Stay off the lawn - Creating smooth paths based on region preferences

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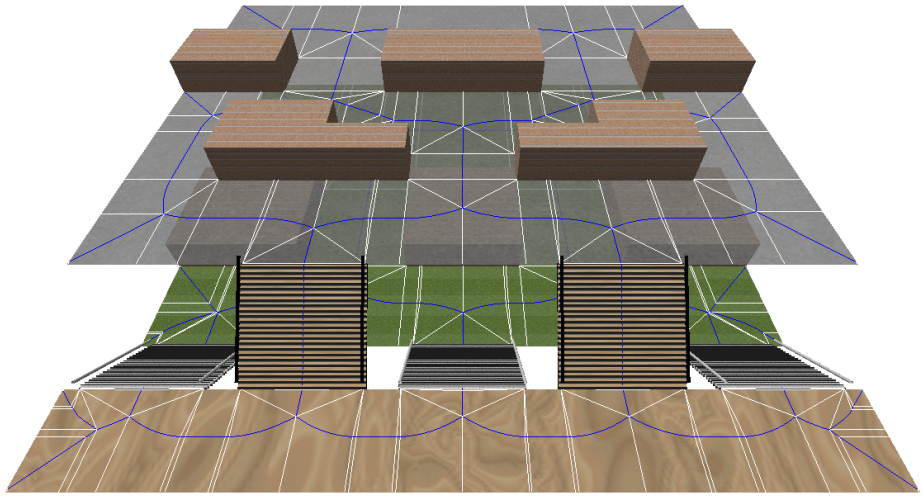
Overview of our research

Path planning and crowd simulation for virtual autonomous agents

General framework based on *Explicit Corridor Map* [1]



Overview of our research

Research on the data structure itself

Overview of our research

Research on virtual crowds

Overview of our research

Combining individual steering behavior with coordinated crowd movement

Motivation

Problems with terrain-based path planning
in current games and simulations

World of Warcraft by Blizzard Entertainment 2004

Grand Theft Auto IV by Rockstar North 2008

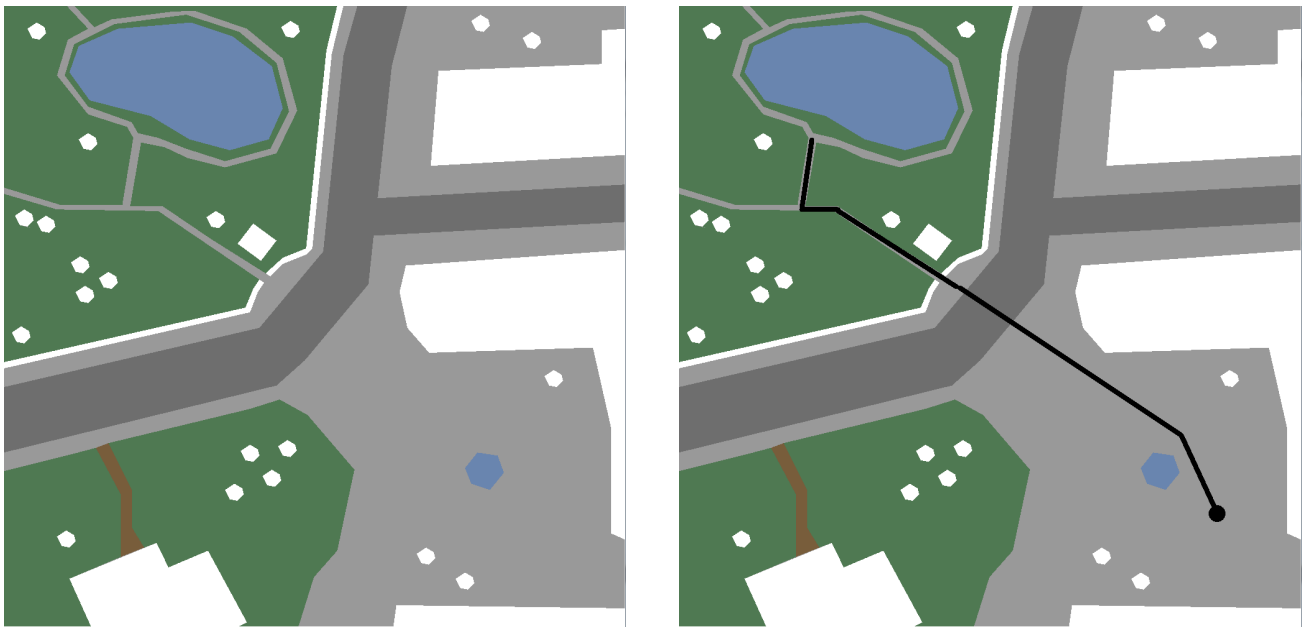
- Inflexible solutions for handling individual terrain preferences
  - Traversable areas treated as equal, independent of individual terrain preferences
  - Unattractive traversable terrain is made impassable for particular characters

