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Department of Biomedical Engineering

Course Name: 19BMT401 – Virtual Reality in Medicine

IV Year : VII Semester

Unit II –MODELING

Topic : Model Management- II

Adaptive LOD Management-continued:

✓An algorithm that selects LOD of visible objects based on a specified frame rate;

✓The algorithm (Funkhauser and Sequin, 1993) is based on a benefits to cost analysis, where cost is the time needed to render Object ***O*** at level of detail ***L,*** and rendering mode ***R.***

✓The cost for the whole scene is

$$\Sigma \text{ Cost } (O,L,R) \leq \text{Target frame time}$$

✓where the cost for a single object is

$$\text{Cost}(O,L,R) = \max(c1\,\text{Polygons}(O,L) + c2\,\text{Vertices}(O,L), c3\,\text{Pixels}(O,L))$$

c1, c2, c3 are experimental constants, depending on R and type of computer

Adaptive LOD Management:

- Similarly the benefit for a scene is a sum of visible objects benefits;

$$\Sigma \text{ Benefit}(O,L,R)$$

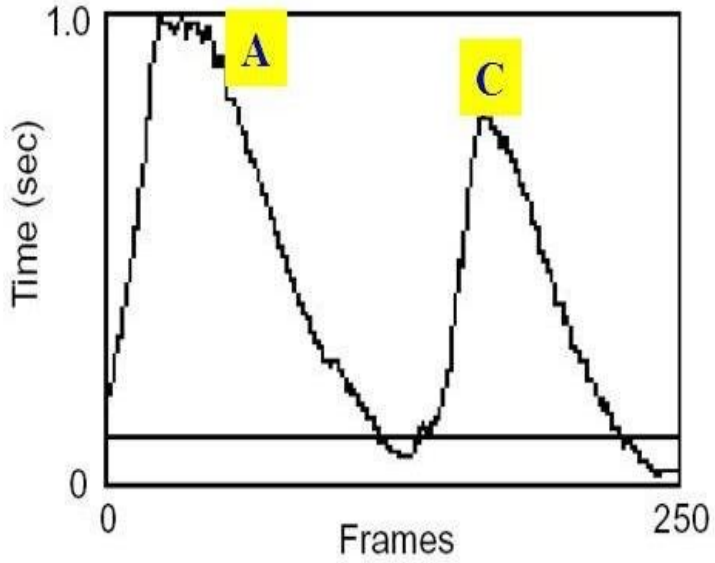
- where the benefit of a given object is

$$\text{Benefit}(O,L,R) = \text{size}(O) * \text{Accuracy}(O,L,R) * \text{Importance}(O) * \text{Focus}(O) * \text{Motion}(O) * \text{Hysteresis}(O,L,R)$$

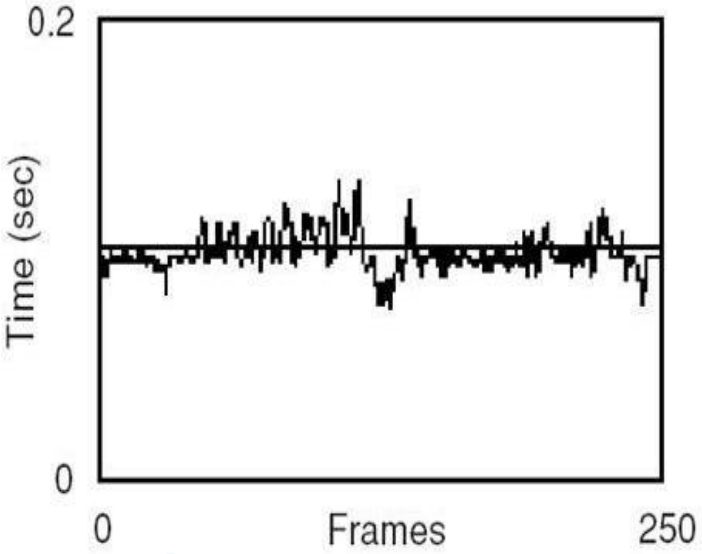
- The algorithm tries to maximize each object's "value"

$$\text{Value} = \text{Benefit}(O,L,R)/\text{Cost}(O,L,R)$$

- Objects with higher value (larger size) are rendered first



No detail elision, 72,570 polygons



Optimization algorithm, 5,300 poly.
0.1 sec target frame time (10 fps)

from (Funkhauser and Sequin, 1993)

