Vehicle Dynamics Expo 2008 - October 23

Automotive Radar and Vision Systems – Ready for the Mass Volume Market

Dr. Dieter Hoetzer, Robert Bosch LLC
Dr. Dirk Freundt, Robert Bosch GmbH
Bernhard Lucas, Robert Bosch GmbH

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Agenda

- What makes North America a Radar and Vision Systems Market?
- A long-range Radar for the high-volume Market
- Multi-purpose Cameras enabling affordable driver-assist Functions
- Warning Strategy: Dependent on the Situation
- Summary and Outlook

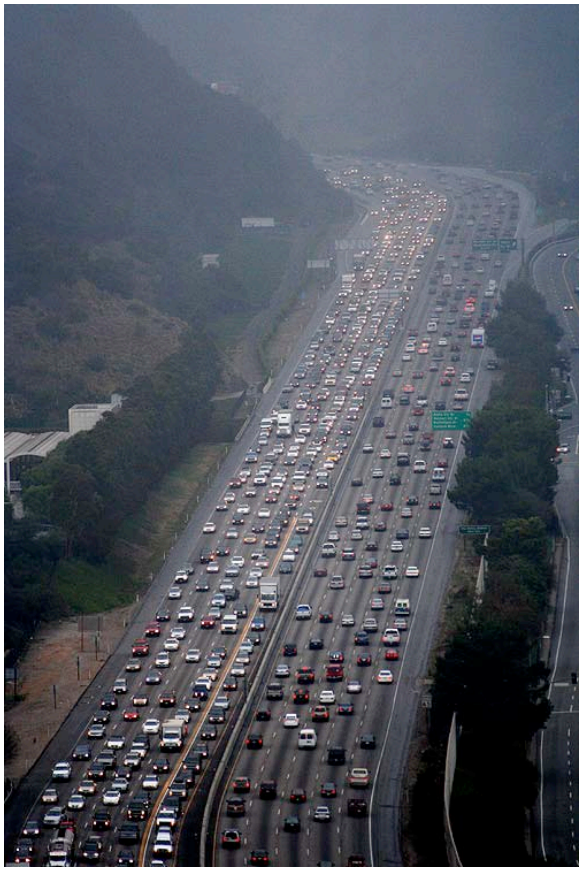
Why North America Needs Radars and Video Systems

Accident Statistics

- Fatalities stagnating at ~43k / yr since > 15 yrs
- >80% of accidents caused by driver distraction
- Rear-end & run-off road accidents > 50%

Driving Behavior & Exposure

- More relaxed & passive driving
  - Land of (Adaptive) Cruise Control
  - Automatic transmissions standard
- Challenging traffic exposure
  - High traffic loads in metropolitan areas
  - Longer commuting distances



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Maximum Potential of FCW and LDW

The Insurance Institute for Highway Safety (IIHS) has looked at crash data from 2002-2006 to see how 5 new technologies can help prevent crashes

- FCW could prevent ~2.3 M crashes / yr, and 7.2 K fatalities
- LDW could prevent ~480 K crashes / yr, and 10 K fatalities
- Blind Spot Warning could prevent ~450 K crashes / yr
- Emergency Brake Assist could prevent ~420 K crashes / yr
- From total ~ 6.3 M crashes / yr, 3.8 M could be prevented by these 5 systems

Source http://www.projo.com/projocars/content/ca_lanedeparture_04-19-08_S69Q1U8_v6.18544f4.html

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New NCAP: Summary

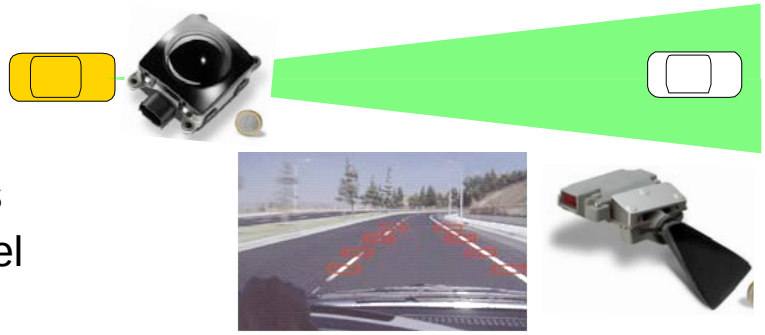
NHTSA People Saving People

Passive Safety

- Frontal, Side & Rollover ratings consolidated in Vehicle Safety Score
- Additional requirements in frontal & side crash
  - Down-grading in star-rating anticipated for several existing vehicles

New Crash Avoidance Rating: 1st Step 2010:

- Electronic Stability Control ESC
- Forward Collision Warning FCW
- Lane Departure Warning LDW
  - Based on test / performance requirements
  - Information / check box on Monroney Label



2nd Step 2012:

- ESC eliminated, other systems added, i.e.
  - Lane keeping support, active brake assist, drowsy driver detection, blind spot monitoring

