# Visual understanding of a scene by automatic movement of a camera

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# The problem

- Some scenes are difficult to understand because of their complexity and the difficulty of positioning a 3D scene on a 2D screen.

- First solution: Methods for automatically computing a good view.

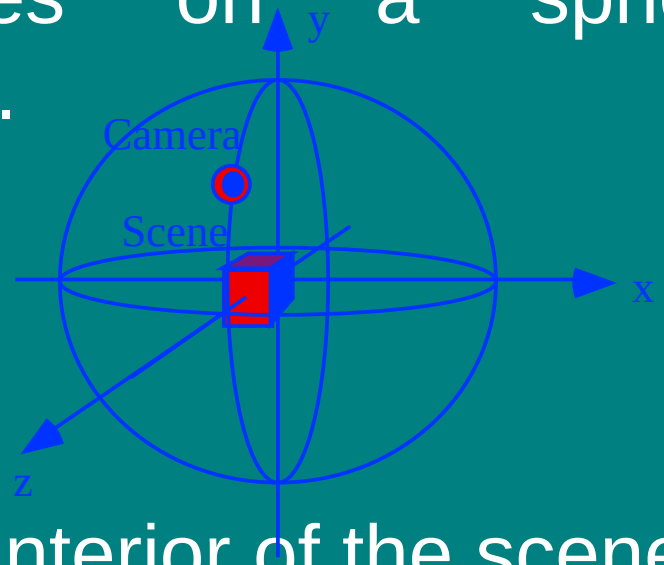
# The problem (continued)

Computing a good point of view is not entirely satisfactory because a single view point is not sufficient for understanding a complex scene.

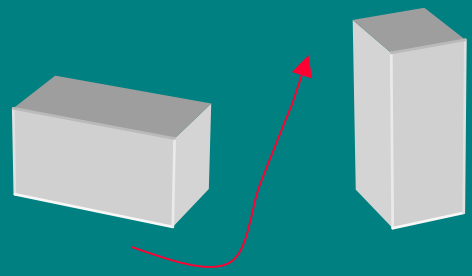
- A possible solution: Using a virtual camera flying over the scene in order to discover interesting views of the scene.

# Two possibilities for exploring a scene with a camera :

- The camera moves on a sphere surrounding the scene.




- The camera visits the interior of the scene.

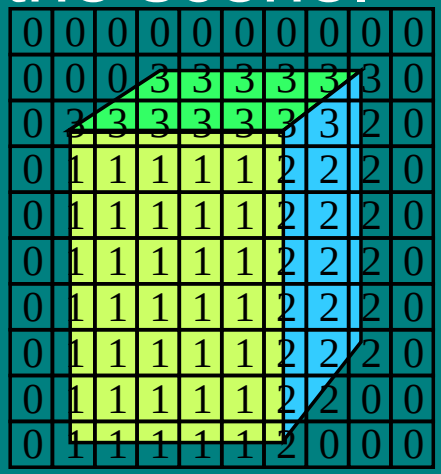


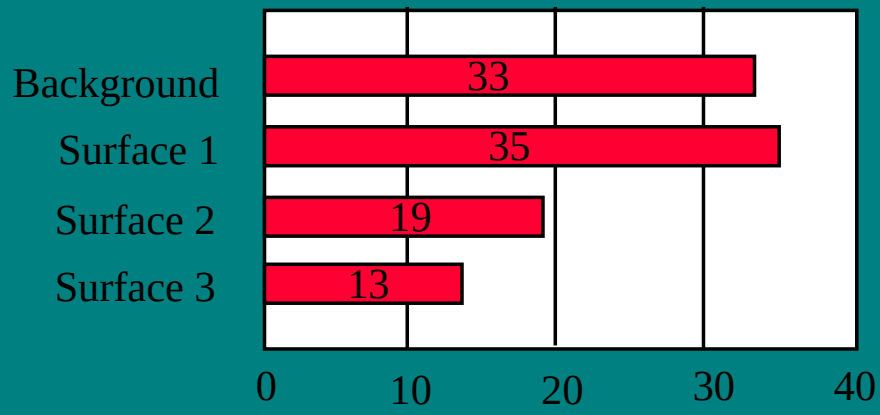
# Requirements for the camera ’s movement

- Choose good view points.
- Fast computation of good view points
- Avoid sudden changes of direction.
- Avoid discontinuities.
- Avoid returns to the starting point.

# Impementing fast computation of a good view point

- Use of the OpenGL graphics library and its integrated z-buffer.
- A distinct colour is given to each surface of the scene.



