Real-Time Path Planning in Heterogeneous Environments

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- Path planning method:
  MIRAN - Modified Indicative Routes and Navigation
- Motivation: start movie

- 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
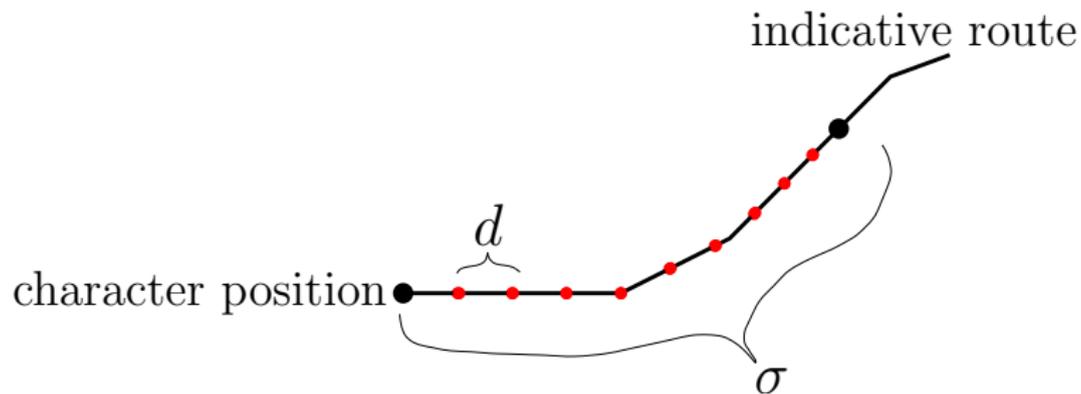   - automatically computed or manually designed
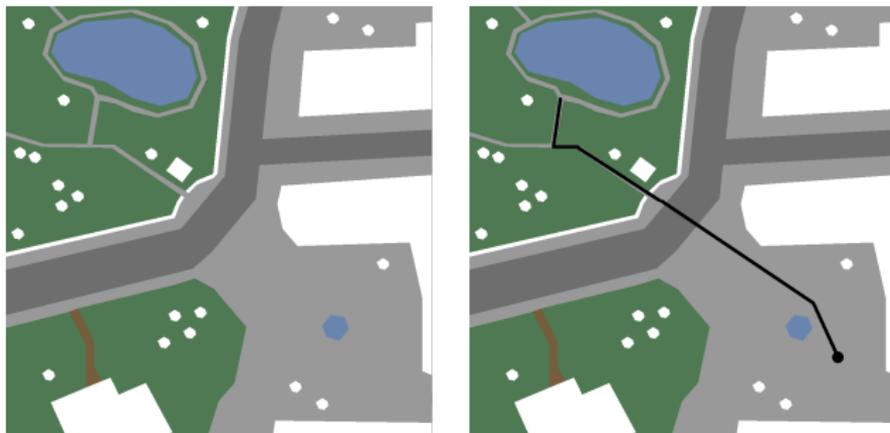
- Output: A natural-looking path that
    - gives the user control over the amount of smoothing
    - is based on a character's region preferences
    - keeps clearance from obstacles
    - avoids unnecessary detours
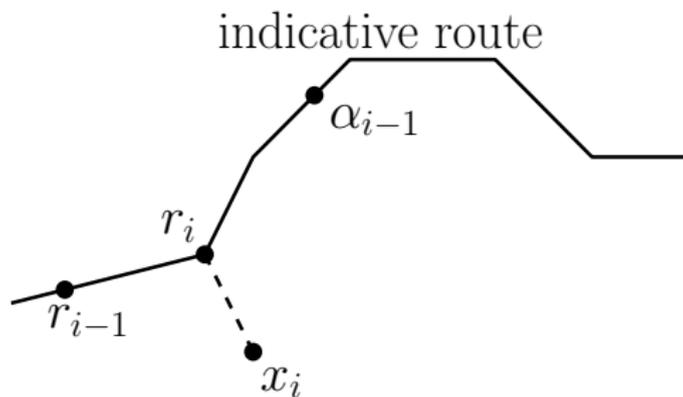   - can be computed in real-time
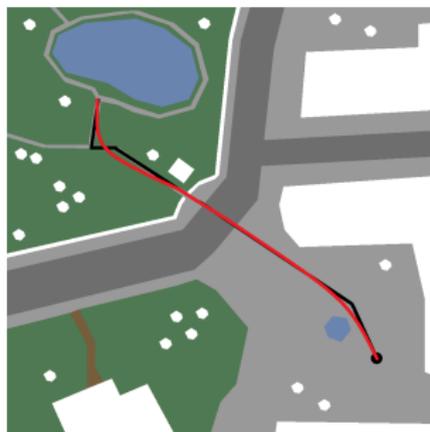
- Step 1: Compute *reference point* on the indicative route
- Step 2: Compute set of candidate attraction points
- Step 3: Pick best attraction point
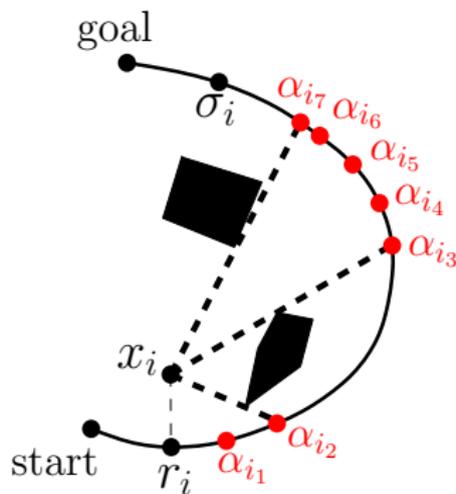- Step 4: Move character towards attraction point

