



RACE CAR STRATEGY OPTIMISATION UNDER SIMULATION

Naveen Chaudhary
Shashank Sharma

Objective

- Computation of optimal racing line given a track
- Design a controller for traversing a car on this optimal racing line found

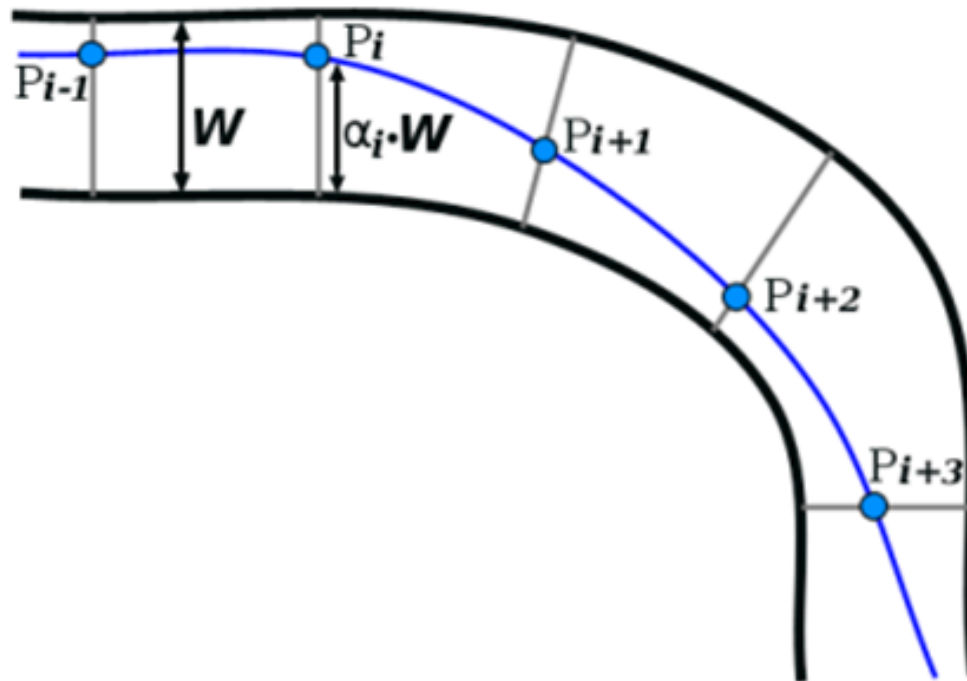
Motivation

- Traditional methods require large amount of computational resources and are impractical for fast pace and real time games.
- Problem demands a more efficient and fast solution
- Enthusiast in computer games.

Determination of optimal path

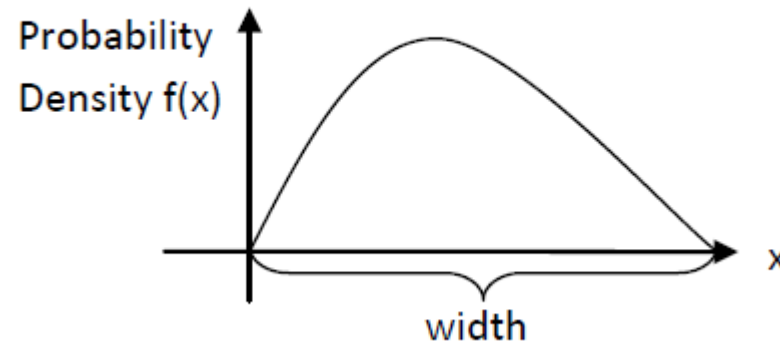
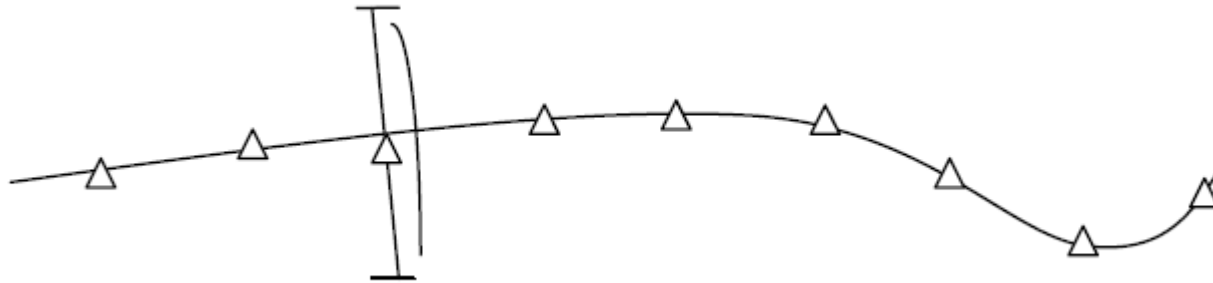
- Track represented as a set of connected polygons
- Waypoints are defined on the connected edges
- Sharp turns avoided
- Three consecutive points should not bend too much towards different directions

