3D RAY-TRACING ACCELERATION TECHNIQUE FOR THE ANALYSIS OF PROPAGATION AND RADIATION IN ENVIRONMENTS MODELLED BY SURFACES WITH ARBITRARY FORM

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In electromagnetic asymptotic ray-tracing techniques like GTD/UTD, the electrical field is calculated as the sum of all rays that reach the observation point or the observation direction: direct, reflected, diffracted and combination of them. The most of the CPU time is spent in determining the surfaces that shadows the ray and the searching of the possible points that can contribute by another effect different to direct ray. So, it is necessary to reduce the number of surfaces involves in such process, applying acceleration techniques like Space Volumetric Partitioning, Binary Space Partitioning or Angular Z-Buffer. When it is necessary good accuracy between the real model and the geometrical model, flat faceted models can not be used and arbitrary surfaces like NURBS must be used. The technique proposed is based on the Angular Z-Buffer but developed to the be used with any kind of surfaces: flat and curve.

The shadowing tests are accelerated using a "*shadowing window*" defined for every surface and sources of electromagnetic field defined in the environment. The space is divided into angular regions named anxels "*angular elements*" that contains the surfaces for a certain margin of directions. When the shadowing test is applied, the anxel where the ray lies is determined and the surfaces contained in it are used for the surface-ray intersection tests. Because there is no analytical formula to determine the intersection between a ray and a surface and it is necessary the use of minimization algorithms like Conjugate Gradiente Method (CGM), the CPU-time required is reduced remarkably, as is shown in the results obtained.

The technique above can be extended and easily applied to speed-up the searching of the possible reflection points. Using the possible margin of the reflected fields, a "*reflection window*" from the source is obtained applying the Snell Law to the surfaces visible from the source. The anxels that contains the margins above are updated with the surface. When the reflected rays are calculated for a specific direction, the anxel where the rays lies is located and the surfaces contained in it will be used to serach the reflection points. The procedure above can be extended to the double reflection case, calculating a "*reflection window*" associated to every surface of the model. In that case, the surface is bounded in a parallelepiped box and the 8 vertexes of the box are used as auxiliary sources to determine an absolute margin of reflection directions from the surface.

The technique proposed has been implemented in FASANT, a code based on GTD/UTD to calculate the radiation pattern of antennas on-board complex structures modelled by NURBS surface. The reduced CPU-time is large for instance 1/6 for a case of an airplane modelled by 304 surfaces.