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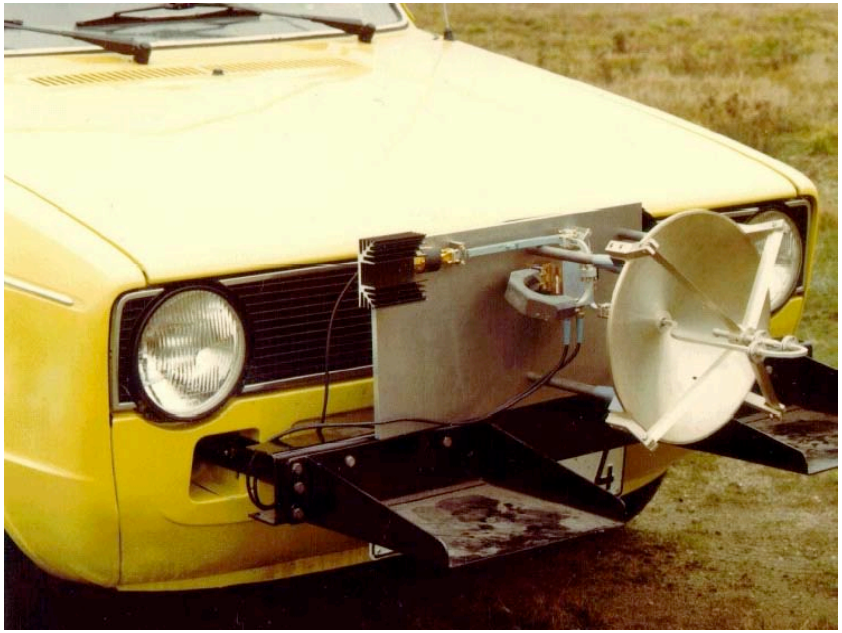
Automotive Radar Systems – First Steps



1974

1981

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First Series Production Radar Generations (2000)

Source: IIR Fachkonferenz 2001; Prof. Winner

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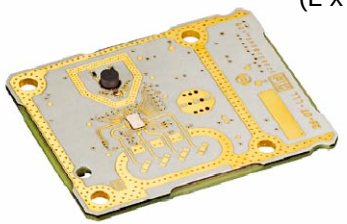
3rd Gen. Long Range Radar Sensor (LRR3)

Performance data (compared to LRR2)

- Field of View: **30°** (16°)
- Range: **0.5…250m** (1.5 …200m)
- Object separation
  - By distance: **1m** (2m)
  - By velocity: **0.6m/s** (1.2 m/s)
  - By angle: **~4°** (none)

74 x 77 x 58 mm
(L x W x H)



Technology:

- 77 GHz Silicon Germanium MMIC **(world's first)**
- Flexray communication **(world's first)**
- Package advantages **(world's smallest)**
- Lead free

Status:

- SOP in 01/2009

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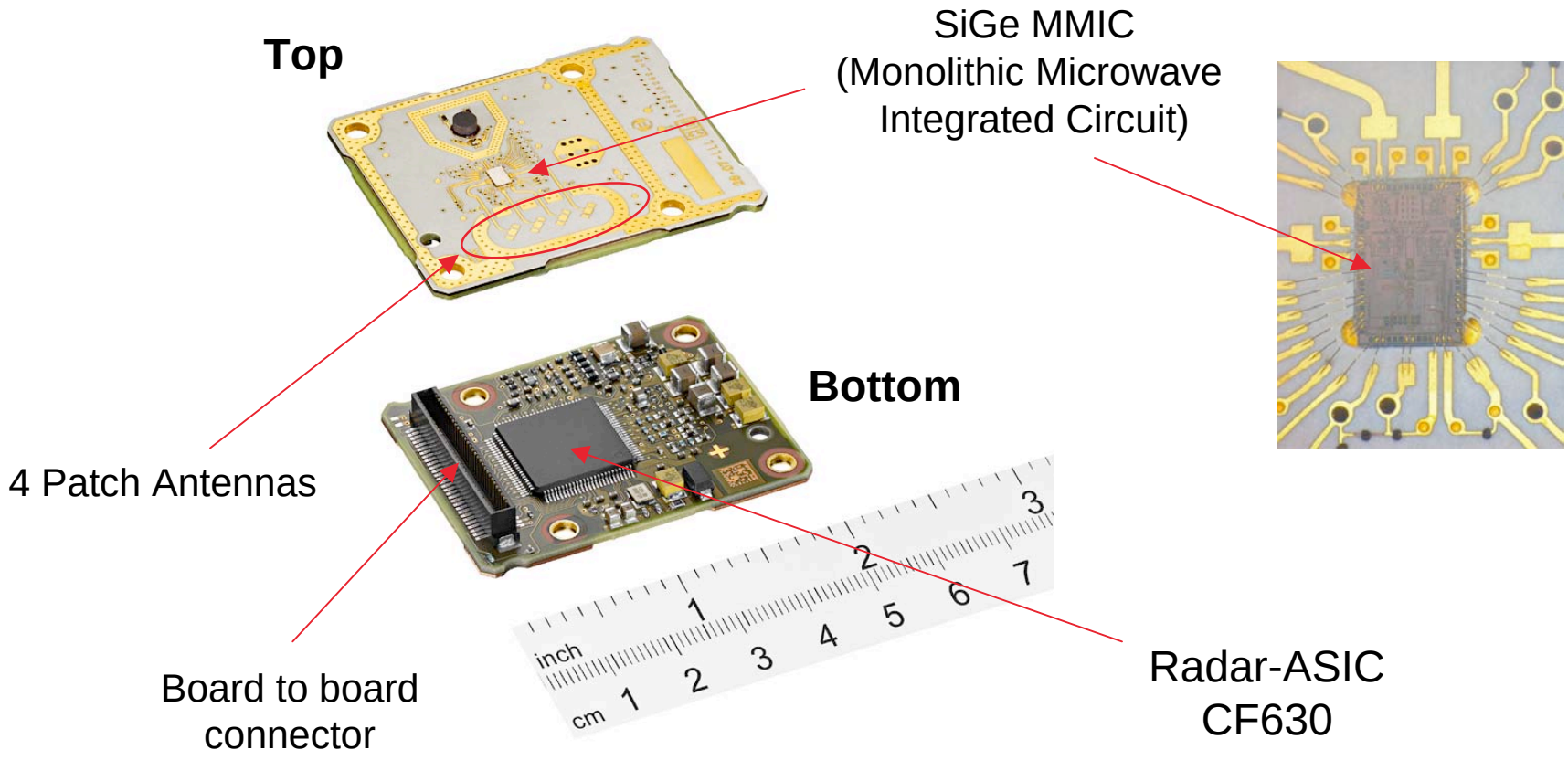
RF-Frontend



