Industrial sponsor Sciencesoft

3D Visualisation of Oil Reservoirs

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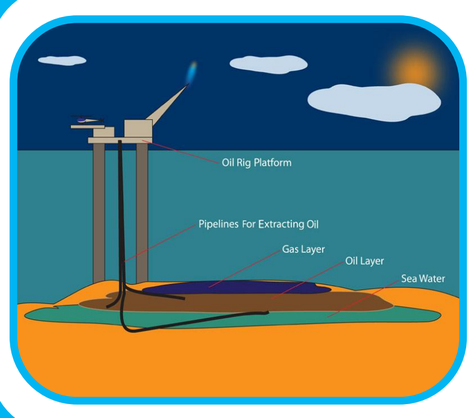
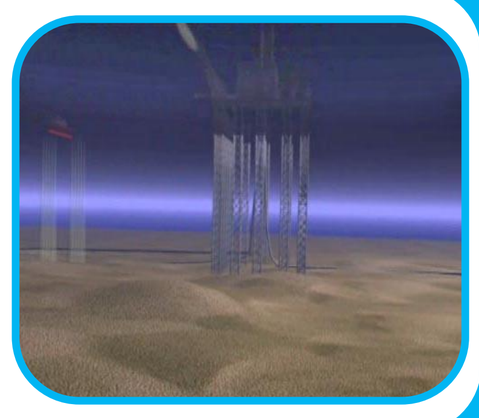
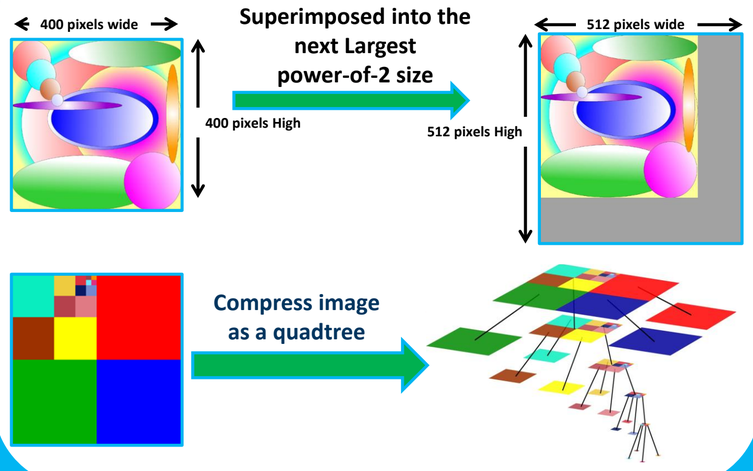


Oil reservoirs are large volumetric datasets and can be several kilometres in both width and breadth and up to several hundred metres deep. Using seismic testing data, these reservoirs are divided into individual cells, each of which represent a hexahedral volume within the reservoir. At present these reservoirs can contain several million of such cells. Simulators calculate the various hydrocarbon data values from the information obtained from rock properties allowing for visual illustrations of the reservoir, its reserves and for accurate predictions of future production levels. Increasing the number of cells used to represent a reservoir decreases the cell volume and allows for greater accuracy. With advancements in multi-core graphics cards we can now visualise oil reservoir models containing up to one hundred million cells. Increasing the number of cells results in extremely large file sizes. Octree data compression techniques will prove to store the data in a more compressed and manageable state. This research also looks at how to improve on industry standard lookup times generated when traversing these datasets of active and inactive cells.

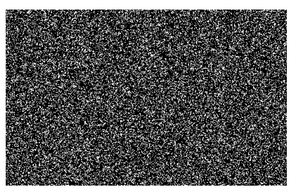


Compressed Quadtree structures – 2D



2D Test Matrices

2 Flavours
10 million & 20 million cell matrices



Randomly scattered active matrices -25 % active

Clustered active matrices -25 % active

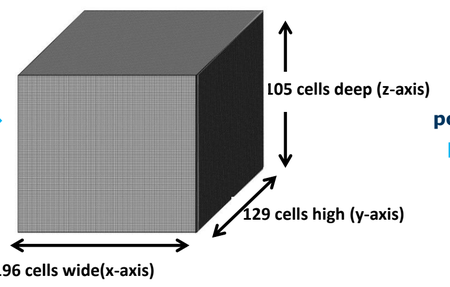
2D Quadtree Results

Quicker search times with both flavours of matrices
Quicker search times with all aspect ratios of matrices
Quicker search times with matrices possessing maximum entropy

