----------------|
| ✓ BSD | ✓ ACC |
| ✓ LCW | ✓ AEB |
| ✓ RCTA/B | ✓ FCW |
| ✓ DOW | ✓ FCTA |
| ✓ RCW | ... |
| ... | ✓ HWP |
| ✓ Ext. LCA | ✓ Parking Pilot |
| ✓ HWA | ✓ 360 Fusion |

关键技术

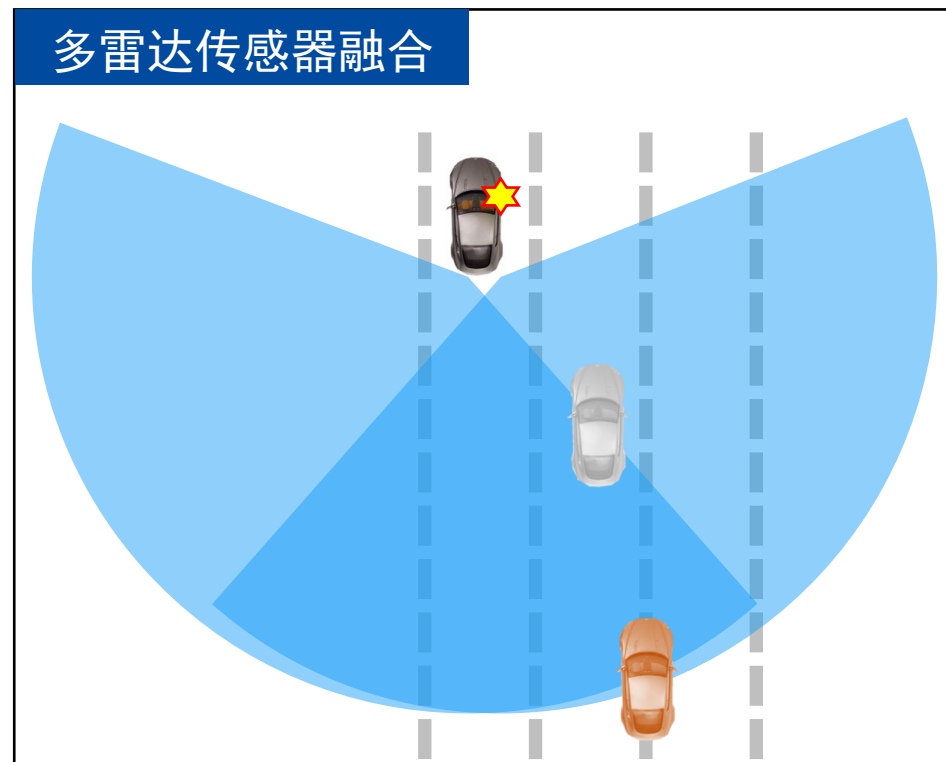
宽波束天线



宽波束天线

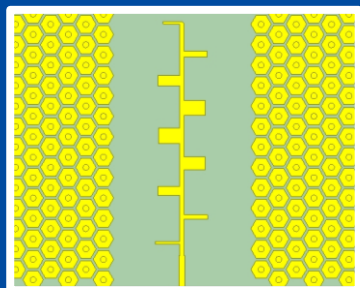
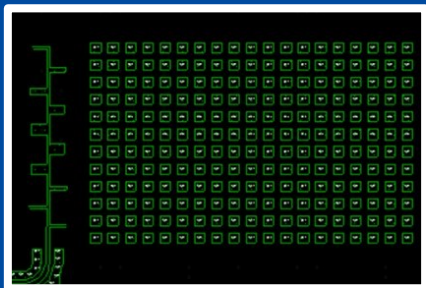


- ✓ 更早的发现目标车辆
- ✓ 满足45至90° 停车位



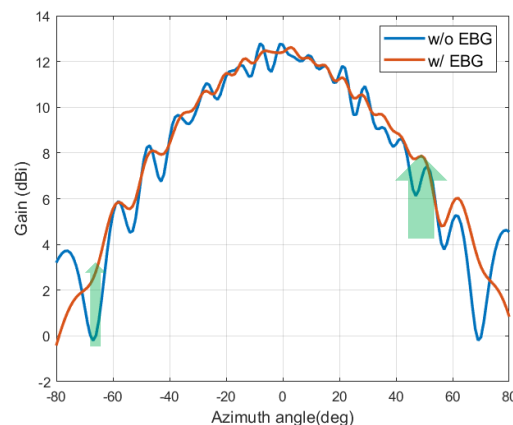
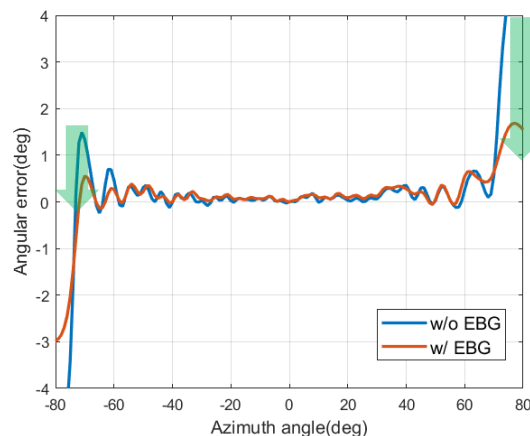
- ✓ 融合区域面积增加
- ✓ 提升系统检测概率

