# NEXT GENERATION SURROUND-VIEW FOR CARS

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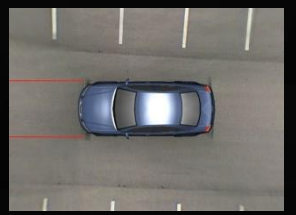
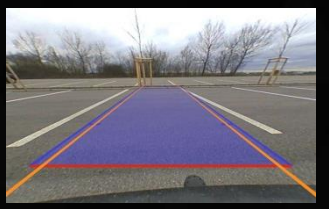
# OVERVIEW

- What is Surround View?
- The Image Based Rendering Approach
- Visual Odometry
- Benefits
- Demo

# WHAT IS SURROUND VIEW?

- Multi-camera ADAS
- Virtual views
  - Top view
  - Bowl view
  - Rectified Perspective/Panorama…
  - …
- SurroundVision
  - Jetson TK1 platform
  - Realtime tweakable
  - Fast Performance



# TYPICAL CONFIGURATION

Left camera

Front camera

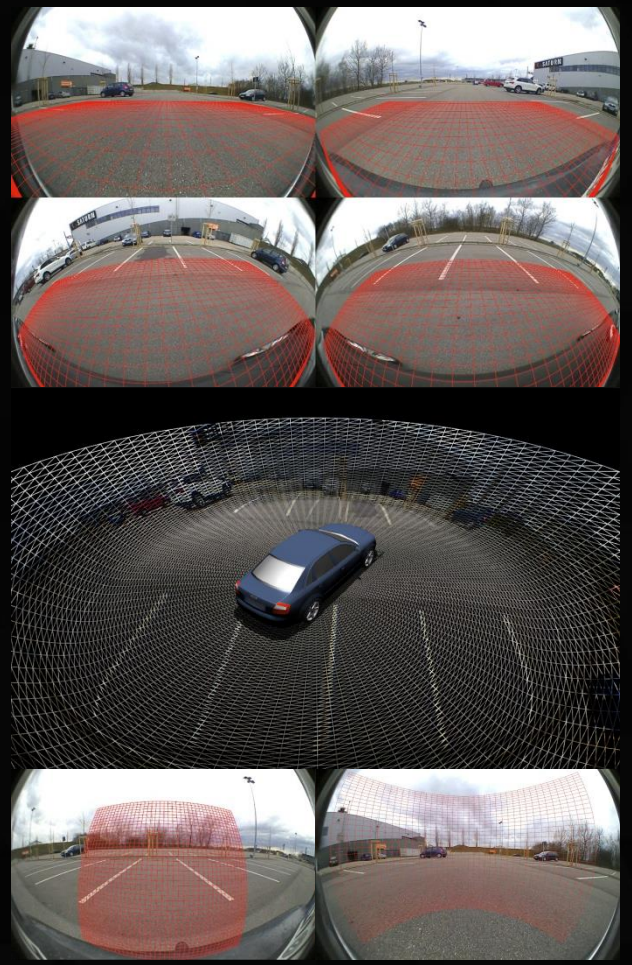
Right camera

Rear camera

Vehicle sensors:
- Velocity
- Steering Angle

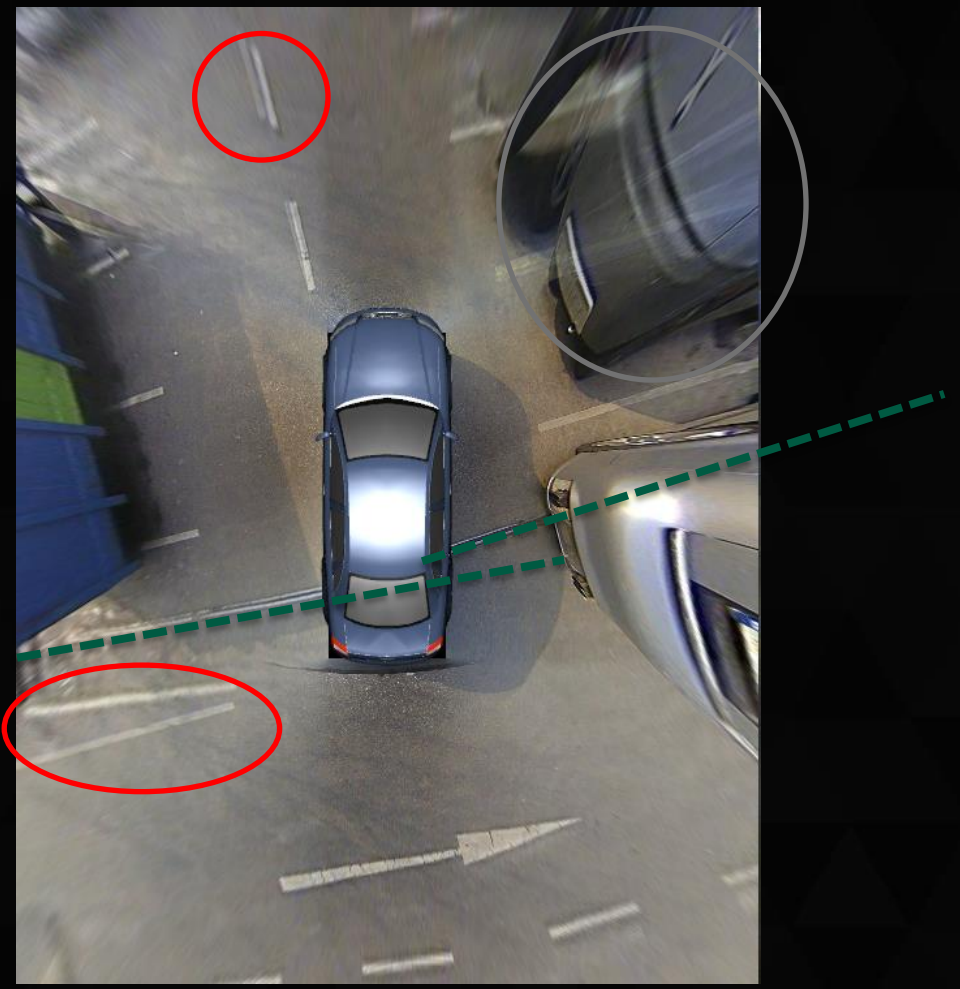
# SVISION IBR SOLUTION

- Use the GPU
  - Well suited domain
  - Very efficient Fixed Function units
- Common IBR approach
  - Define a 3D mesh and project vertices
  - GPU Fixed Function HW interpolates values
  - Blend texture mapped texels in shader
- Virtual Cameras
  - Allow to augment the final image (guidelines, obstacles,…



