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

- 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
More problems

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
Two user-controlled parameters

- The **shortcut parameter** $\sigma$
- The **sampling distance** $d$
Step 1: Compute *reference point* $r$

$r_i := \textit{first closest point}$ on the indicative route between former reference point $r_{i-1}$ and former attraction point $\alpha_{i-1}$
Step 2: Compute set $\mathcal{A}$ of candidate attraction points

- Visible points along the indicative route between $r_i$ and $\sigma_i$ discretized with sampling distance $d$
Step 3: Pick best *attraction point* $\alpha$ from $\mathcal{A}$

- Each line segment between $x$ and $\alpha_j$ is weighted with the underlying type of terrain and the curve length distance from $r$ to $\alpha_j$.
- Lower terrain costs $\Rightarrow$ lower weight
- $\alpha_j$ further ahead on the indicative route $\Rightarrow$ lower weight
Step 4: Move character towards $\alpha$
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.

N. Jaklin, A. Cook IV, and R. Geraerts.
Real-time path planning in heterogeneous environments.