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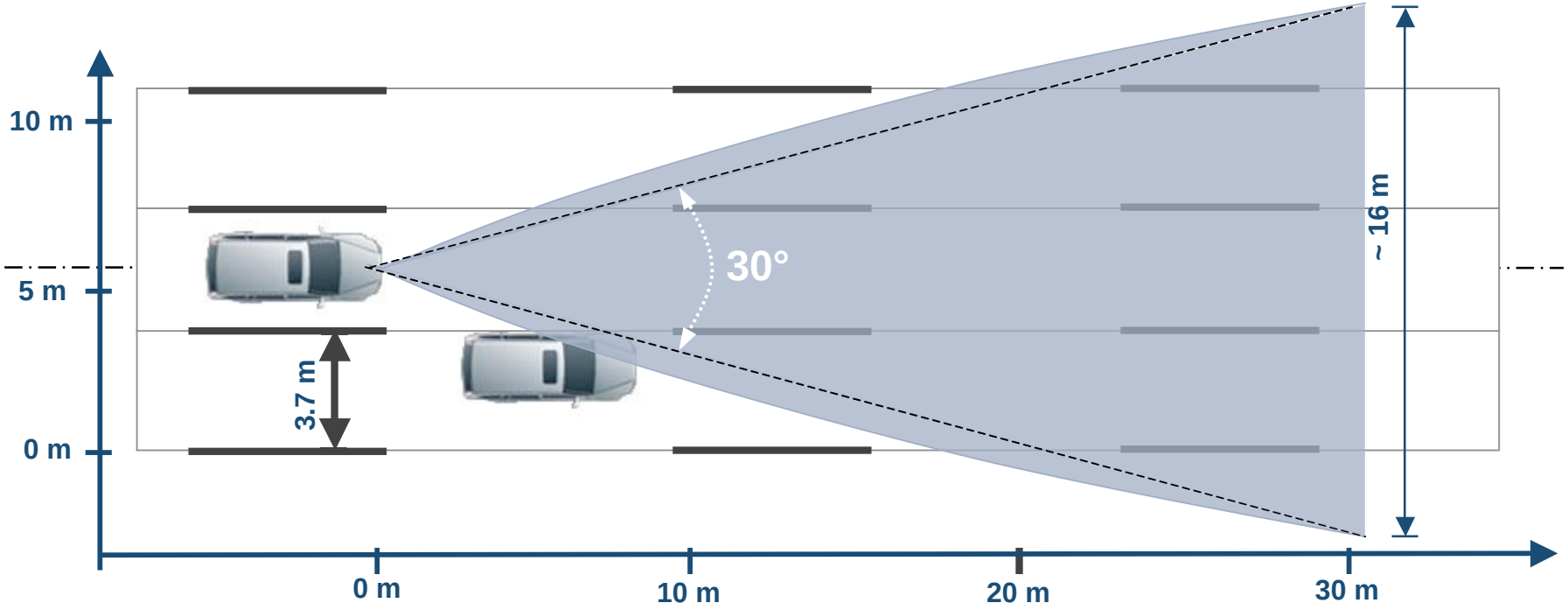
LRR3 Field of View (Near field)



Cut-in detection starting at ~2m heading distance

M 1:200

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LRR3 Driving results (separability)

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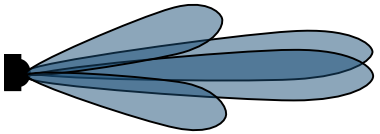
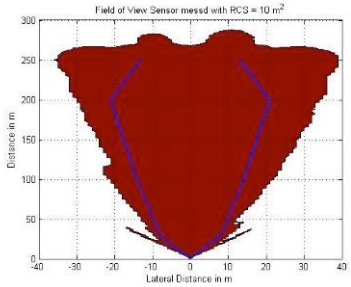
LRR3 Platform