# Formula to compute importance of a view point

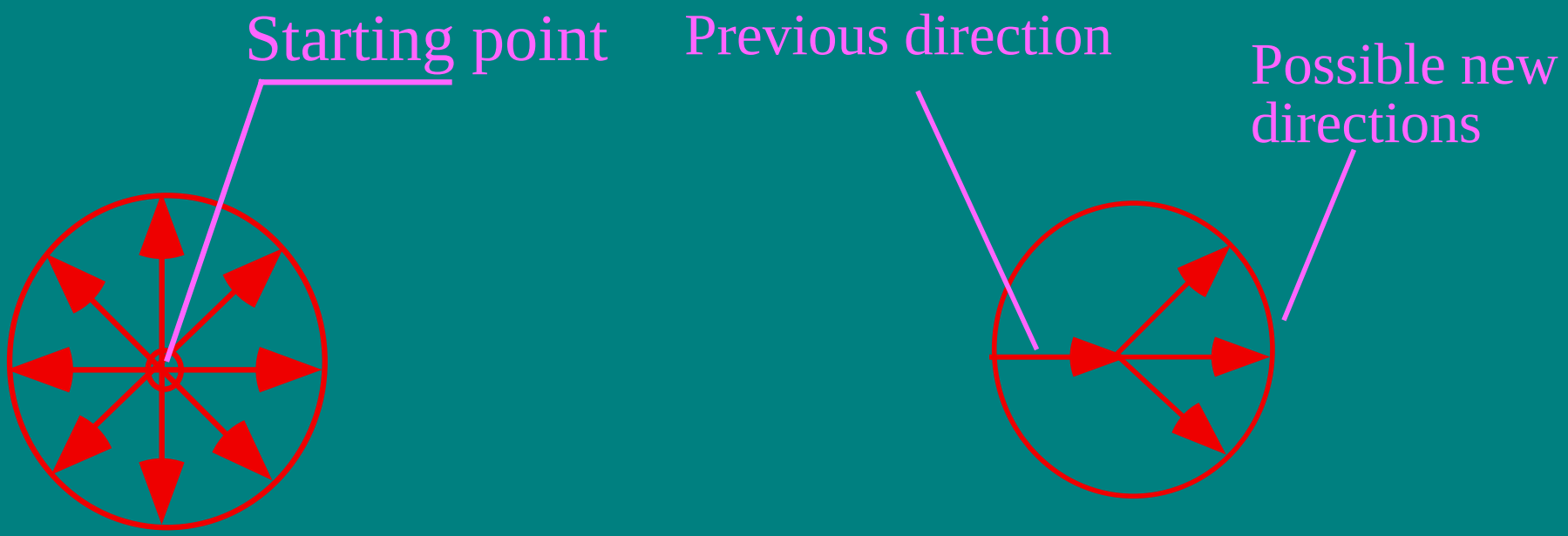
$$I(V) = \frac{\sum_{i=1}^{n} \left[\frac{P_i(V)}{P_i(V)+1}\right]}{n} + \frac{\sum_{i=1}^{n} P_i(V)}{r}$$

where:

- I(V) is the importance of the view point V,
- Pi(V) is the number of pixels corresponding to the polygon number i in the image obtained from the view point V,
- r is the total number of pixels of the image (resolution of the image),
- n is the total number of polygons of the scene.

In this formula, [a] denotes the smallest integer, greater than or equal to a.

# Possible directions of the virtual camera.



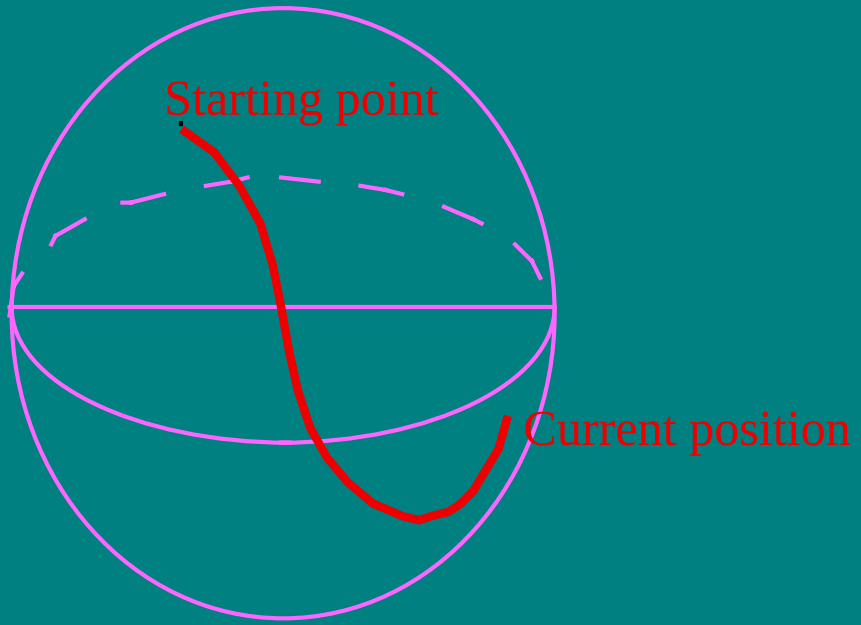
# Heuristics guiding the camera ’s movement.

