Ray Tracing Evolution

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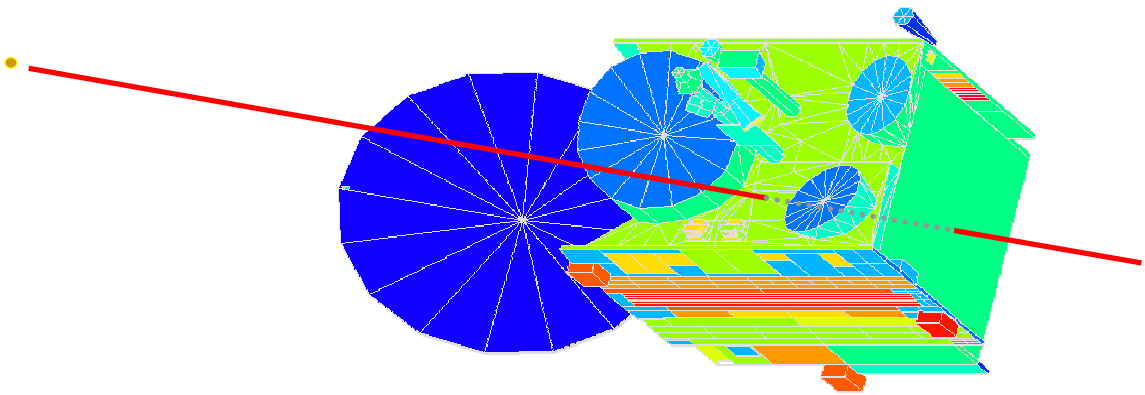
- *Main purpose*
- *Octree technique description*
- *First results*
- *Development status*

Why use the Ray Tracing

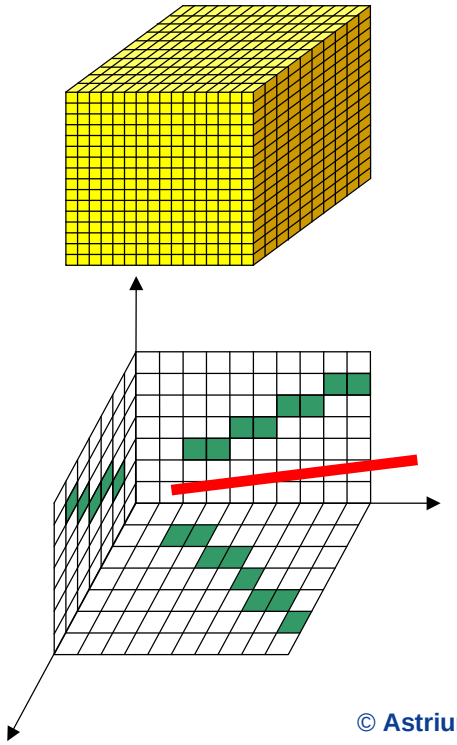
- Model physical phenomena
  based on *rectilinear* propagation of particles



Applications :
- thermal radiation
- radiation dose
- perturbing forces/torques
- contamination
- électromagnetism
- micrometeoroids ...

Present technique (Thermica/Esarad)

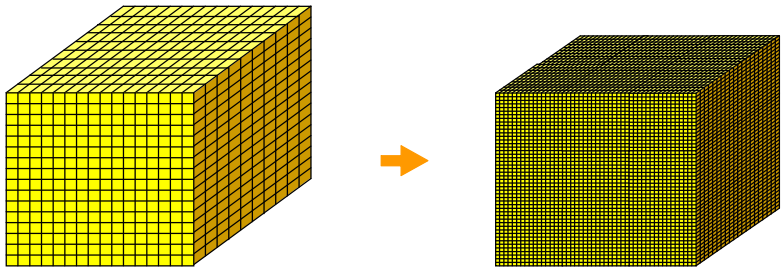
- Space discretization in *homogeneous* voxels
- Ray propagation in voxels : simple & fast algorithm (few integer additions)
- Intersection tests with each surface of voxels along the ray path : directly impacts *Performances*



Engineering evolution constraints

- Today 's modelling requires (all together) :
  - bigger models
  - more accuracy (i.e. more rays)
  - parametric studies

⇒ Reduction of voxel size



⇒ **Exponential increase of the memory size**
⇒ **Reduction of the ray propagation speed**