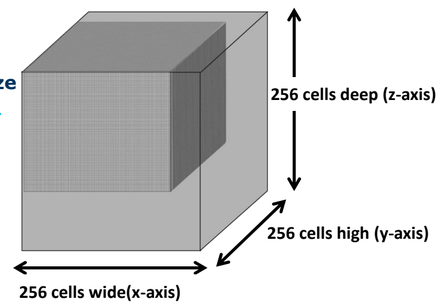
3D Matrix At Power-of-2 Size Generated From Reservoir Sample

196 x 129 x 105 cells
2654820 total cells
1= active cell
0 = inactive cell

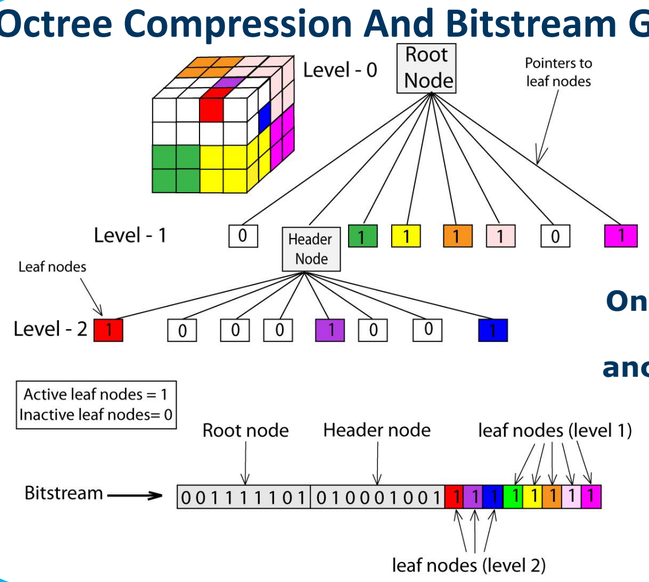
Populates a 3D matrix



Superimposed into the next power-of-2 matrix size

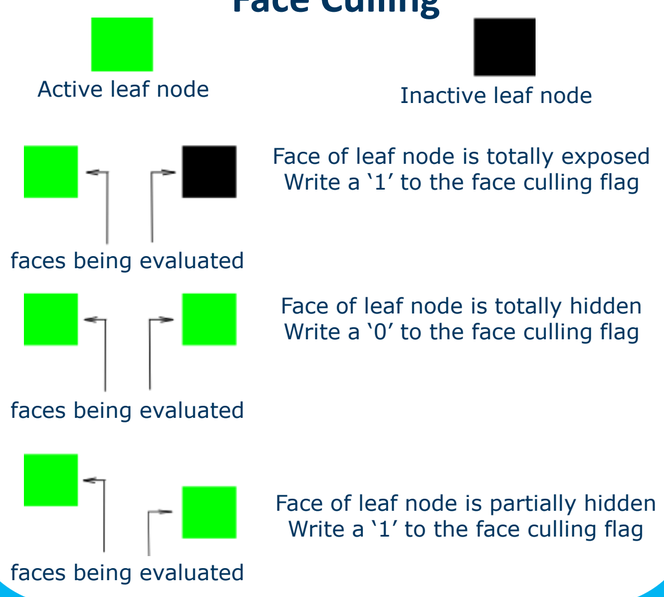


Octree Compression And Bitstream Generation – 3D



Only writes active leaf nodes and their ancestor header nodes to the bitstream

Face Culling



Compressed Vertex Tables

Option 1
Only active leaf nodes populate a compressed vertex table and sent to the graphics card

Option 2
Only the exposed faces of each active leaf node populates the compressed vertex table and sent to the graphics card

Octree - 3D De-compression Savings

No need to add pointers during de-compressing
Vertex table values are sent straight to the graphics card
Lossless compression of floating point vertex co-ordinates

3D Visualisation

3D oil reservoir model visualisations
Only exposed active octree leaf node faces are drawn
Retains the geological characteristics of fault lines