Grand Theft Auto IV by Rockstar North 2008

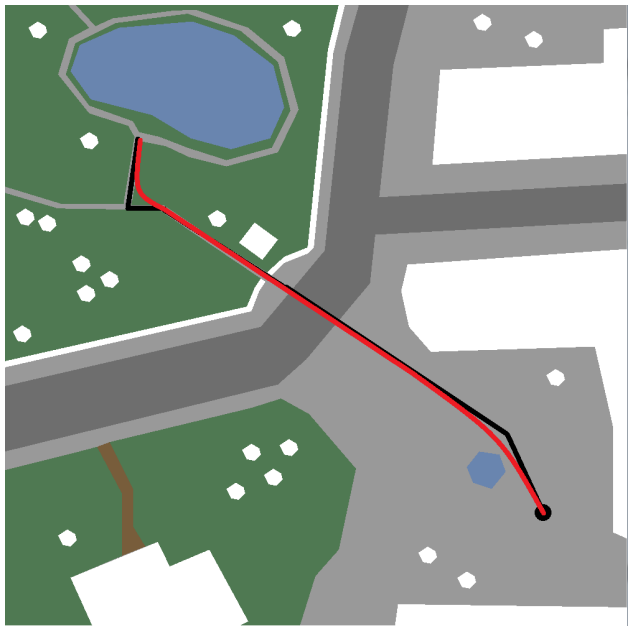
- Paths are often illogical and not visually convincing
  - Unnecessary detours
  - No smooth trajectories
  - Unnatural clearance from obstacles
  - Characters do not look ahead enough
  - Obstacles or rough terrain is ignored

World of Warcraft by Blizzard Entertainment 2004

- Input:
  - A $2D$ polygonal environment
  - Virtual characters with sets of individual region preferences
  - An *indicative route* that roughly guides a character
    - automatically computed or manually designed