LRR3 (standard)

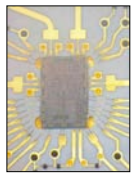


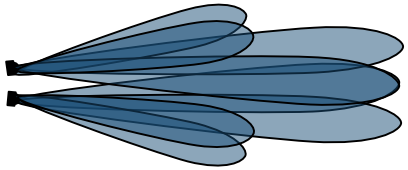
distance 0.5 … 250 m
FoV 30° @ 30 m



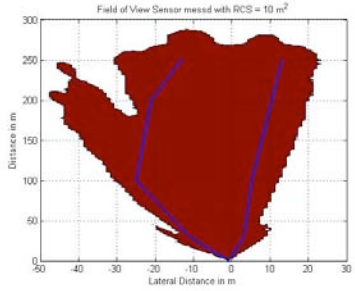
Double-LRR

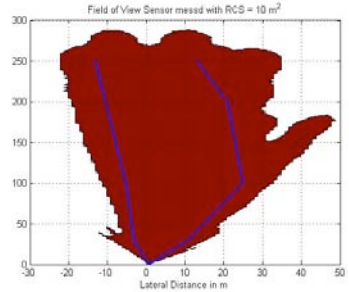
SiGe MMIC Mixer modification





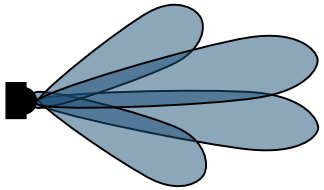
distance 0.5 … 250 m
FoV 60° @ 30 m



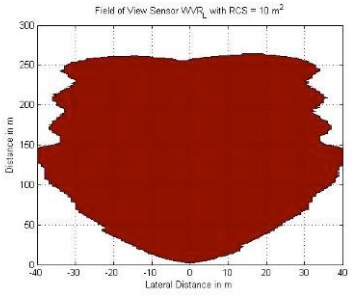


WVR
(Wide View Radar)

Lens modification



distance 0.5 … 200 m
FoV 50° @ 30 m



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Packaging Advantages of a Single and Double LRR

- Open Integration possible due to small size and radar design
- No expensive coverage necessary due to integrated lens-heating
- Potentials for a double sensor integration (symmetrical design)

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Cameras for Lane Departure Warning and beyond

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Integration of Cameras behind the Windshield

Infinity FX35

Buick Lucerne

Mercedes S-class

- Packaging example Night Vision
- IR sensitive camera
- Camera hided behind beauty cover

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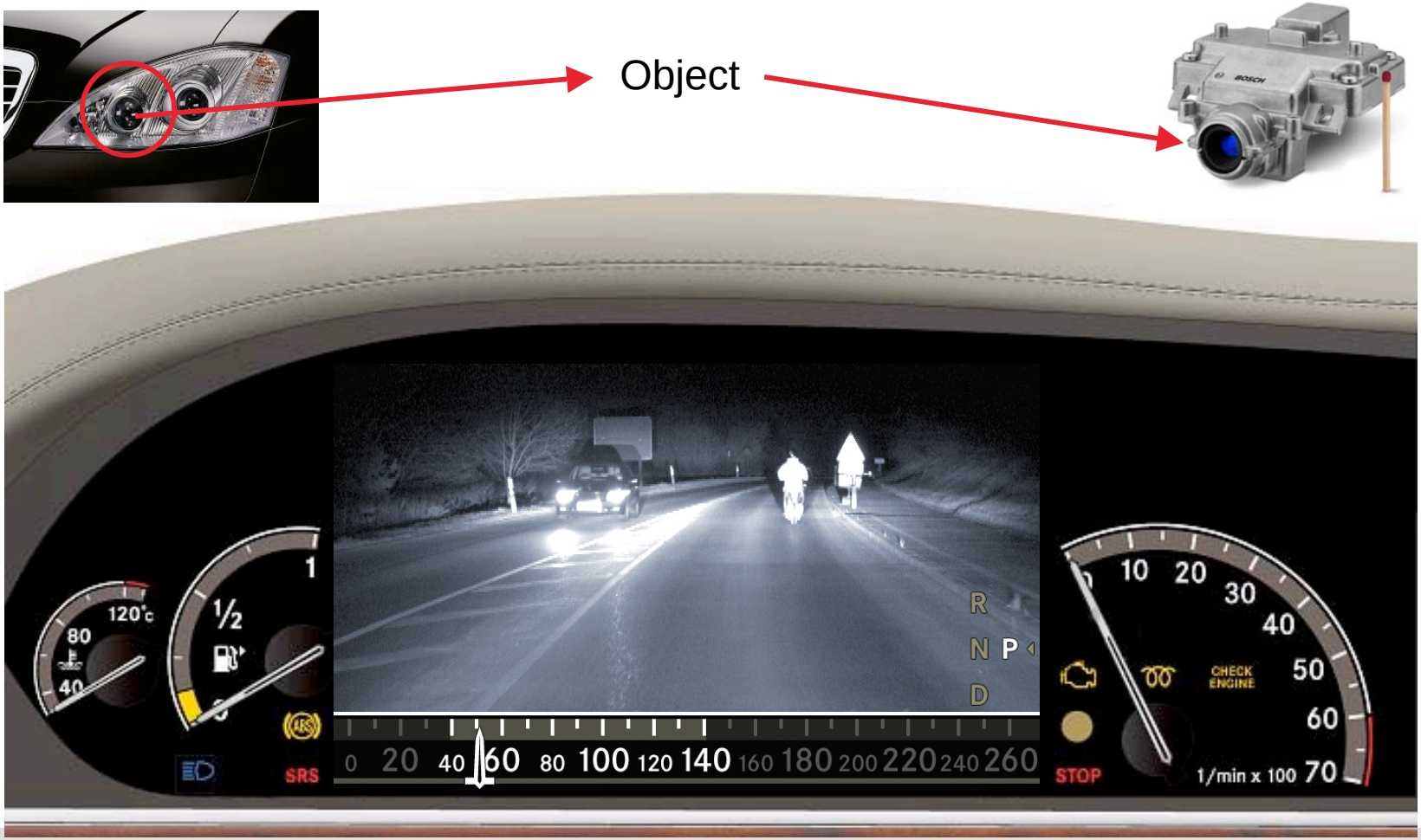
Night View Mode – Enhanced Drivers' View