人工电磁超材料



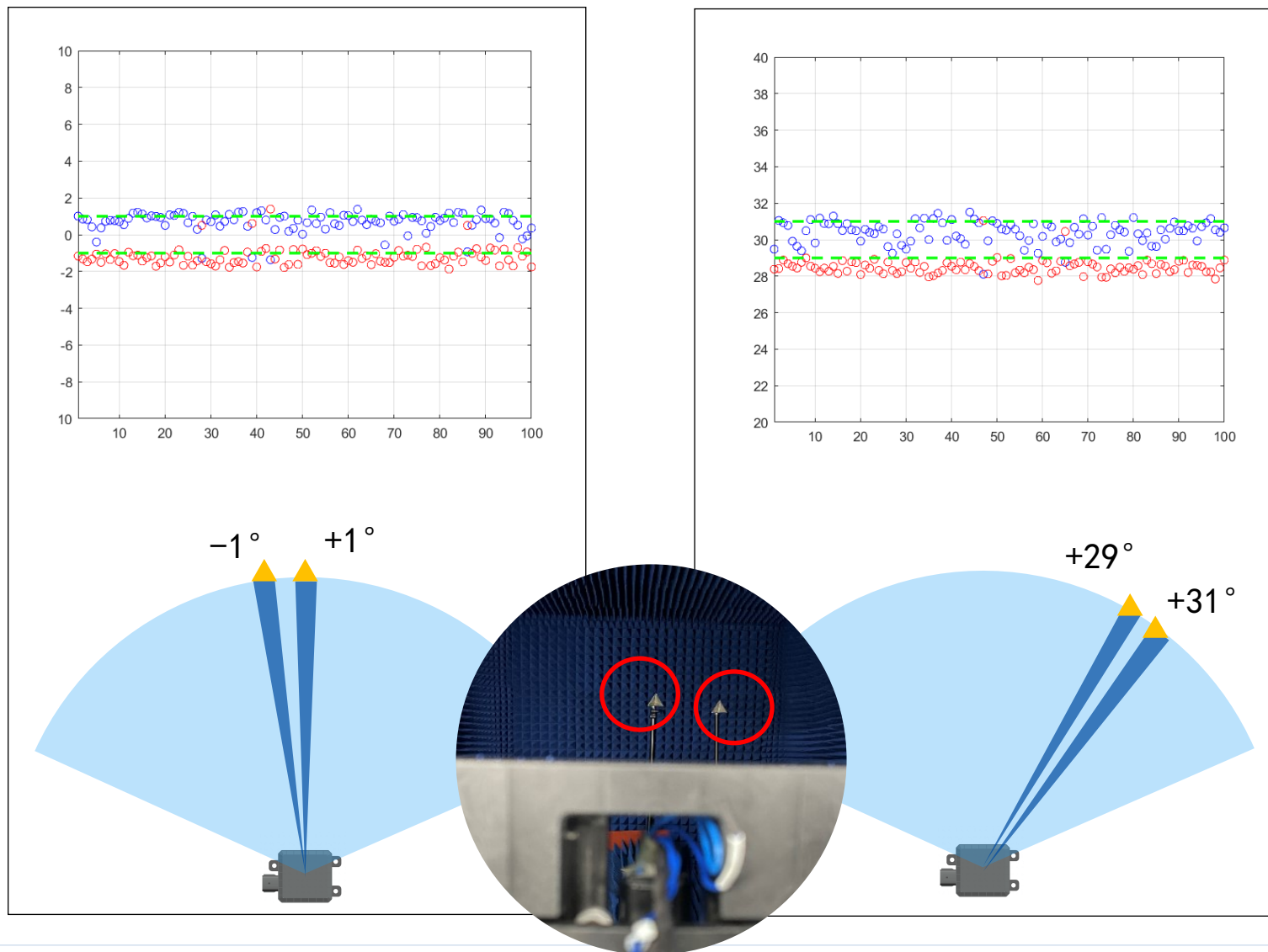
- 电磁带隙(EBG) : Electromagnetic Band Gap
- 左手材料(LHM) : Left-Handed Material
- 频率选择表面(FSS) : Frequency Selective Surface

.....