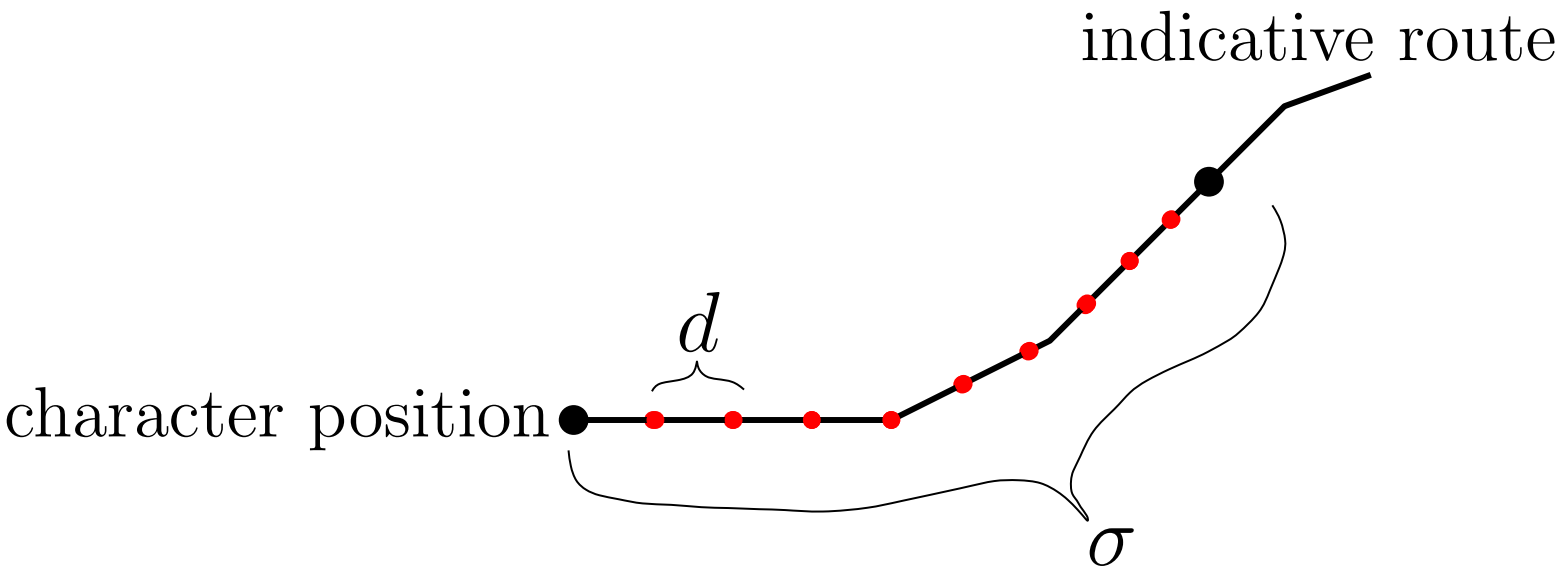
- Output: A natural-looking path that
  - gives the user control over the amount of smoothing
  - is based on a character's region preferences
  - keeps clearance from obstacles
  - avoids unnecessary detours
  - can be computed in real-time



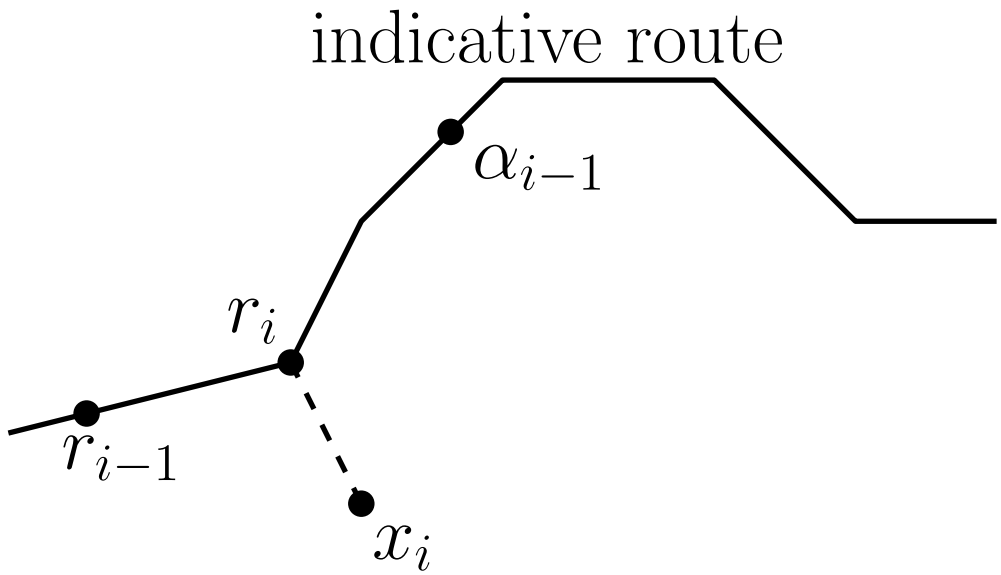
The MIRAN method - Overview

- Step 1: Compute *reference point* on the indicative route
- Step 2: Compute set of candidate attraction points
- Step 3: Pick best attraction point
- Step 4: Move character towards attraction point