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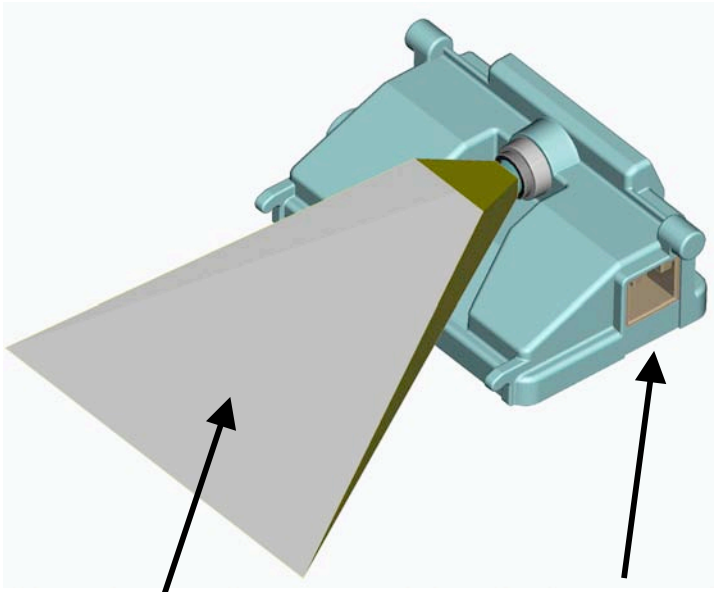
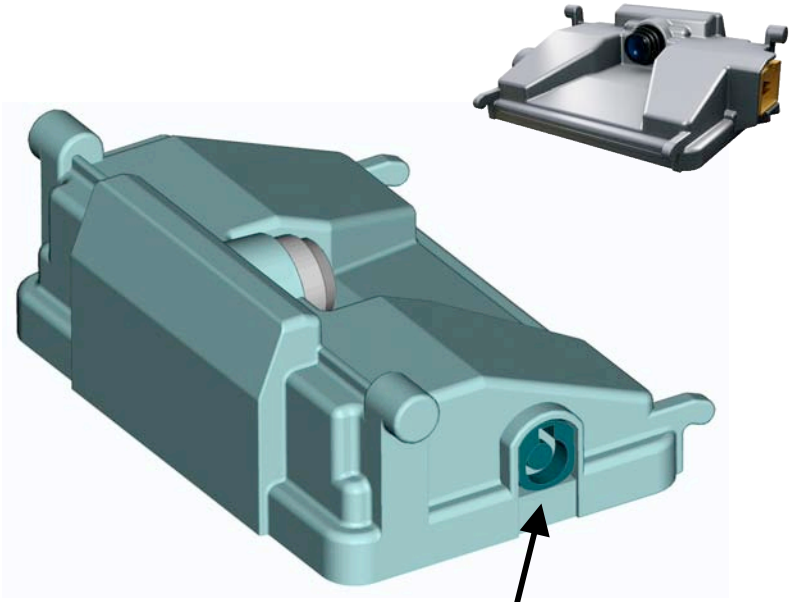
Design of a Multi Purpose Camera (MPC)



visualization of cone of light

Power / CAN connector + pins for windshield heating



Rosenberg HSD connector for video output

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Multi Purpose Camera Family

MPC Functions:

- Lane Departure Warning/ Lane Keeping Support
- Driver Alertness Monitoring
- Sliding Headlamp Control
- Road Sign Recognition
- ACC/PSS support (radar-video sensor data fusion)
- Night Vision / NV plus

Features MPC Family:

- Up to 5 functions in 1 box
- CMOS camera with integrated control unit
- Modular platform with few flexible components
- Highly integrated video chip including CPU for customer specific application
- Housing customer specific