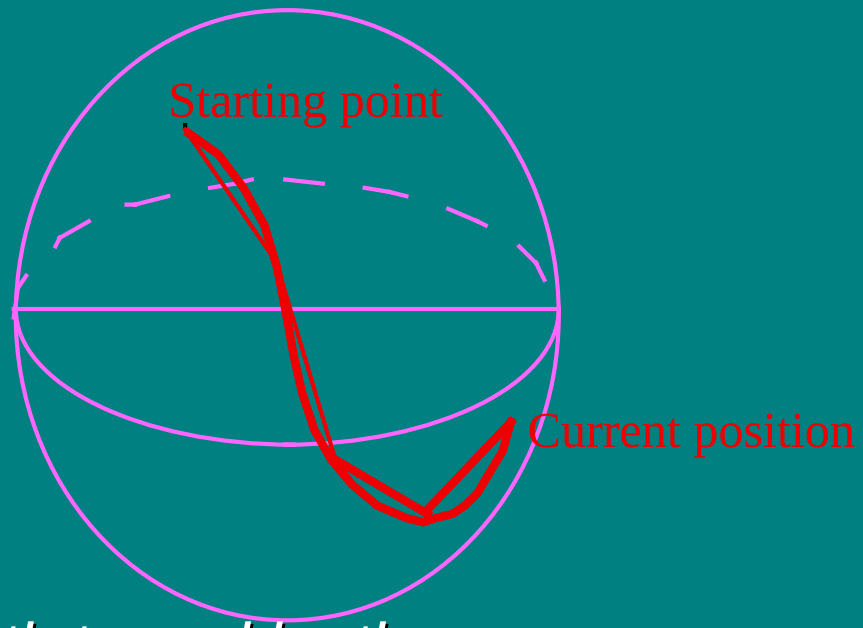
- In order to give the user a good knowledge of the scene’s properties, a maximum of interesting regions of the scene must be viewed by the camera, with a minimum displacement from the starting point.

- Fast return to the starting point must be avoided.

