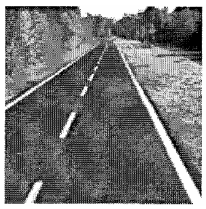
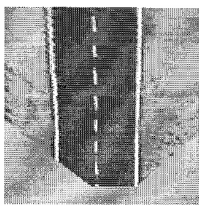
Lane Tracking Survey

Computer Vision Group
DARPA Urban Challenge
Ben Franklin Racing Team

Generating a Road Model

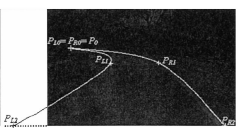
Straight lines
• road markings form parallel lines in an inverse-perspective-warped image.
• *note:* best for looking ahead <10 m





Parabolic
• parabolic approximation of inverse-perspective-warped image

Spline
• smoothly interpolates a series of points
• uses vanishing point (line) detection



Clothoid
• a spiral curve with a curvature that is changing at a constant rate

note: accurate curvature model (parabolic, spline, clothoid) is necessary for modeling >30 m ahead of vehicle

Feature Extraction

Edge based techniques
• *pros:* easy/works well with solid and segmented lines
• *cons:* fails when there are many extraneous lines (A),(B),(C)

Frequency based techniques
• *pros:* effective in dealing with extraneous edges
• *cons:* confused by complex shadowing; limited effectiveness during lane-change maneuvers (B)

Adaptive road template
• *pros:* assuming a constant road surface texture
• *cons:* fail in circular reflectors and solid line lane markings with nonuniform pavement texture (A)

(A)

(B)

(C)

Post Processing

Generates a robust estimate of actual lane position based on the extracted features:

• **Hough transform**

• **Dynamic programming on extracted line segments:** removes outliers more effectively than Hough transforms

• Enhancing or attenuating features based on **orientation or likelihood**

• **Cue scheduling:** determines which of the multiple features should be extracted, processed, and fed into the position-tracking module.

• Culling features based on elevation using **stereo vision**: outlier removal based on 3D location found with stereo camera system

Vehicle Modeling and Position Tracking

Kalman filtering / Extended Kalman filtering

Finds optimal estimation of vehicle location and orientation, limits search area

Particle filtering

a method that searches a set of particles that represent the target location and moves them to positions of high probability to concentrate computational power in those areas of interest.

note: more complex vehicle models might help to improve stability and perform precise movements