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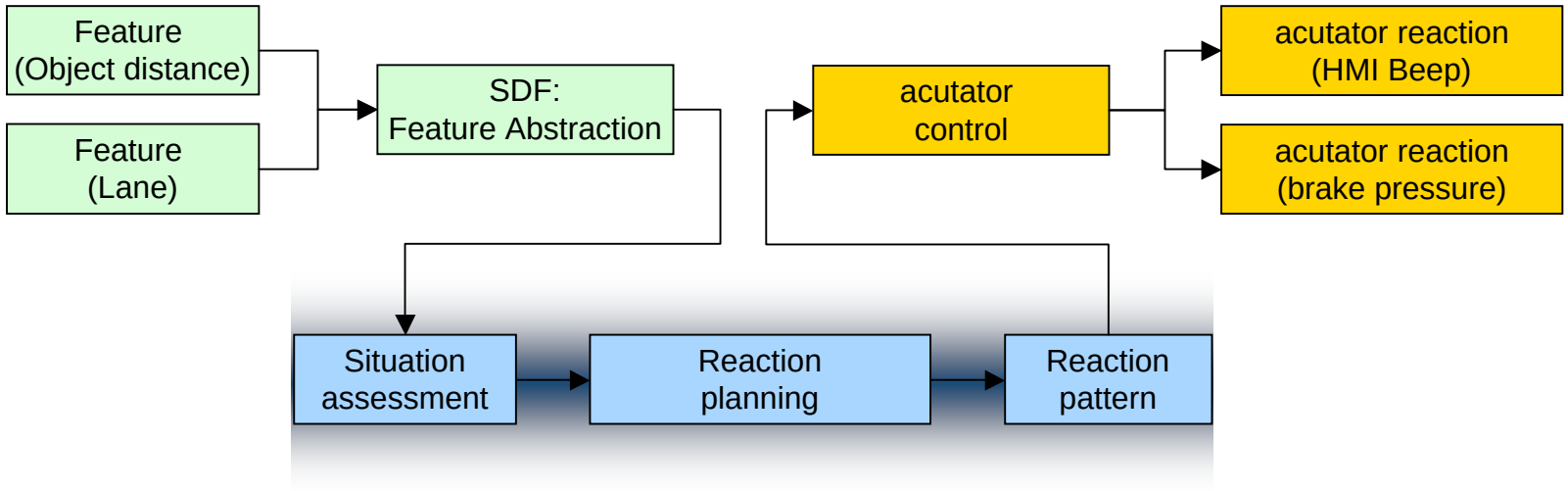
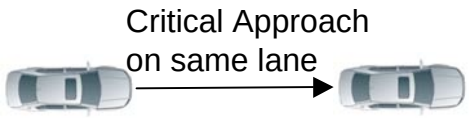
Situation based approach



- **“React in a way, that supports the best outcome in a given situation”**

- Example:



Reaction patterns

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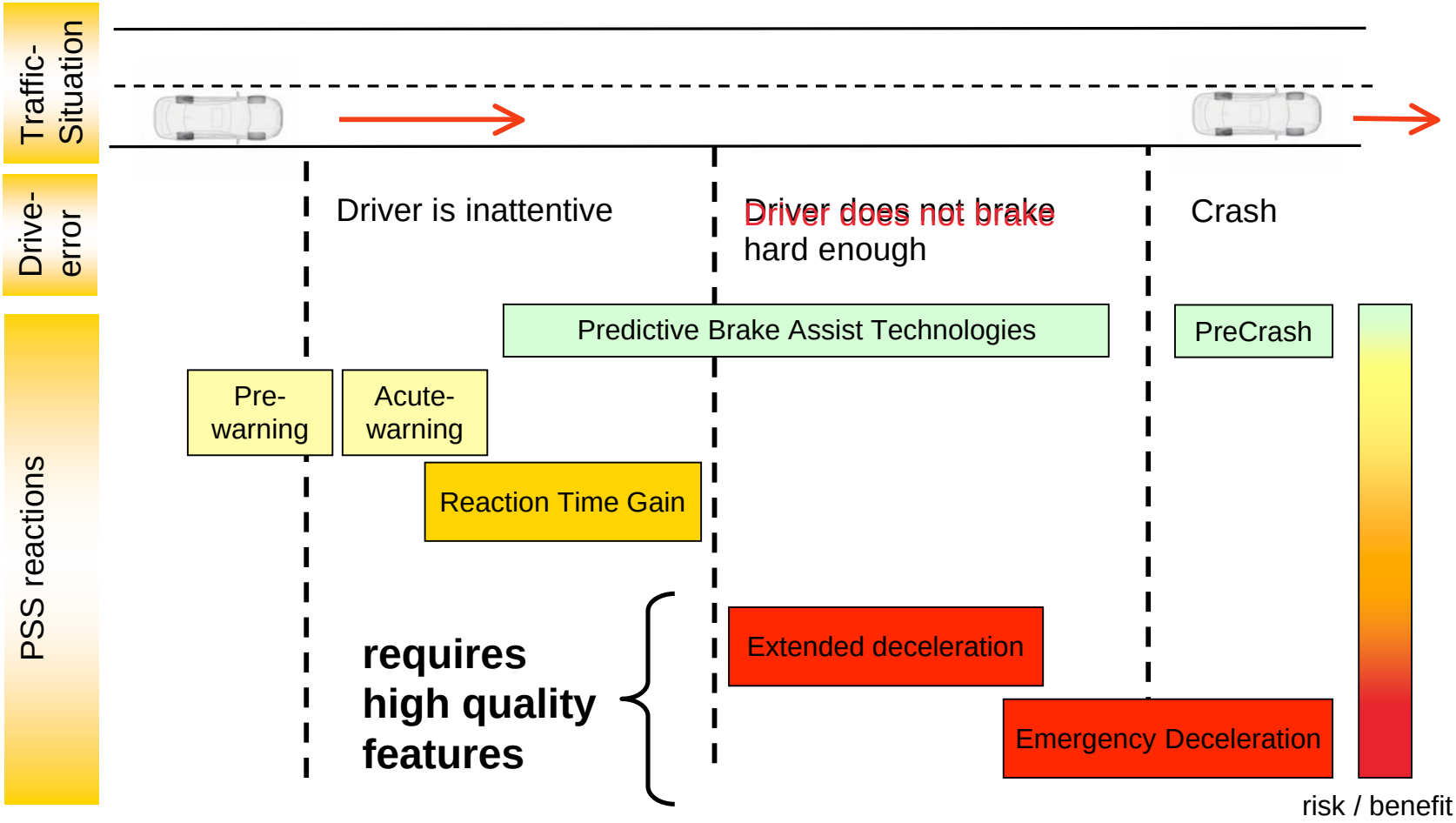
Possible System Reaction in Front Crash Situations