Track representation



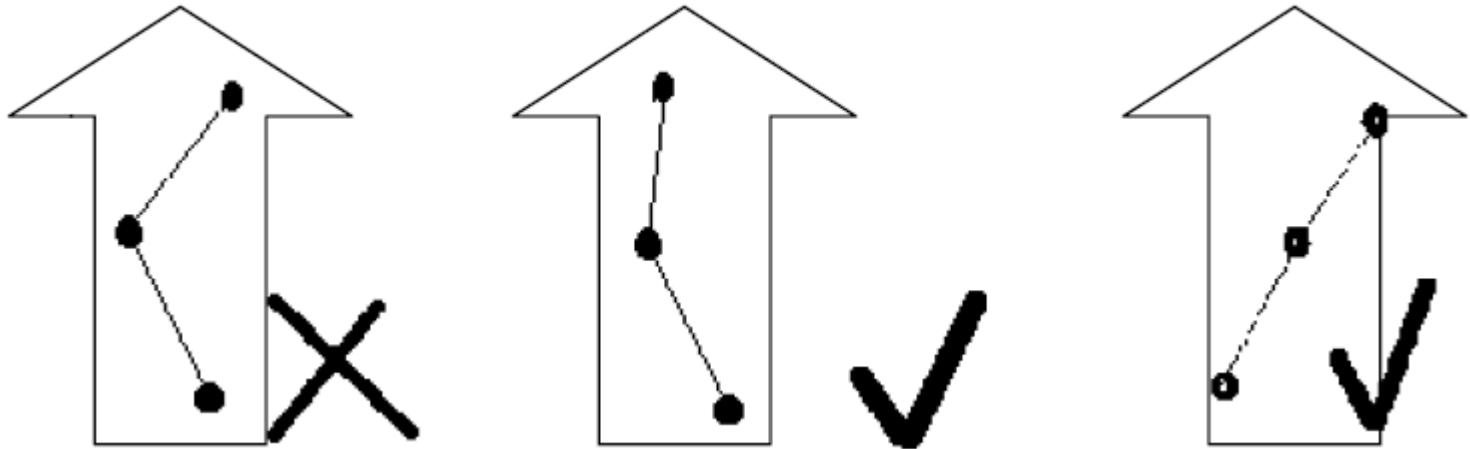
Track represented as connected polygons [5]

Choice of direction along the width



Probability density along width of track [6]