- ✓ 改善边缘幅度波动、相位误差
- ✓ 降低天线RCS，吸收多次回波干扰
- ✓ 提升雷达检测稳定性

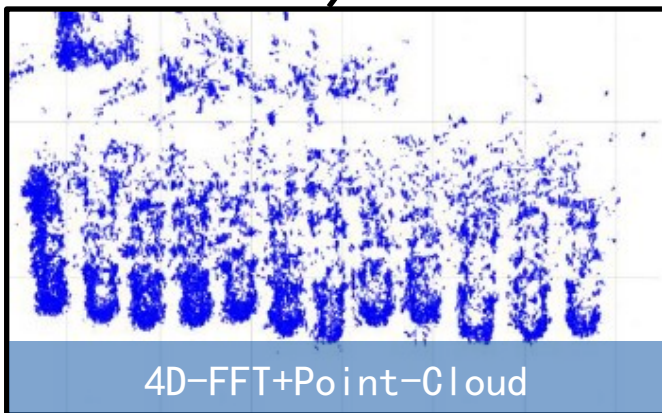
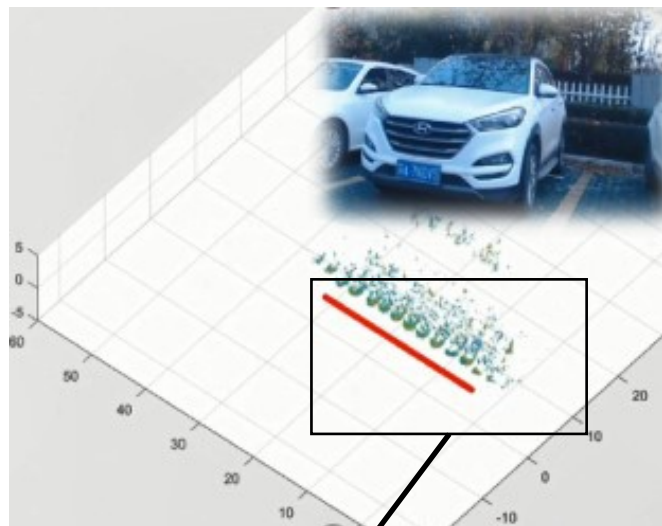
高分辨角度估计



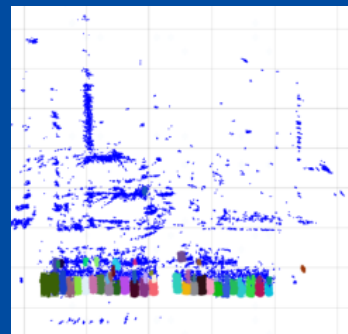
- 大口径稀疏阵列
- 多芯片级联MIMO系统
- 多目标角度估计算法

- ✓ 同距同速目标分辨
- ✓ 体目标的更多检测点
- ✓ 目标轮廓识别

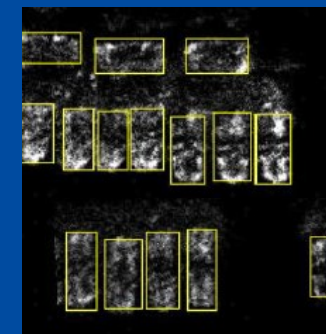
目标识别与分类



- 机器学习
- DBSCAN
- 基于密度的聚类
- 目标识别



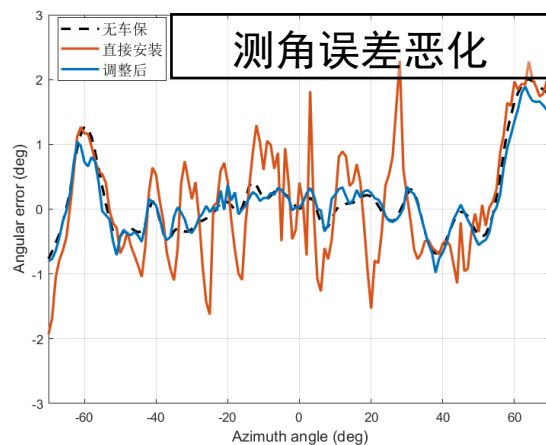
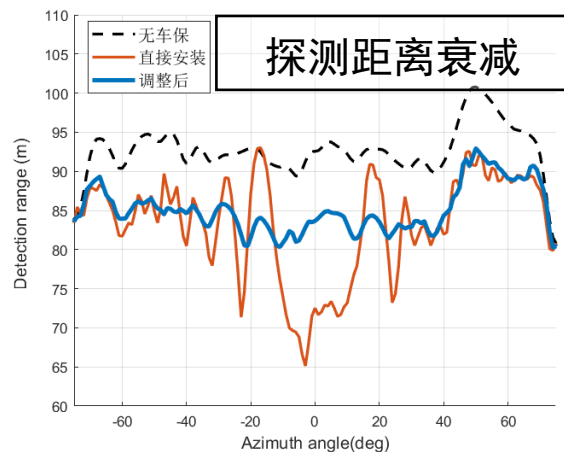
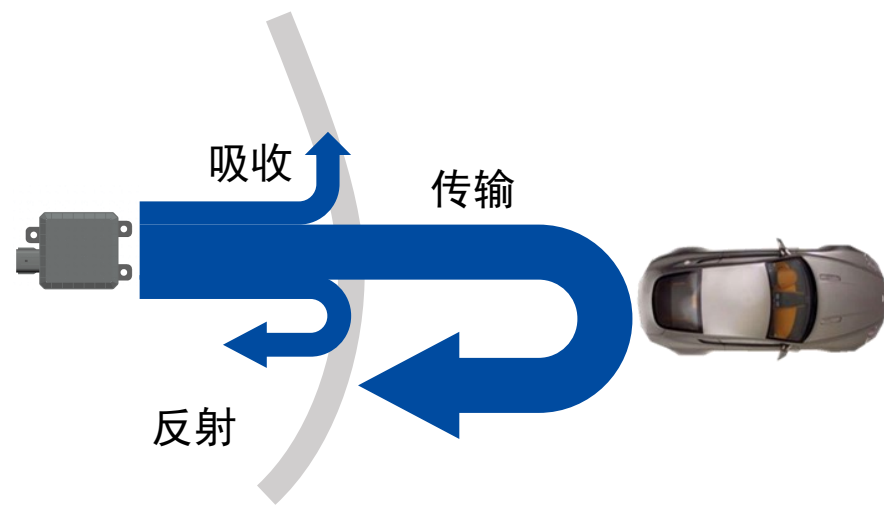
- 深度学习
- Faster RCNN
- 轮廓、尺寸识别
- 方向估计
- 目标分类