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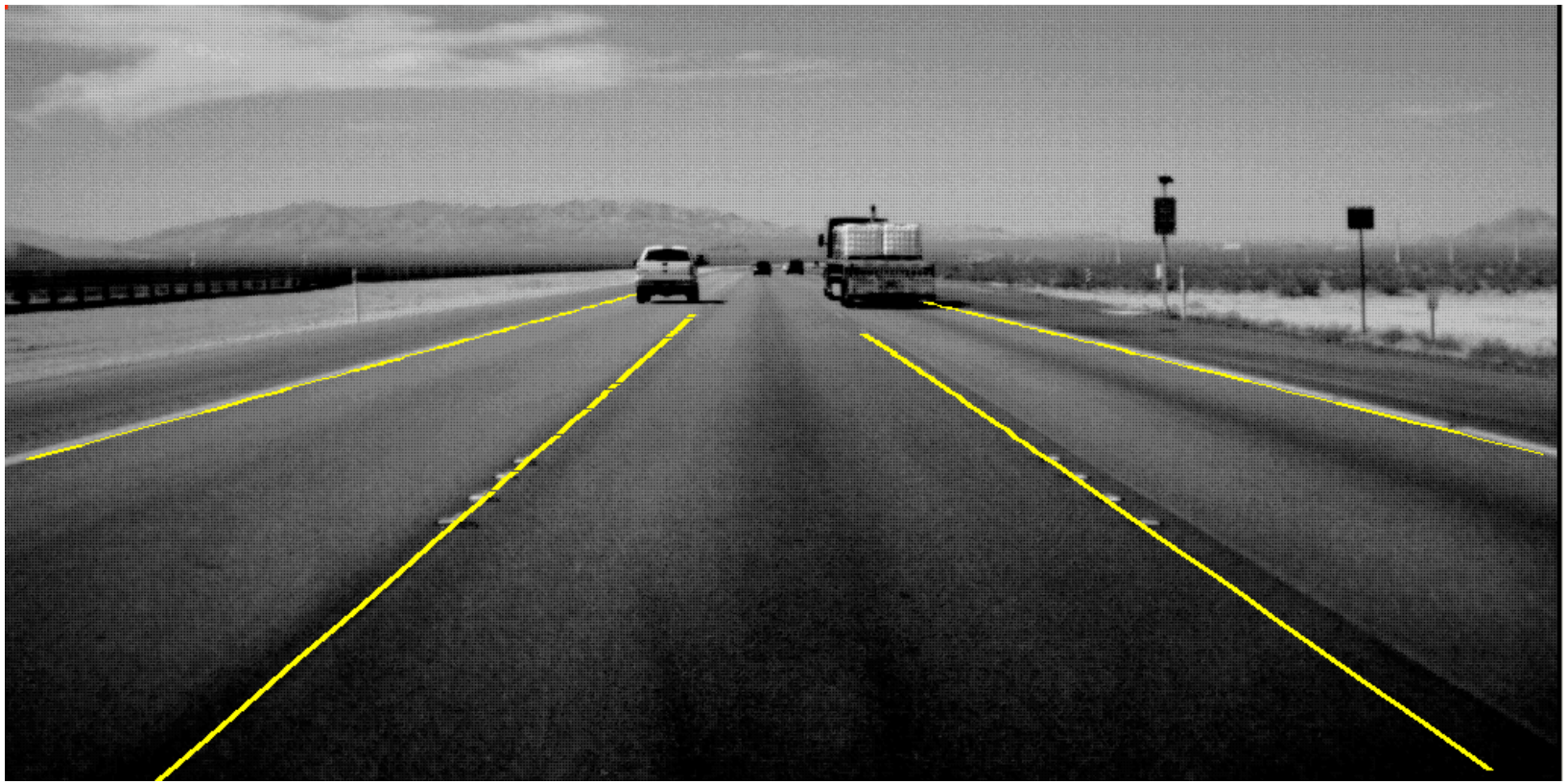
Summary and Outlook