Choice of points

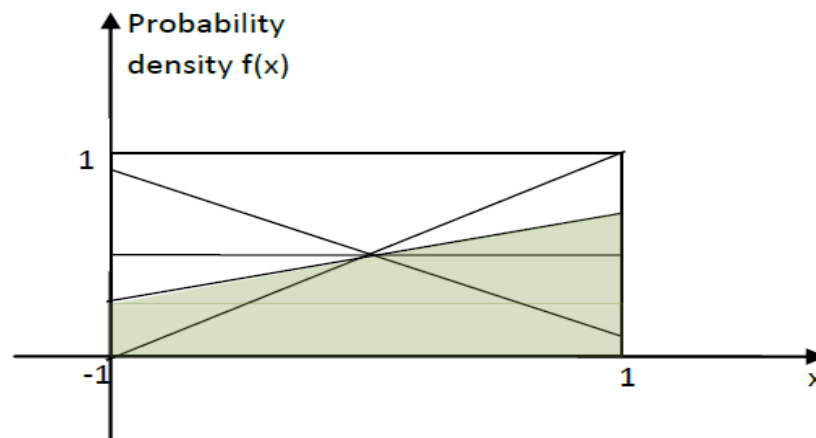
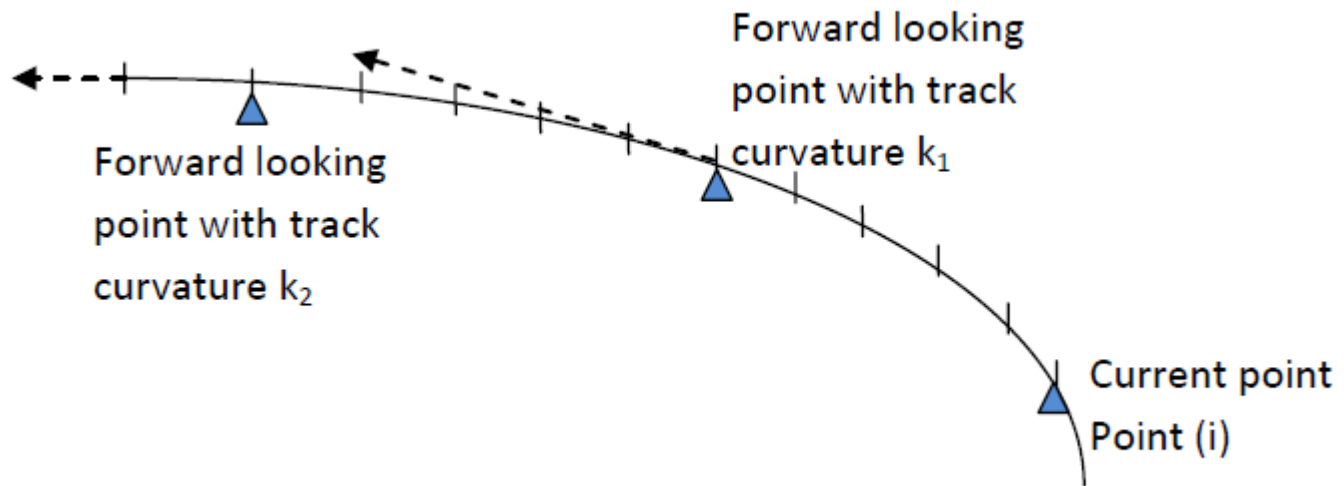


Sharp turns to be avoided [6]

How to select the path?

- Set the starting point 0
- For each point i chose the point $i+1$
- Run many times and compare
- Best energy and best time path are selected
 - Energy Consumption
 - $E = \int_s \sqrt{|K(s)|} ds$
 - Where, K is the curvature of the path s

Forward looking algorithm



Linear approximation of probability density function [6]

Design of controller to drive on optimal path found

- ANN implementation
- Inputs-
 - Current speed of the car
 - Angle of the car with the axis
 - Current gear
 - Lateral speed of the car
 - R.P.M of the wheels
 - Current position on the track
- Outputs-
 - Accelerate / brake value
 - Gear change
 - Steering

Cost function for ANN

- Distance from optimal racing line
- Difference between current speed and max possible speed at that point

Platform

- TORCS (The Open Racing Car Simulator)
 - <http://www.torcs.sourceforge.net/>



References

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- [3] C. H. Tan , J. H. Ang , K. C. Tan and A. Tay "Online adaptive controller for simulated car racing", Proc. IEEE Congr. Evol. Comput., pp.2239 -2245 2008.
- [4] L. Cardamone , D. Loiacono and P. L. Lanzi "On-line neuroevolution applied to the open racing car simulator", Proc. IEEE Congr. Evol. Comput., pp.2622 -2629 2009.
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- [6] Y. Xiong, "Race Line Optimization" thesis submitted to MIT, September 2010.



Questions??



Thank You