

Nanocomposites and nanomaterials

Voxel-based mesh generation for computational electromagnetics simulations

A.O. Demchuk¹, I.M. Bolesta¹

¹ *Department of Electronics, Ivan Franko National University of Lviv, Ukraine.
E-mail: demchuk.antonina@gmail.com*

Mesh generation is an important pre-processing step for computational electromagnetics methods, such as the discrete dipole approximation (DDA) or finite-difference time-domain (FDTD) methods. Due to the difficulty of solving differential equations for complex geometries analytically, meshes are used to create discrete representations of complex physical objects and environments.

Mesh generation[1] refers to the process of discretizing a space into a set of smaller elements. The space is usually defined as the surface boundary that can be filled with solid units, in the simplest case pixels for two-dimensional space or voxels when the space is three-dimensional. Voxel is the smallest box-shaped unit of volume supplied with numerical values, such as a type of material, optical constants, void space, etc. A connected set of voxels of the same type represents a physical object.

Although many meshing generation methods exist, few of them are designed to deal with voxel-based geometric objects. The mesh generation tools have to meet the requirements for complex geometries simulation: to have a rich graphical user interface (GUI) to compose 3D complex objects; to generate mesh based on surface description of objects; to set material properties to the voxels; to change mesh resolution (size of voxels); to visualize and verify the generated mesh; to export generated mesh into a file.

The Blender[2] meets prior requirements and is used to create and voxelize nanoparticles with different shapes and sizes. The Blender is a free open-source tool and provides the GUI extensibility through add-ons written in Python programming language. The Remesh modifier and BlenderFDS plugin are used to generate voxel-based meshes and set material properties to the voxels. The Blender suite and computational electromagnetics simulation tools were used to calculate optical spectra of silver nanoparticles of different shapes.

1. Zhang H. Mesh generation for voxel-based objects // West Virginia University Morgantown, WV, USA. -2005.-**131**.
2. Blender project - free and open source 3D creation software.
<https://www.blender.org>