3D Path-finding in a voxelized model of indoor environments

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Current work

• Trying to find a model representation or method suitable for
  • different sized actors (width & height) with
  • different mode of locomotion (walk, drive, fly)

• Utilizing distance maps
Topics

• Distance transform
• Path-finding with distance transform
• Slope estimation of ground voxels
Distance transform

• Flood Fill
• Borgefors
  • 2 passes
    • Forward pass
    • Backward pass
  • Similar to convolution filter
  • Propagation of the distance value (recursive)
• Dorst
  • Towards one point
  • More than 2 passes
Path-finding with distance transform 2D

Input
White = Inf
Black = 0

Dilate
radius = 2

Distance field
Flood fill

Path
Steepest descent
Path-finding with distance transform 3D

Input
Red = Inf
Transparant = 0

Dilate
Vertical radius = 2
Horizontal radius = 1

Distance field
Dorst
7 passes

Path
Steepest descent
Question

• Can I include the size of the actor in the distance field computation so that it is accounted for in the path-finding?
Slope estimation of ground voxels

- Convolution filter for gradient calculation
- Plane fitting with least squares
Slope estimation: Convolution filter

1. Create local height map (3x3) of ground voxels
2. Apply Prewitt operator
3. Calculate magnitude

\[ G_x = \begin{bmatrix} -1 & 0 & +1 \\ -1 & 0 & +1 \\ -1 & 0 & +1 \end{bmatrix} \times A \quad \text{and} \quad G_y = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ +1 & +1 & +1 \end{bmatrix} \times A \]

\[ G = \sqrt{G_x^2 + G_y^2} \]
Slope estimation: Plane fitting

1. Select neighborhood of ground voxels
2. Fit plane using least squares adjustment
3. Derive normal vector from plane equation
4. Calculate angle between normal vector and up vector
Slope estimation
Interesting papers