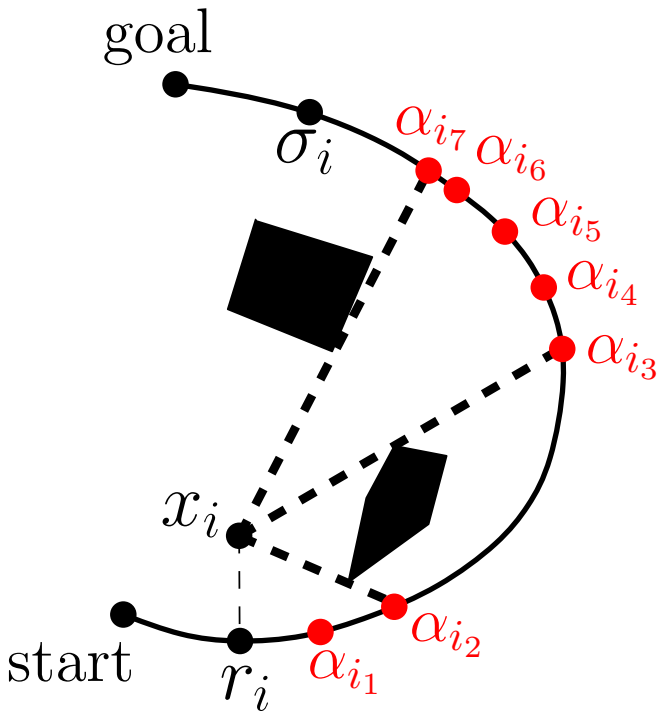
- The *shortcut parameter* σ
- The *sampling distance* d



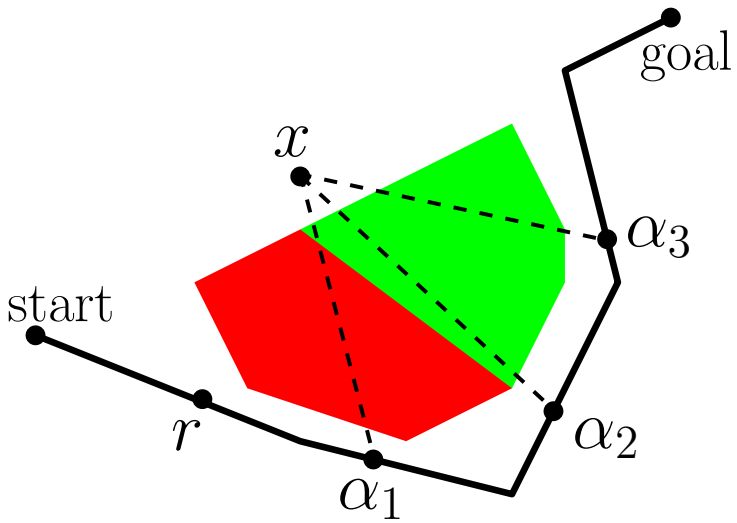
- r_i := *first closest point* on the indicative route between former reference point r_{i-1} and former attraction point α_{i-1}



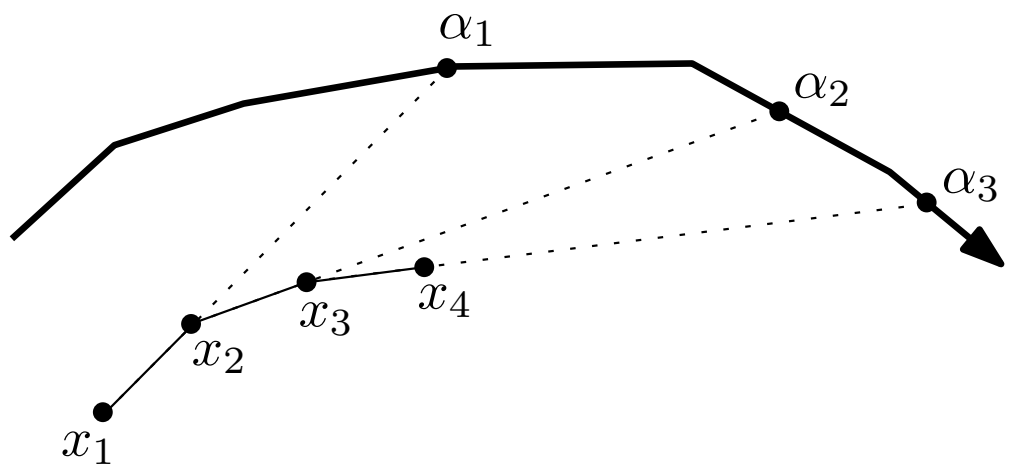
- Visible points along the indicative route between r_i and σ_i discretized with sampling distance d