Level of detail segmentation – rendering mode

No detail elision, 19,821 polygons

Optimization, 1,389 poly.,
0.1 sec target frame time

Level of detail – darker gray means more detail

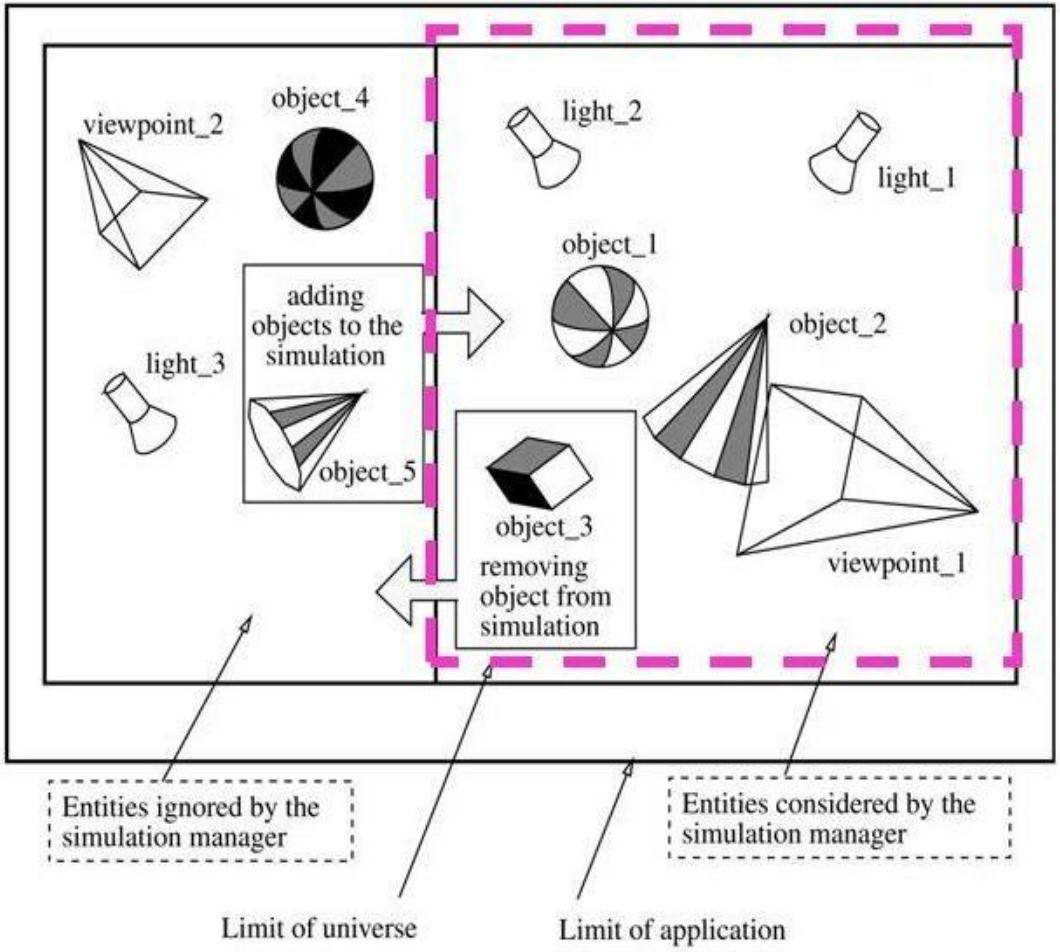
from (Funkhauser and Sequin, 1993)

Cell segmentation:

- ✓It is another method of model management, used in architectural walk-through;
- ✓To maintain the "virtual building" illusion it is necessary to have at least 6 fps (Airey et al., 1990)
- ✓Necessary to maintain ***interactivity*** and ***constant frame rates*** when rendering complex models.

