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# Geometry modifiers

Here we describe a set of functions that can be used to alter the geometry of material objects before the FDTD calculation. Typically they operate on a single material (controlled by index of material in the material file entered via MEDIUM_VECTOR directive) and they shrink or expand it, or add something to it.

Probably most useful function of this type is addition of **roughness**. This is done via ballistic deposition with limited diffusion, so it really simulates the process of random surface topography creation when a material is deposited (e.g. using evaporation). Simulation is performed within box defined by (i0 j0 k0 in jn kn) that can be eventually subsampled (parameter subsampling) to get better control over results. Particles are flying from box boundaries in random direction unless they leave box or get attached to the material. Materials that are not listed in this directive have no impact on the process (as they would be vacuum). Jump mobility is given in voxel units and controls maximum distance allowed for relaxation, jump probability controls probability of such process (in range of 0-1). Number of particles is typically in range of tens of thousands at least.

Sample parameter file: *mod_roughen.*
*A 300x300x300 computational domain with a sphere modified by roughen.*
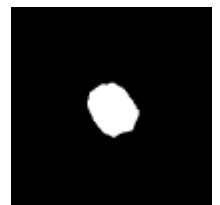


The roughness can be also added by a simpler and faster procedure similar to addition of gaussian noise to an image (but done in 3D). Here, 3D gaussians are added to random places in the computational volume and using thresholding the new object surface is determined.
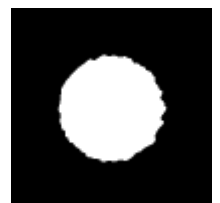
Sample parameter file: *mod_grow.*
*A 300x300x300 computational domain with a sphere modified by growth.*



Sample parameter file: *mod_expression.*
*A 300x300x300 computational domain with a sphere modified by expression.*

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