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A

Código GLSL

Algoritmo A.1 Busca pela menor célula que contém $\mathbf{p}$ a partir do nível ℓ .

```

vec3 query( inout int level, const vec3 p ) {
    // check if a cell exists at the current 'level' and position 'p'
    vec3 k = S(level, p); // generate a key for the cell
    ivec2 cell = texture3D( cellTex, H(k) ).ra; // fetch cell
    int voxels = cell.y; // save the address of the cell's voxel block
    if( computeId(k) == cell.x ) { // is this the right cell?
        while( level <= maxLevel ) { // cell exists, try to descend the tree
            k = S( ++level, p ); // generate key for the child cell containing p
            cell = texture3D( cellTex, H(k) ).ra; // fetch cell
            if( computeId(k) != cell.x ) { // is this the right cell?
                --level; // no cell at this level, go back to the last valid level
                break; // the last visited cell is the smallest one
            }
            voxels = cell.y; // keep track of the smallest cell
        }
    } else { // no cell at the current 'level' and position 'p'
        while( level > 0 ) { // ascend the octree until we find a valid cell
            k = S( --level, p ); // generate key for the parent cell
            cell = texture3D( cellTex, H(k) ).ra; // fetch cell
            if( computeId(k) == cell.x ) { // is this the right cell?
                voxels = cell.y; // the first cell we find upwards is the smallest
                break; // so we are done
            }
        }
    } // map 1D address of the cell's voxel block to an unnormalized 3D texture coord
    return map1Dto3D( voxels, voxelTexDim ) + 0.5;
}

```

Algoritmo A.2 Lançador de raios baseado em traçado por esferas.

```

// Fragment Program:
uniform vec3 eye;           // ray origin in world space
uniform float isovalue;     // value of the isosurface; usually 0
uniform float tolerance;    // intersection tolerance for sphere-tracing
varying vec3 fragment_pos;  // from the vertex program, in world space

float reconstructDist( const vec3 vb, const vec3 cp ) {
    return texture3D( voxelTex, ( vb + cp ) / voxelTexDim ).a;
}

void main()
{
    // ray starts at the fragment's position, on the surface of the ADF's AABB
    vec3 pos = fragment_pos; // current position along the ray
    vec3 dir = normalize( pos - eye ); // ray direction
    // compute the distances at which the ray enters and leaves the ADF's AABB
    float rayLength, maxRayLength;
    intersectAABB( eye, dir, rayLength, maxRayLength );
    // traverse the distance field until we hit the isosurface or leave the AABB
    int level = 1; // initial level for queries
    for( int i = 0; i < MAX_ITERATIONS; ++i ) {
        vec3 vb = query( level, pos ); // locate the cell's voxel block
        vec3 cp = toCellSpace( pos, level ); // pos into cell space
        float d = reconstructDist( vb, cp ) - isovalue;
        rayLength += d; // step along the ray
        pos = eye + dir * rayLength; // update the current position
        if( d < tolerance ) { // did we hit the isosurface?
            vec3 normal = reconstructNormal( vb, cp );
            gl_FragColor = shade( pos, normal, -dir );
            return;
        }
        if( rayLength >= maxRayLength ) // did we leave the AABB?
            discard; // ray does not intersect the isosurface
    }
    discard; // we have exceeded MAX_ITERATIONS
}

```