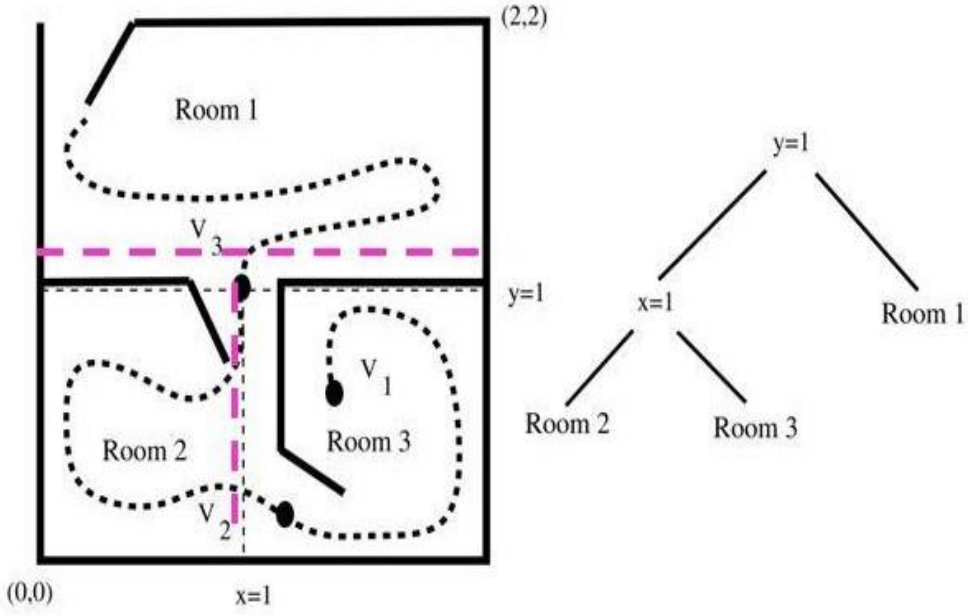
Model management

Only the current "universe" needs to be rendered



Cell segmentation – increased frame rate

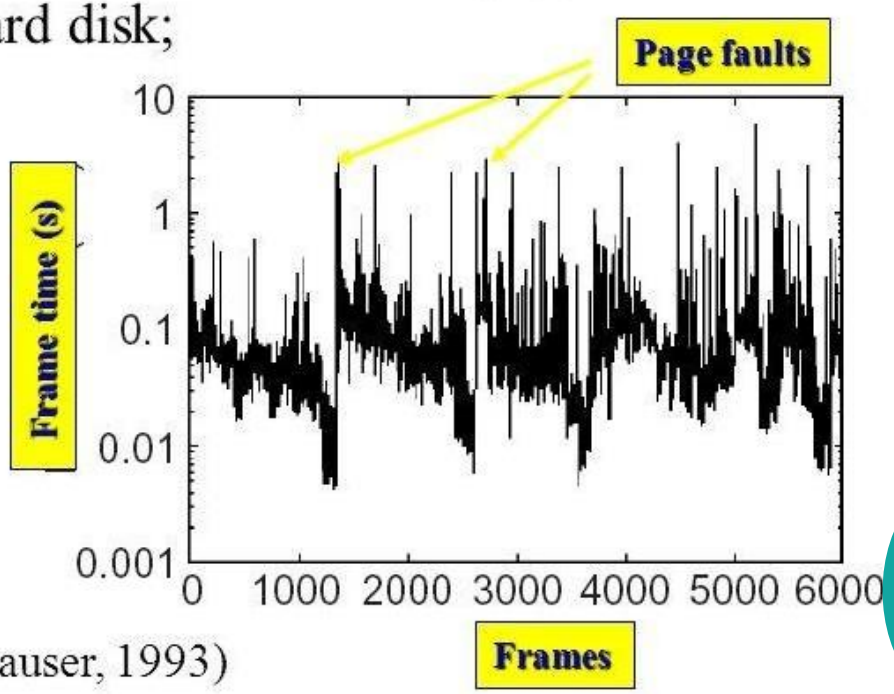
- ✓Buildings are large models that can be partitioned in "cells" automatically and off-line to speed up simulations at run time;
- ✓Cells approximate rooms;
- ✓Partitioning algorithms use a "priority" factor that favors occlusions (partitioning along walls)



a) Automatic floor plan partition (Airey et al., 1990)