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

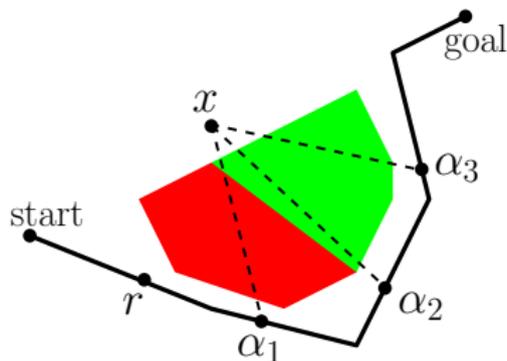- $r_i :=$ *first closest point* on the indicative route between former reference point r_{i-1} and former attraction point α_{i-1}

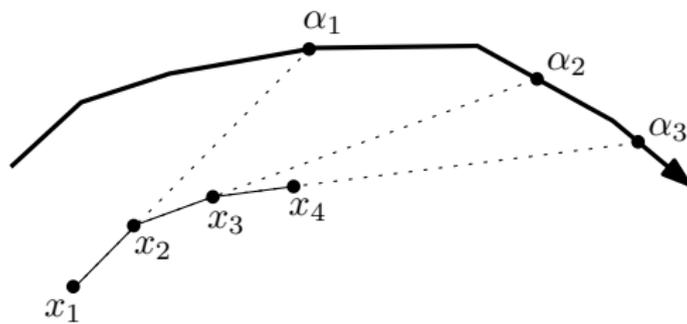- Visible points along the indicative route between r_i and σ_i discretized with sampling distance d

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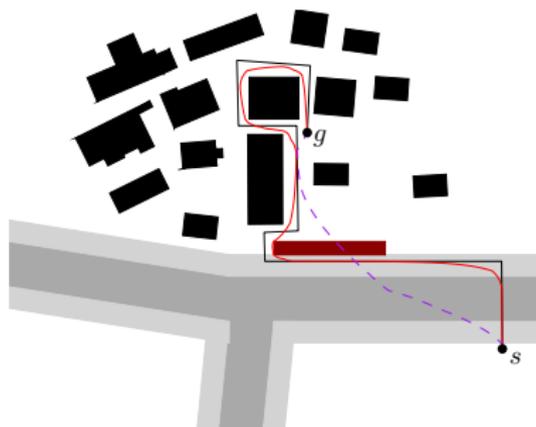
Start Demo

- Comparison with the *Indicative Route Method* (IRM)
  by Karamouzas et al. [2]

- Overall scene size: 200×200 units
- shortcut parameter $\sigma = 40$
- sampling distance $d = 10$
- Running times: 4.66ms (MIRAN), 4.48ms (IRM)

- Handle disc-shaped characters with variable radius in a better way
- Improve computation of indicative routes as input for MIRAN
- Extend terrain-based movement to local collision-avoidance routines
- Generalize MIRAN to (multi-layered) $3D$ environments with height information
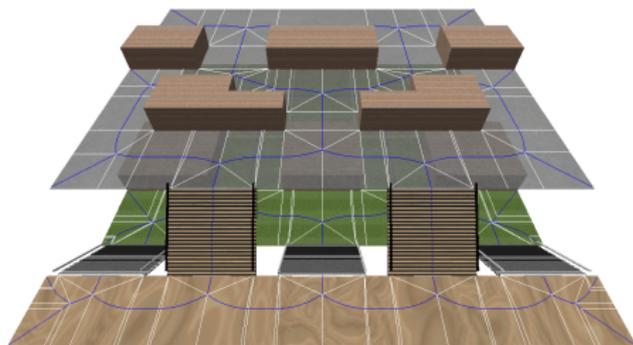
Thank You!
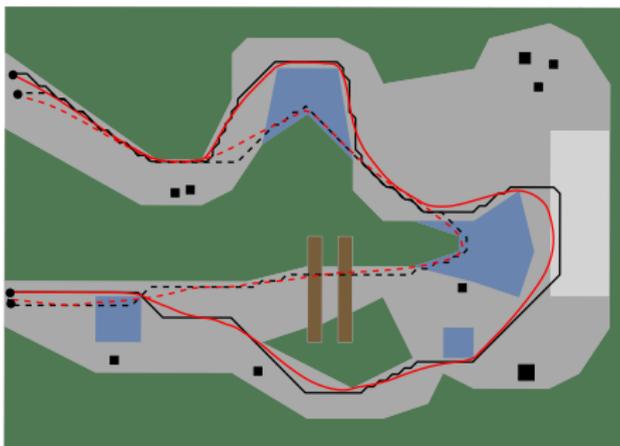
📄 R. Geraerts.
Planning short paths with clearance using Explicit Corridors.
In *Proceedings of the IEEE International Conference on Robotics and Automation*, pages 1997–2004, 2010.

📄 I. Karamouzas, R. Geraerts, and M. Overmars.
Indicative routes for path planning and crowd simulation.
4th International Conference on Foundations of Digital Games, pages 113–120, 2009.