# Heuristics guiding the camera ’s movement (continued).

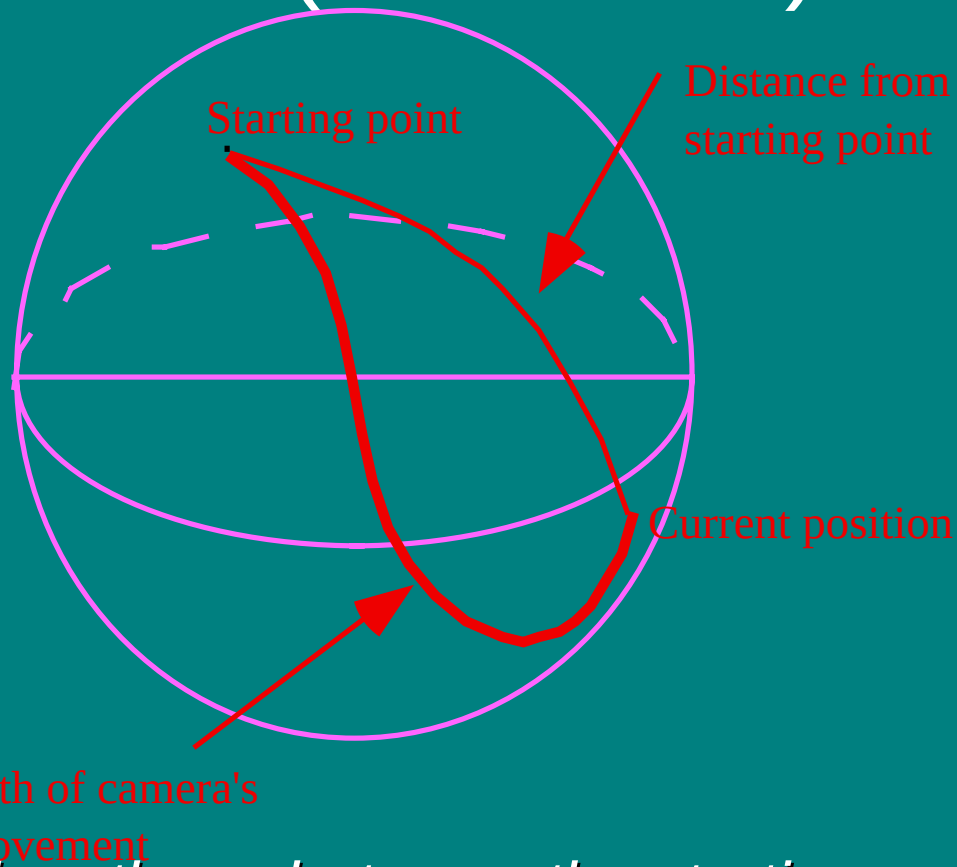
- Use two kinds of distance




*Continuous and discretised path traced by the camera*

# Heuristics guiding the camera ’s movement (continued).




*Minimal length arc between the starting point and the current position*

# Heuristics guiding the camera ’s movement (continued).

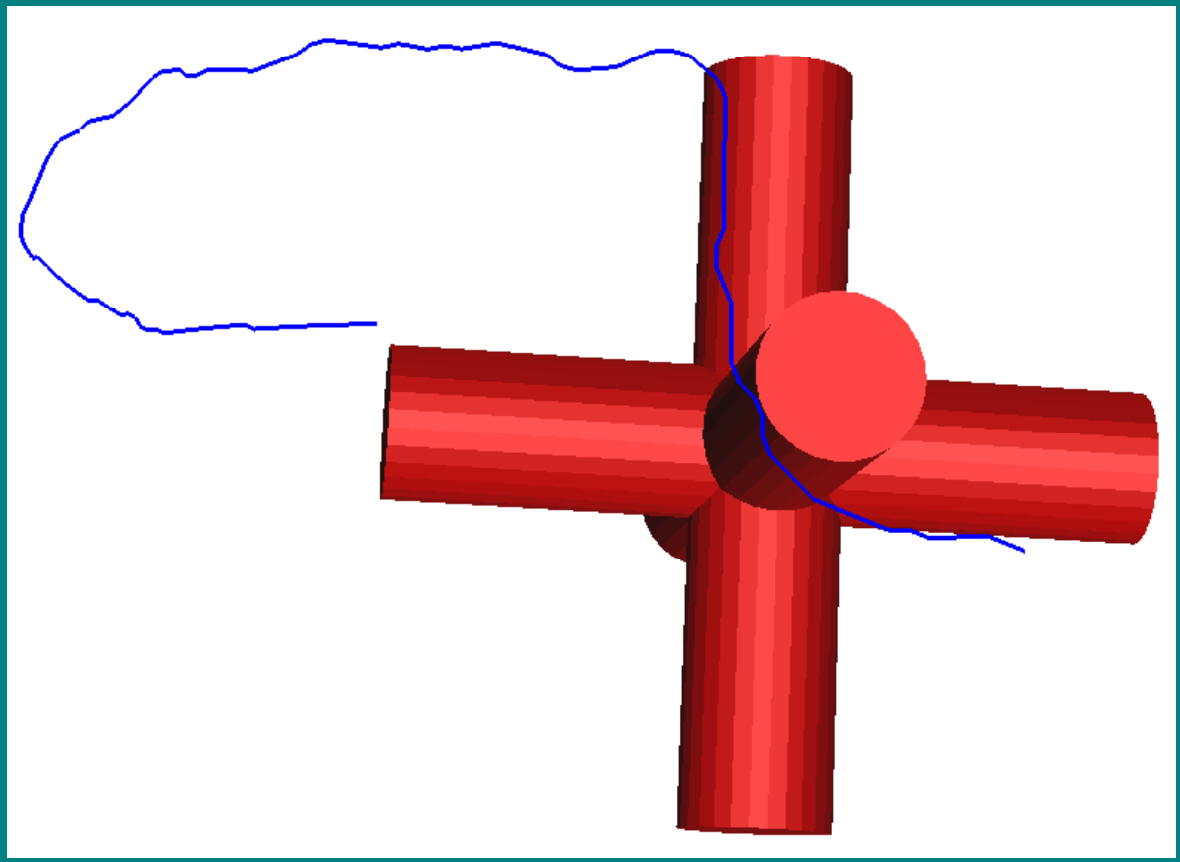
- The heuristic function takes into account :
  - The global view direction note for the camera’s position ($n_c$).
  - The path traced by the camera from the starting point to the current position ($p_c$).
  - The distance of the current position to the starting point ($d_c$).