Cell segmentation

- ✓Building model resides in a fully associative cache;
- ✓But cell segmentation alone will not work if the model is so large that it exceeds available RAM;
- ✓In this case large delays will occur when there is a page fault and data has to be retrieved from hard disk;

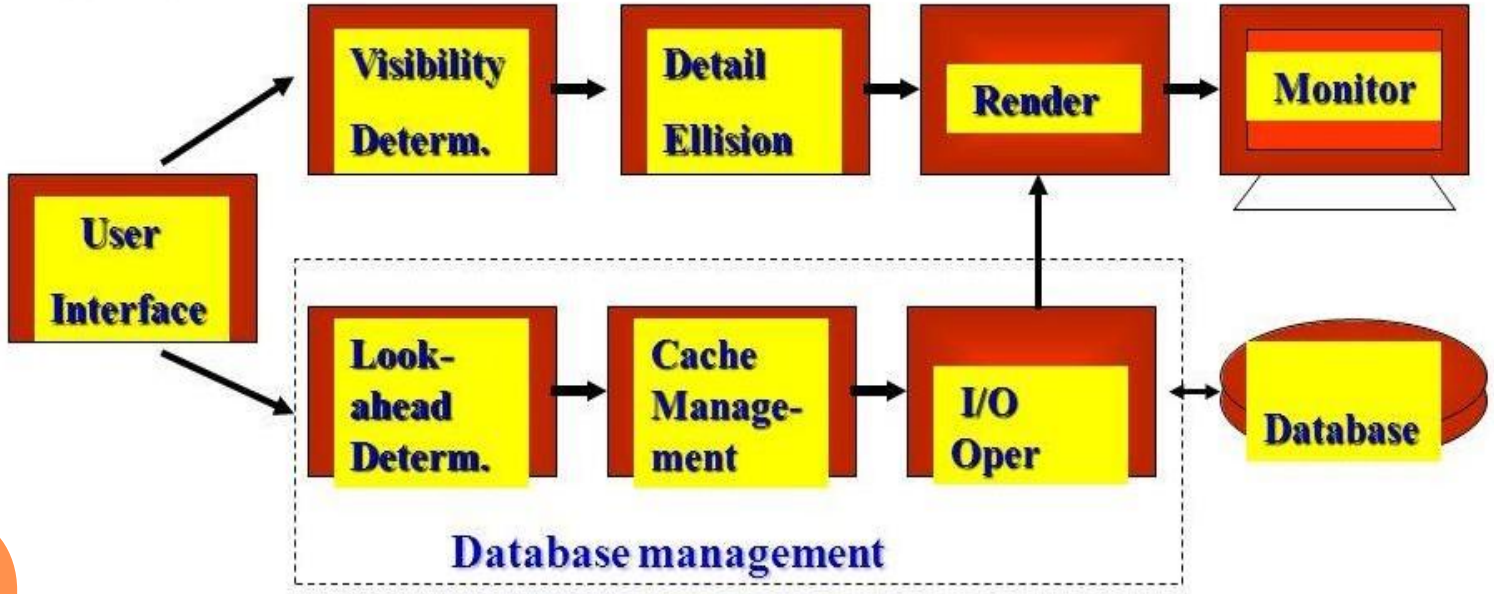


From (Funkhauser, 1993)