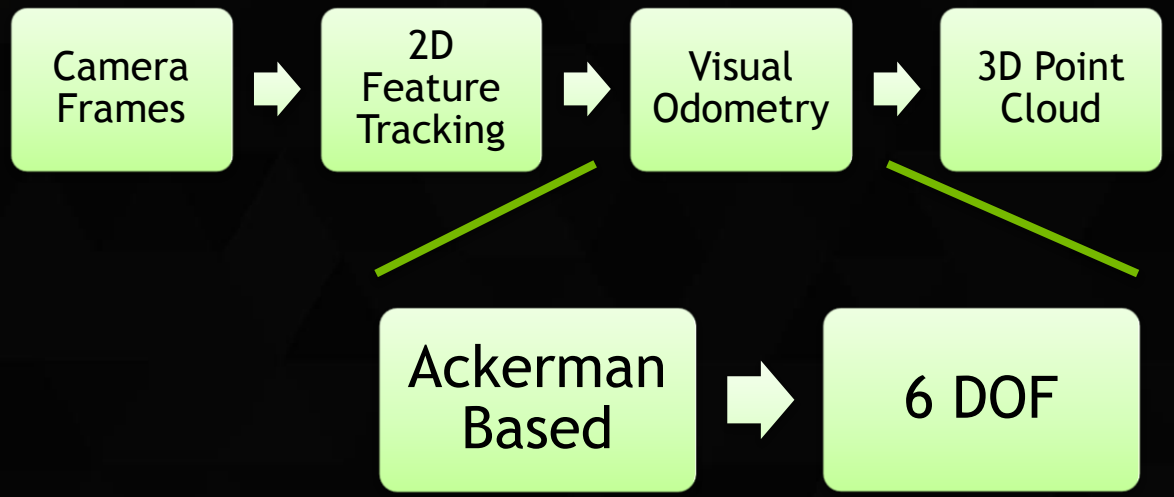
# COMMON PROBLEMS

- Common issues
  - Color mismatch
  - Image misalignments
    - Miss calibration
    - Asynchronous streams
    - Car orientation
  - Heavy Distortion on features above ground
- How to solve
  - Visual odometry (online self calibration)
  - Computer vision techniques



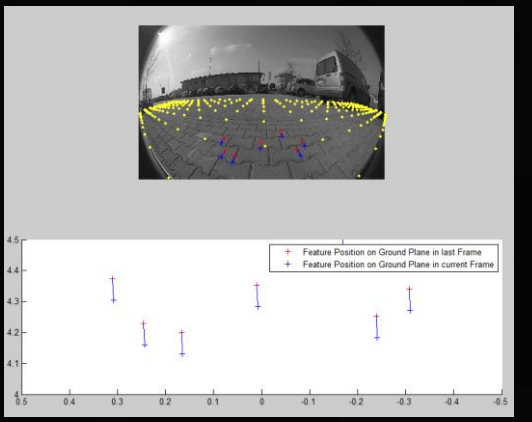
# VISUAL ODOMETRY

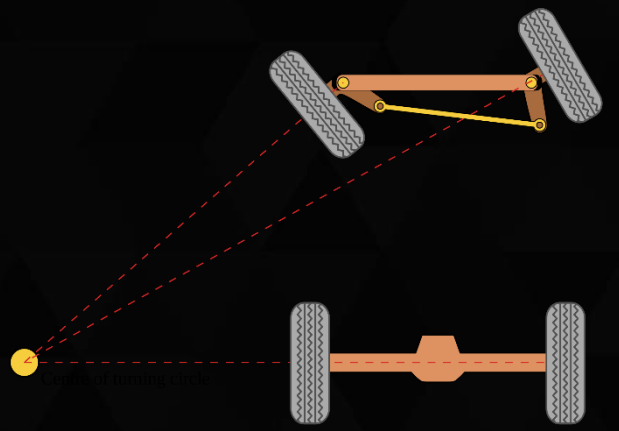
- Reconstruct Car in the World
- Information from Car Sensors is not accurate enough
- Computer Vision can give us higher accuracy from the Video Streams!



# VISUAL ODOMETRY – ACKERMAN BASED

- Two Degrees of Freedom
  - Velocity
  - Steering Angle
- Reconstruct from 2D tracks on the ground plane
  - One track is sufficient!
- Downside: Cannot reconstruct non-planar motion
  - E.g. Pitch/Roll during acceleration