- North America will be the driver for affordable safety functions based on radar and camera technologies
- Most recent technologies and innovative algorithms introduced into the sensors allow the integration into advanced safety relevant systems
- Cost efficient designs and manufacturing processes encourage applications even in lower class car segments
- Advanced situation classification based on radar and video sensors enables benefit-oriented warning strategies without annoying the driver

Lane Departure Warning

Back

Challenge Bots' Dotts



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Vehicle Object Detection

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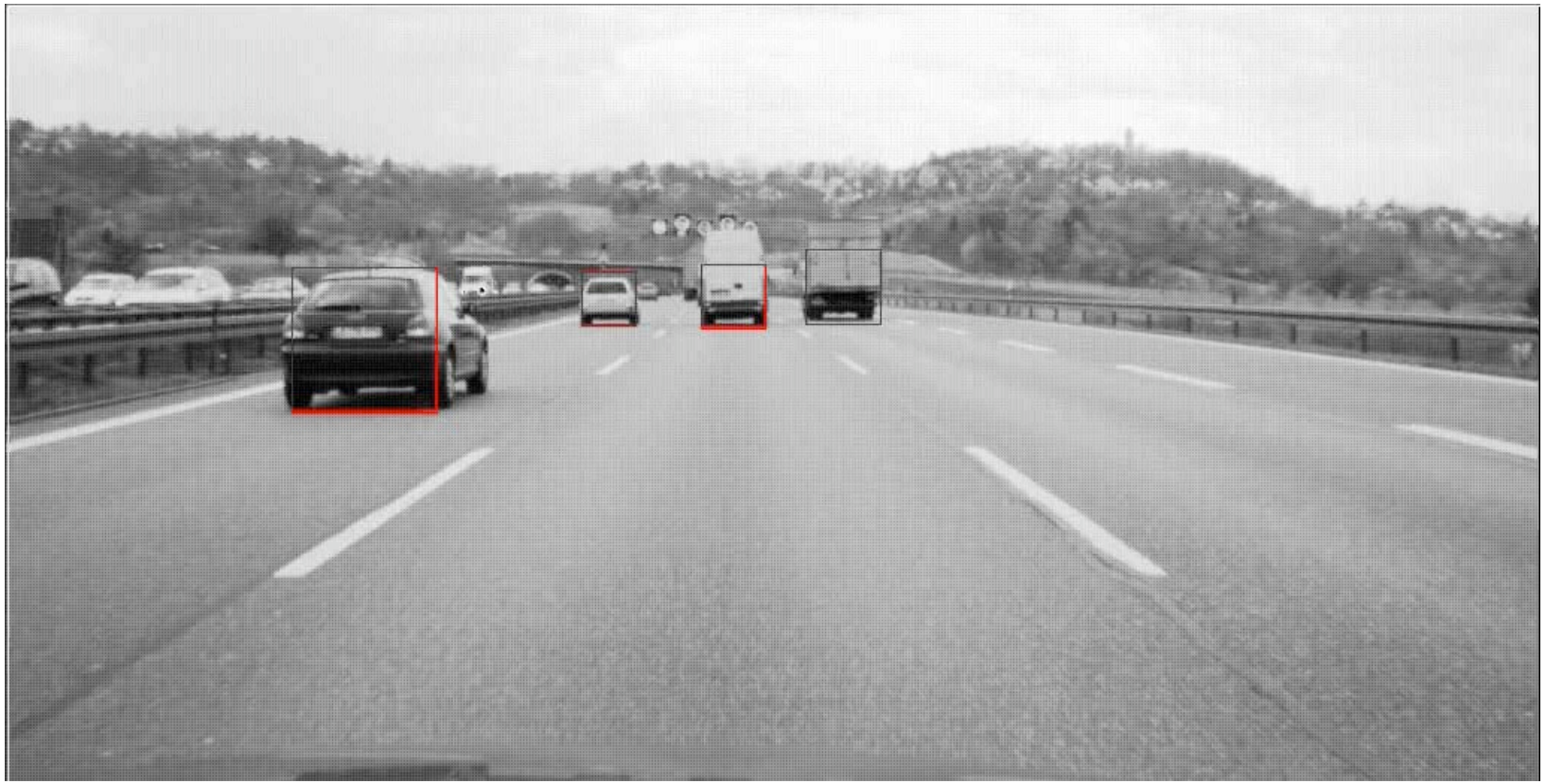
Challenge Object Detection



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Pedestrian Detection at Night

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