- Each line segment between x and α_j is weighted with the underlying type of terrain and the curve length distance from r to α_j.
- Lower terrain costs $\Rightarrow$ lower weight
- α_j further ahead on the indicative route $\Rightarrow$ lower weight



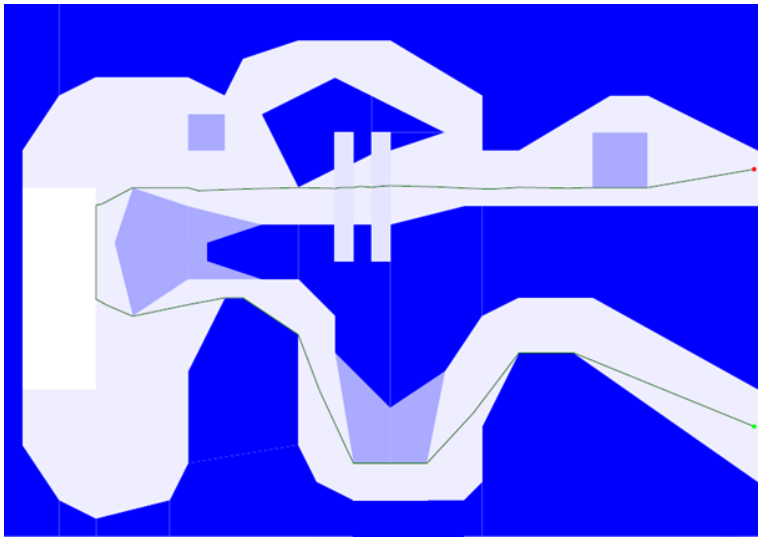
Step 4: Move character towards α

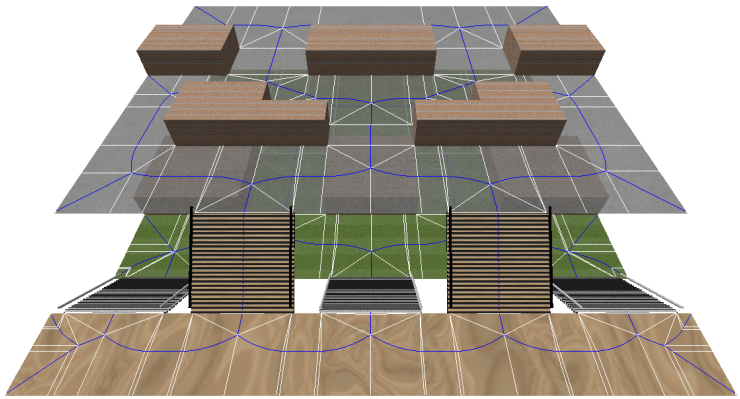


Forest example

Future work

- Improve the computation of indicative routes
- Handle disc-shaped characters with variable radius
- Extend terrain-based planning to local collision-avoidance routines
- Use continuous set of candidate points instead of sampling the indicative route
- Generalize MIRAN to (multi-layered) $3D$ environments with height information





Thank you!

R. Geraerts.

Planning short paths with clearance using Explicit Corridors.
In *Proceedings of the IEEE International Conference on Robotics and Automation*, pages 1997–2004, 2010.

N. Jaklin, A. Cook IV, and R. Geraerts.

Real-time path planning in heterogeneous environments.
Computer Animation and Virtual Worlds (CAVW), 24:285–295, 2013.