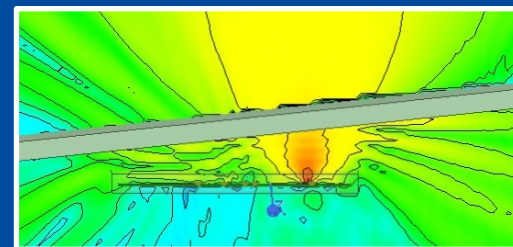
- ✓ 360 Fusion: 环境地图
- ✓ 自动泊车: 障碍避让, 车位搜寻...
- ✓ 点云数据与其他传感器融合



保险杠适配

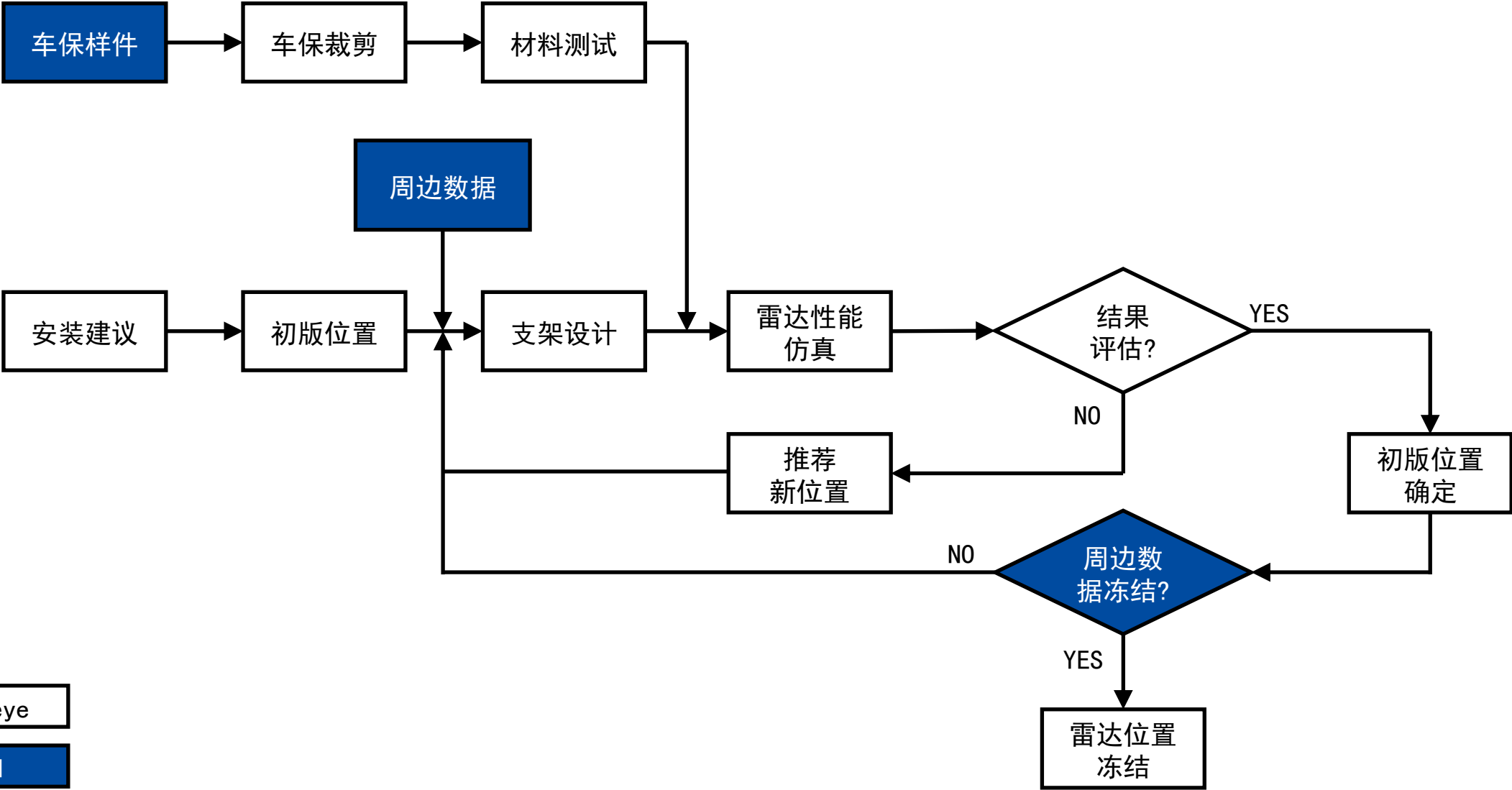


- 材料参数测试
- 电磁参数测试