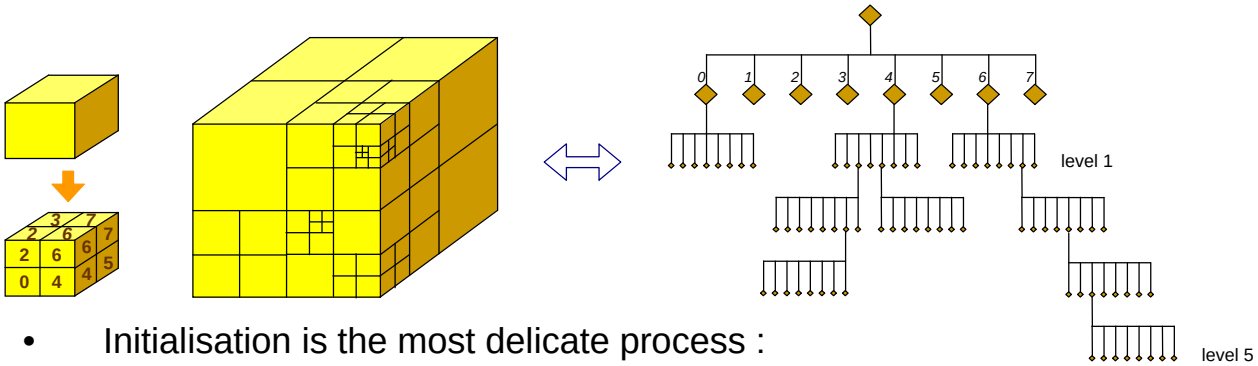
Industrial approach

- CPU and memory evolutions are likely not to be sufficient

- Development of a new technique :
  - solving the engineering modelling problems for the next 10 years
    ⇒ **think of additional features**
  - with optimal investment (other priorities exist)
    ⇒ **avoid too sophisticated methods**
  - available quickly
    ⇒ **use what is already proven**

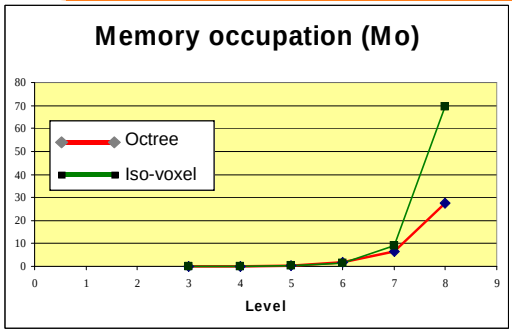
Octree method

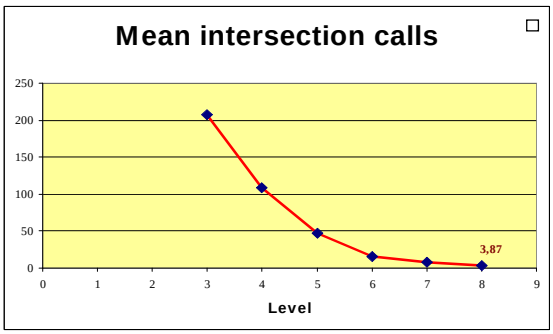
- The space decomposition is represented by a tree with nodes being terminals or fathers of 8 other nodes

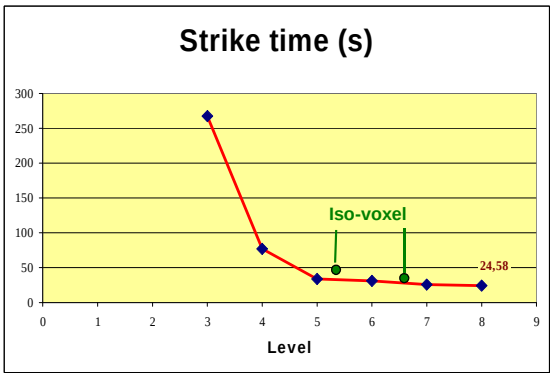


- Initialisation is the most delicate process :
  - not enough nodes/levels
    ⇒ CPU consumption during RT
  - too many nodes/levels
    ⇒ CPU consumption during initialisation
    ⇒ memory size

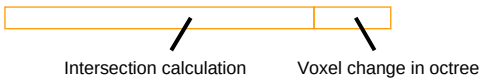
First results (HB7 model)







RT CPU time :



The higher the number of levels, the higher the voxel changes

Development status

- Performed on **classical Thermica shapes**, including prisms and revolution shapes
  Additional tests still necessary on various big models to confirm the initialization method
- Current development on **cut surfaces** with significant improvements compared to MMS algorithms developed in Esarad phase 1 (1990).
- Ray-Tracing on **Nurbs and Meshed surfaces** to be done
- Ray-Tracing **implementation** in Thermica V4 foreseen in **June 2002**