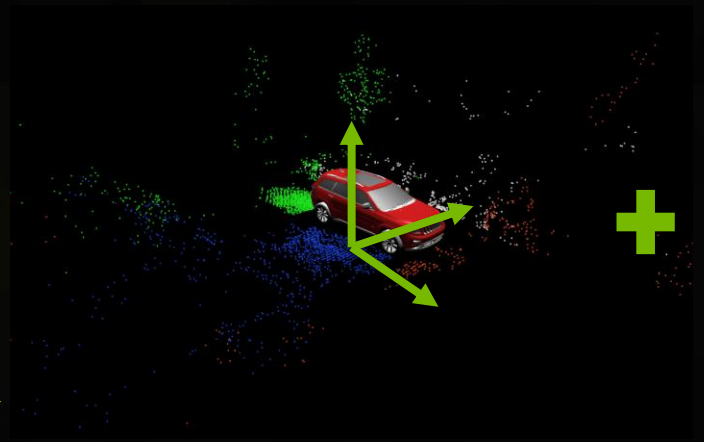


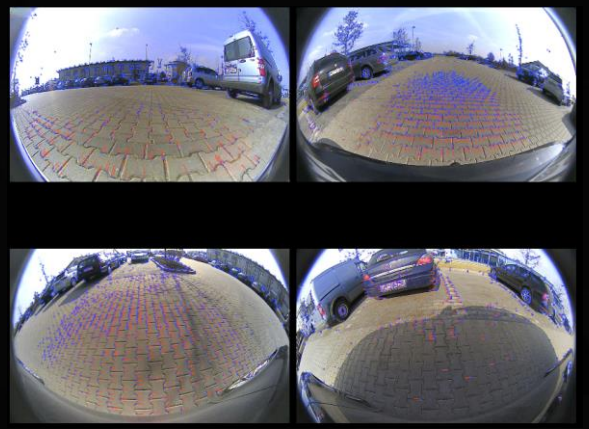
Ackerman Principle: (CC, Andy Dingley, Wikipedia)

# VISUAL ODOMETRY – 6DOF

- Reconstruct full 3D position and orientation of the Car
  - Not limited to planar motion
- 3D-to-2D Motion Estimation
  - Point Cloud and 2D Feature Tracks
  - Non-Linear Optimization (LM)



3D from T-1

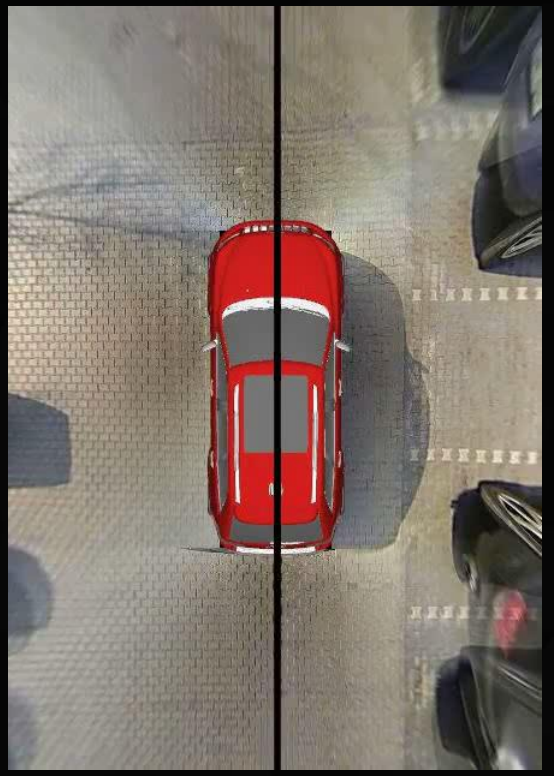


2D T-1 -> T

3D at T

# BENEFITS

- Camera Stabilization for Top View
  - Pitch and roll variations due to car motion