- 建模和电磁仿真
- 最小距离衰减评估
- 保险杠分级
- 安装方案设计



- ✓ 改善反射造成的检测性能损失
- ✓ 评估吸收或折射造成的性能衰减

保险杠适配

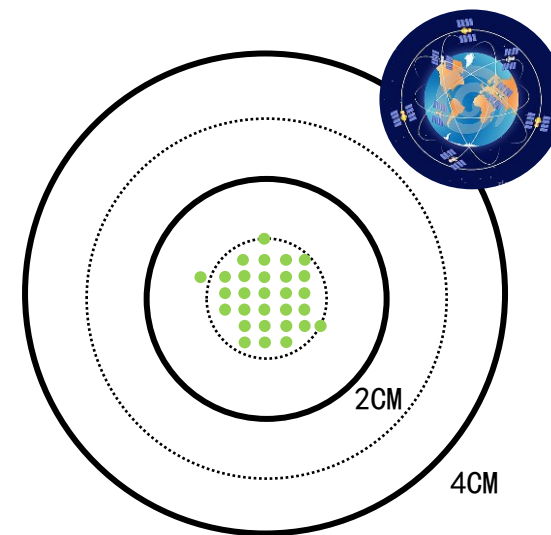
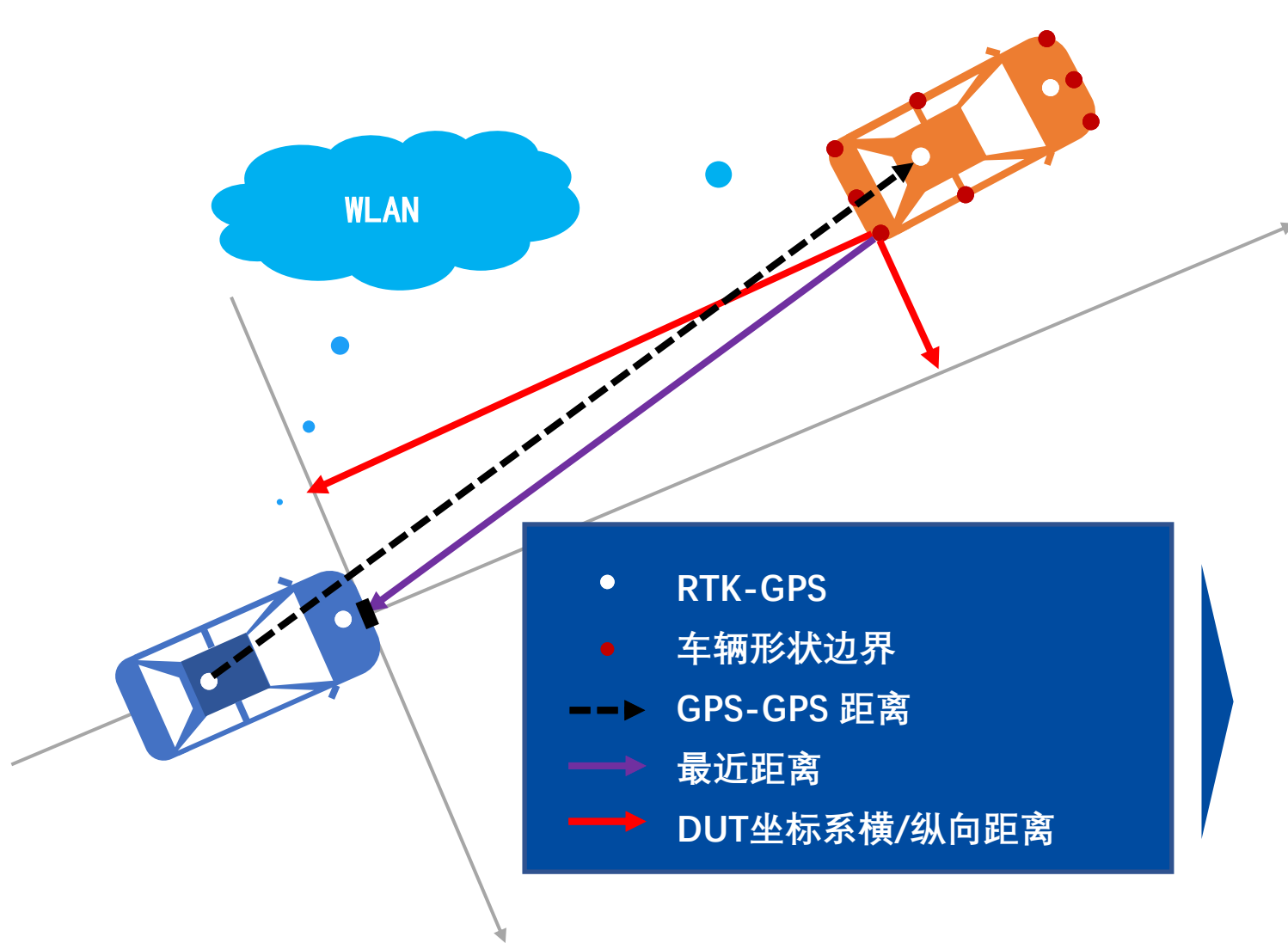