$$w_c = \frac{n_c}{2}\left(1+\frac{d_c}{p_c}\right)$$

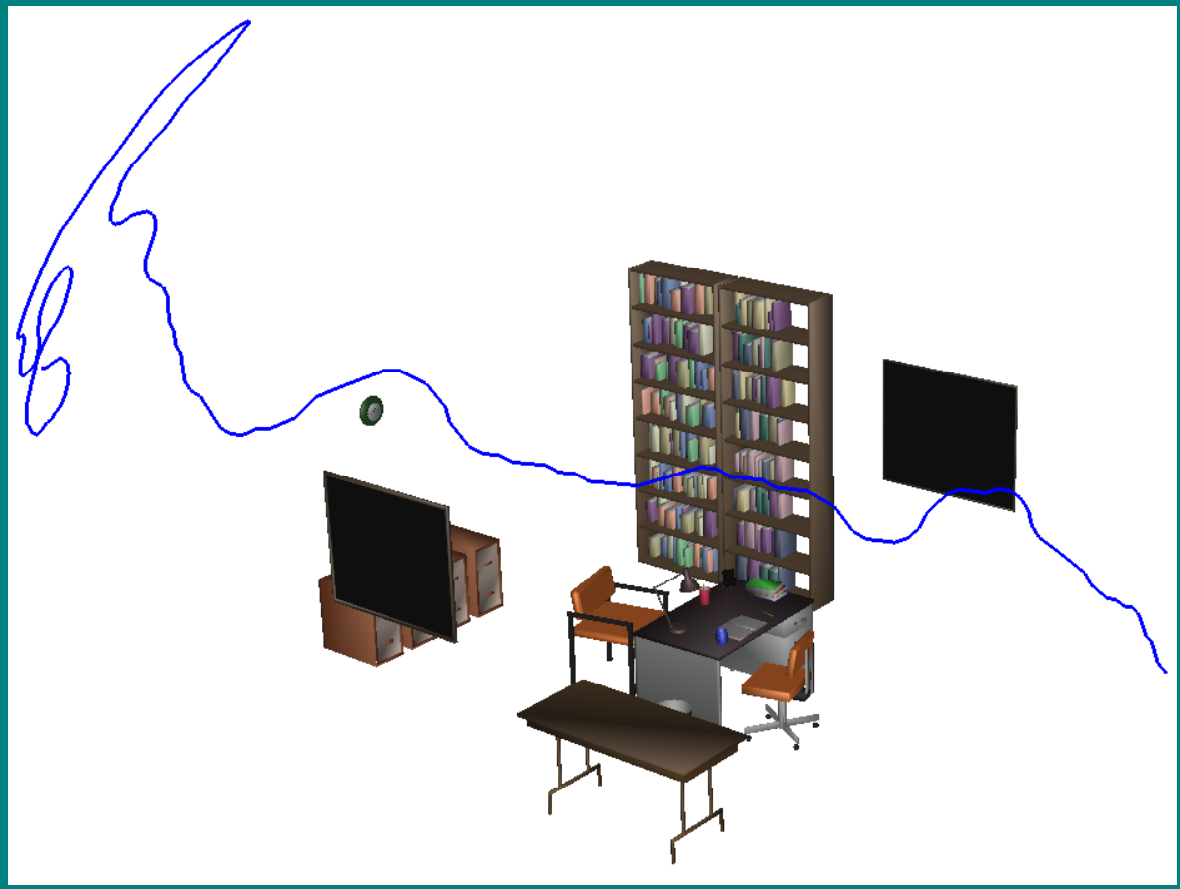
# Results

- Results are satisfactory for scenes we have tested.
- Sometimes, the trajectory of the camera is deteriorated at the end of the movement.
- In any case, the scene is generally well understood before movement's deterioration.

# Results (continued)



# Results (continued)



# Future work

- Improvement of the « good direction » criterion.
- Integration of learning mechanisms.
- Development of scene visiting techniques.