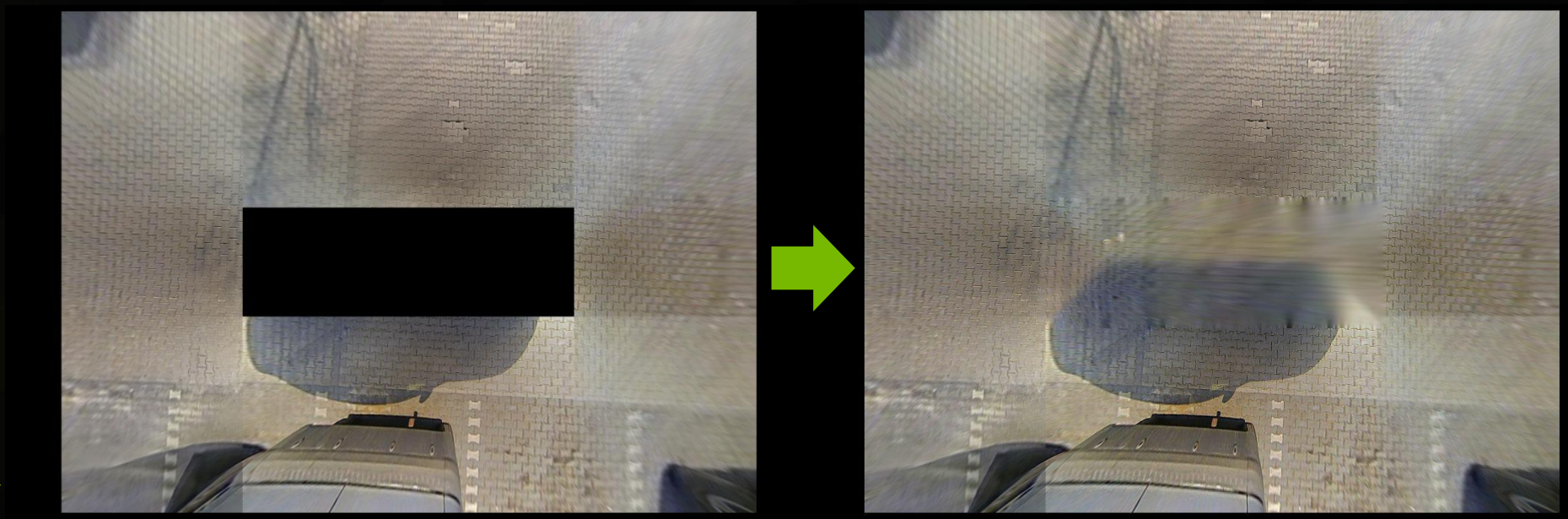


# BENEFITS

- Missing/dropped frames
  - Full 3D image warping

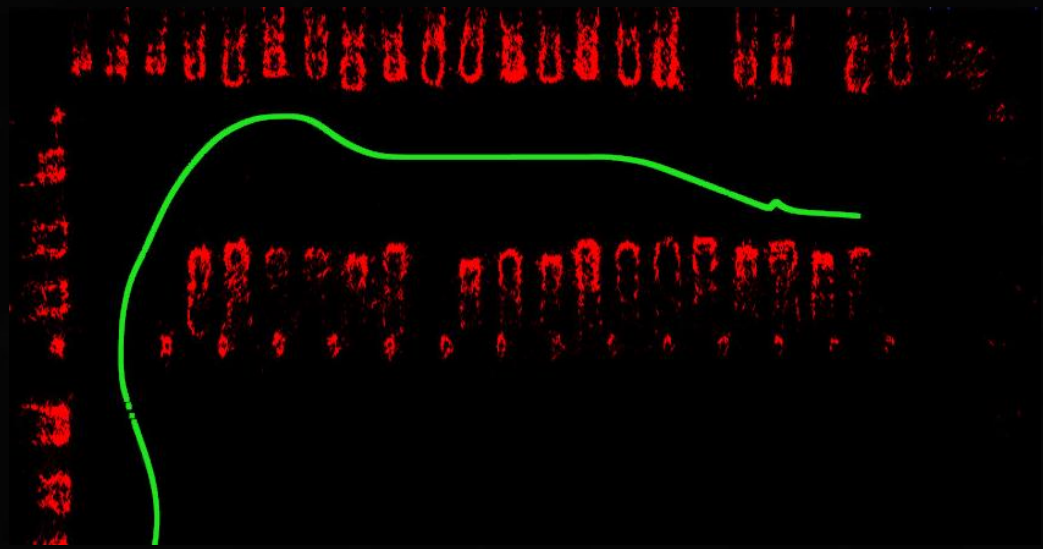
# BENEFITS

- Reconstruct missing information from previous frames
  - Get rid of black box under the car and bowlview sides



# ...AND MANY MORE

- Obstacles
  - 3D world reconstruction as part of SFM. Add clustering and filtering
- 2D Maps
  - GPU computed in realtime. Aid to navigation and self driving vehicles



# DEMO

# THANK YOU

JOIN THE CONVERSATION

#GTC15