Hawkeye

OEM

ADAS场景测试

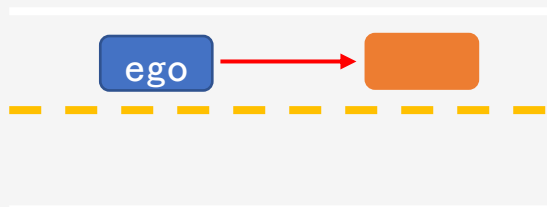
隼眼场景测试验证系统



- ✓ 高精度，低延时，全天候
- ✓ 合作目标测试
- ✓ 雷达目标感知信息验证
- ✓ ADAS报警信息验证

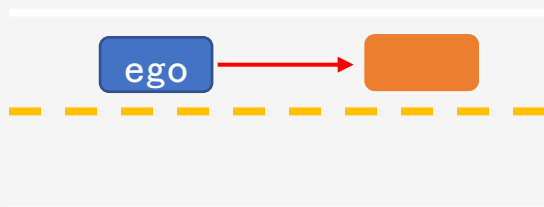
隼眼场景测试验证系统

FCW/AEB碰撞预警/刹车



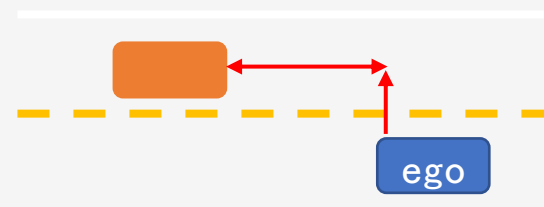
TTC/距离/制动减速度

ACC自适应巡航