Combined Cell, LOD and database methods

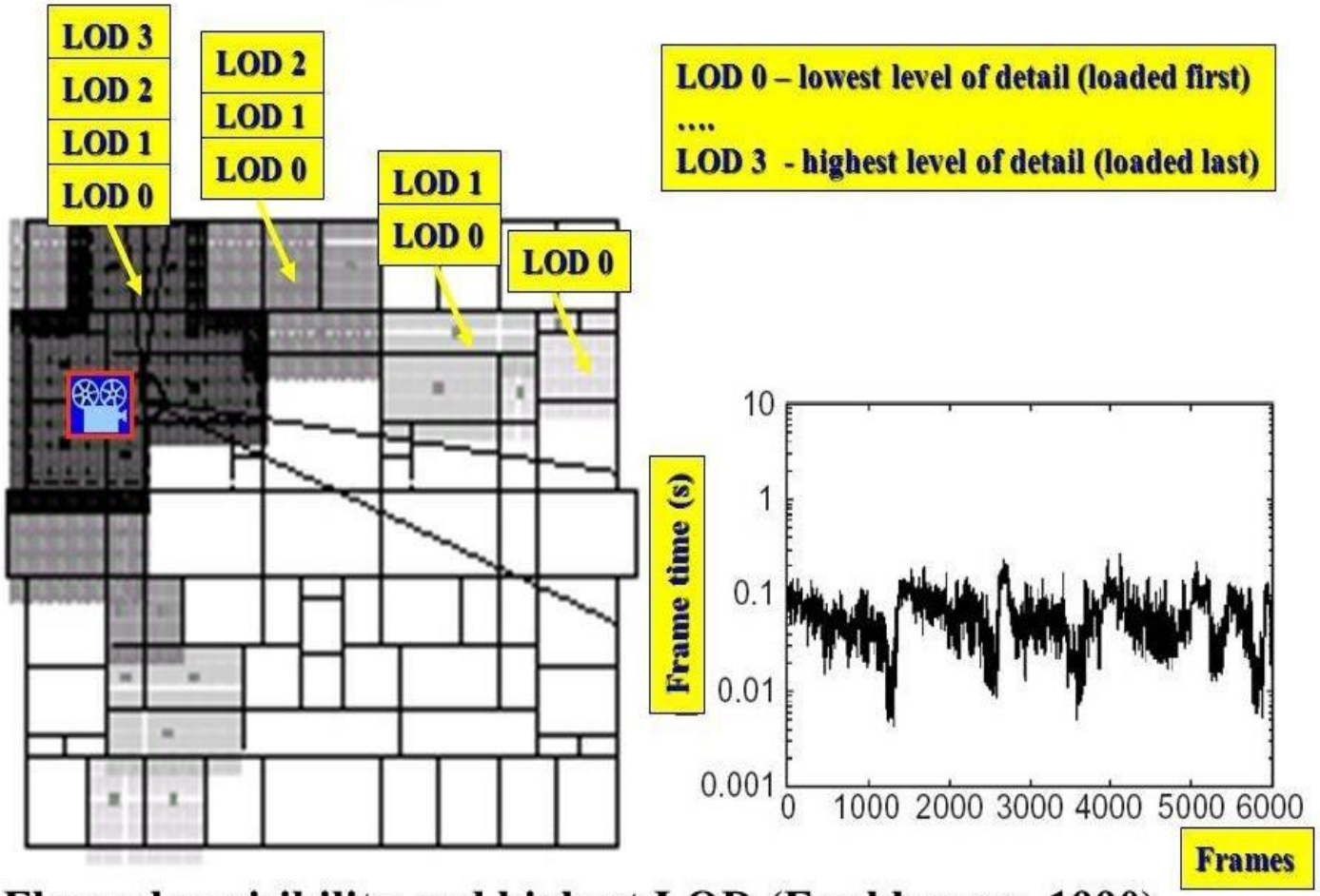
✓It is possible to add database management techniques to prevent page faults and improve fps uniformity during walk-through;

✓It is possible to estimate how far the virtual camera will rotate and translate ***over the next N frames*** and pre-fetch from the hard disk the appropriate objects.



Floor plan partition (Funkhouser, 1993)

Database management



Floor plan visibility and highest LOD (Funkhouser, 1990)

Thank You