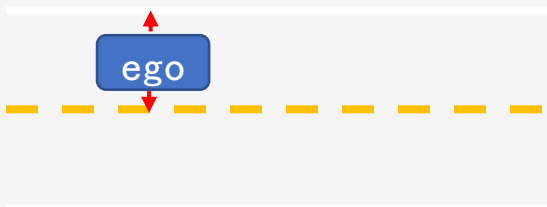
TTC/距离/速度

LCW变道预警



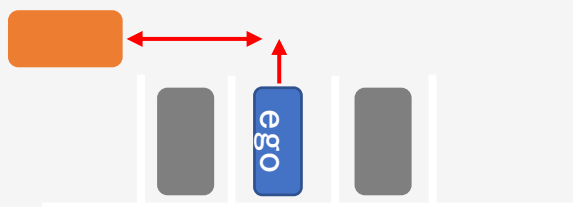
TTC/距离

LKA车道保持



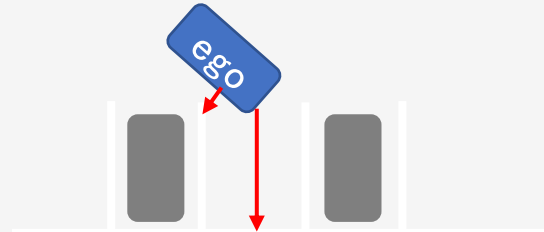
距离

RCTA倒车预警



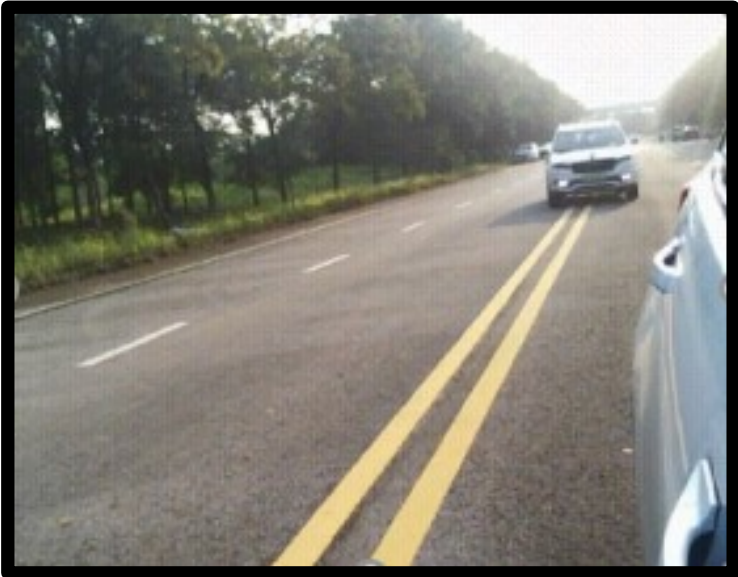
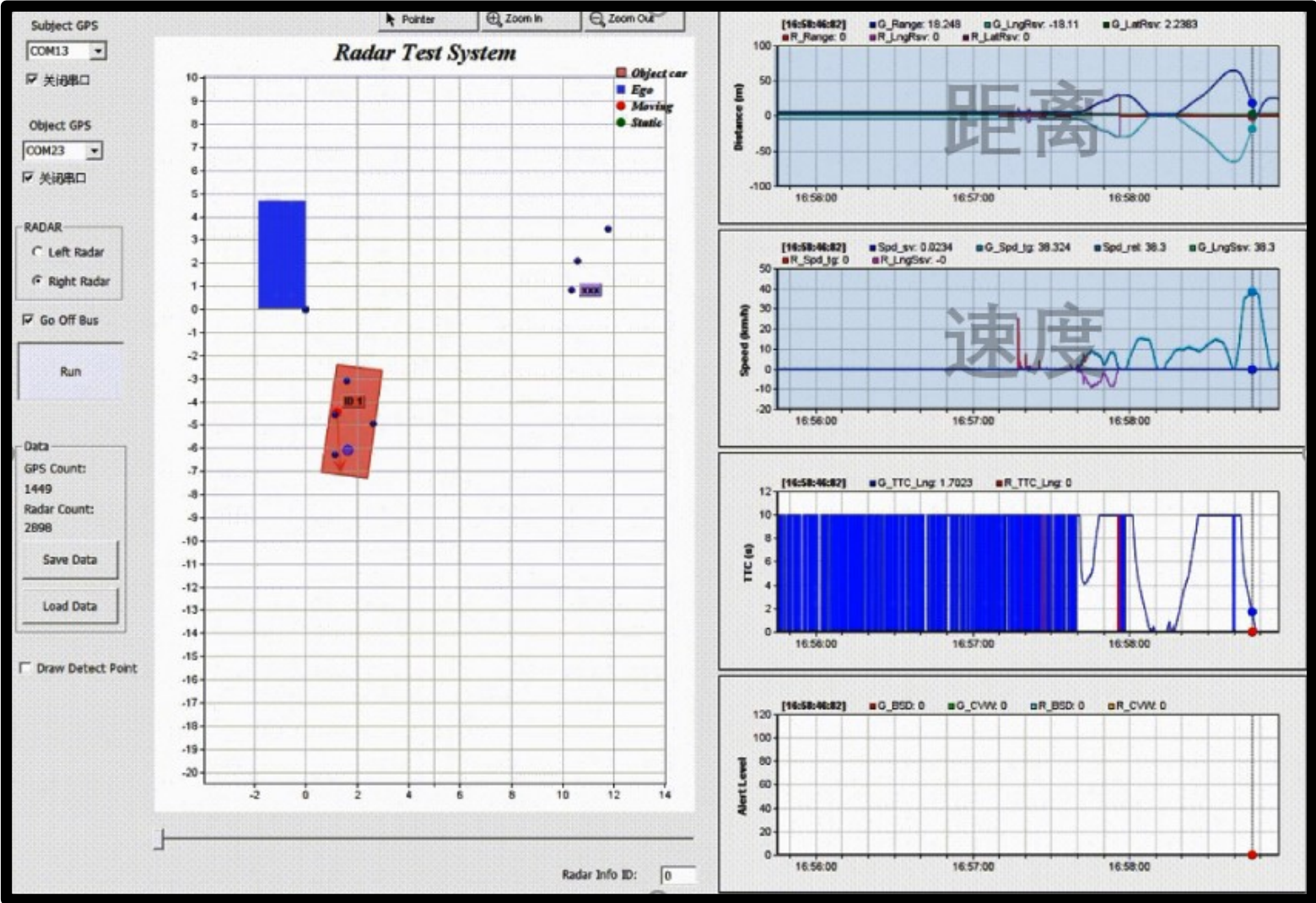
TTC/距离

APA自动泊车

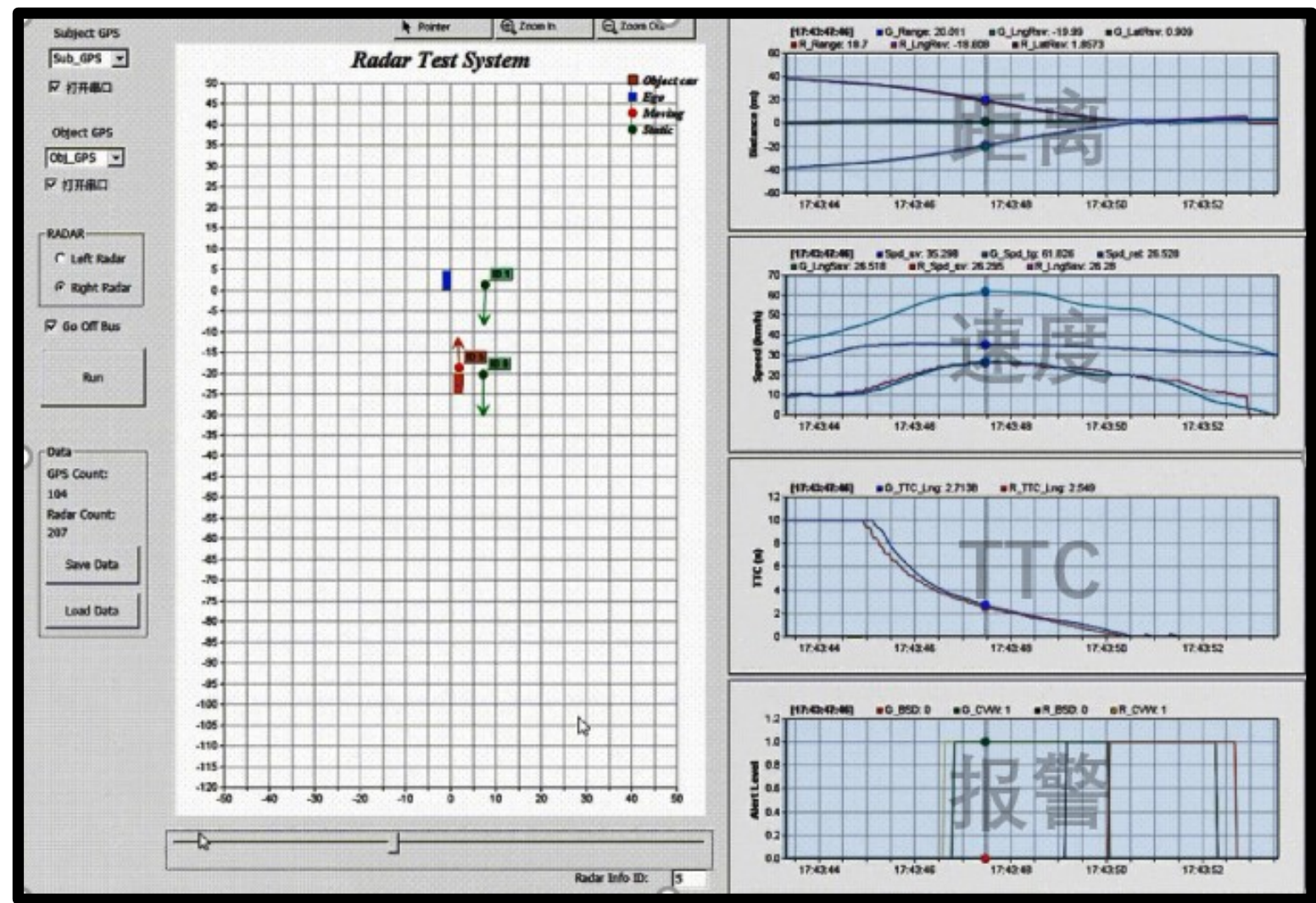


距离/轨迹

场景I:检测与跟踪评估



场景II: ADAS功能与报警



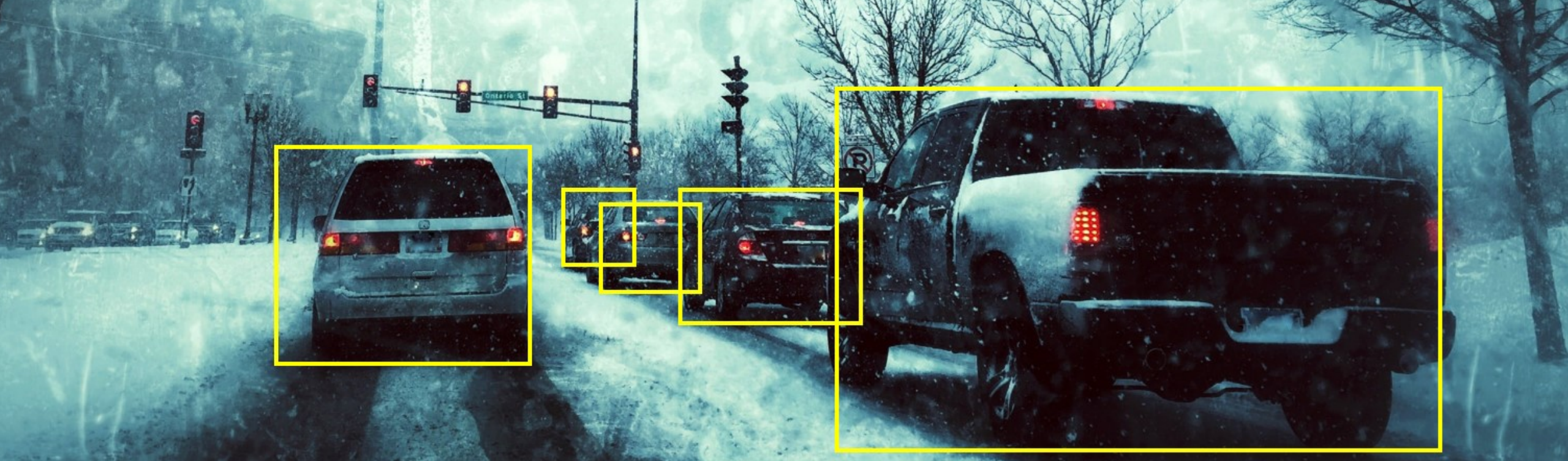
结束语



“Autonomous Cars Allow Extended Individual Mobility for All”



图片来源：互联网



感谢聆听！

让毫米波技术触手可及

HAWKEYE
隼眼科技