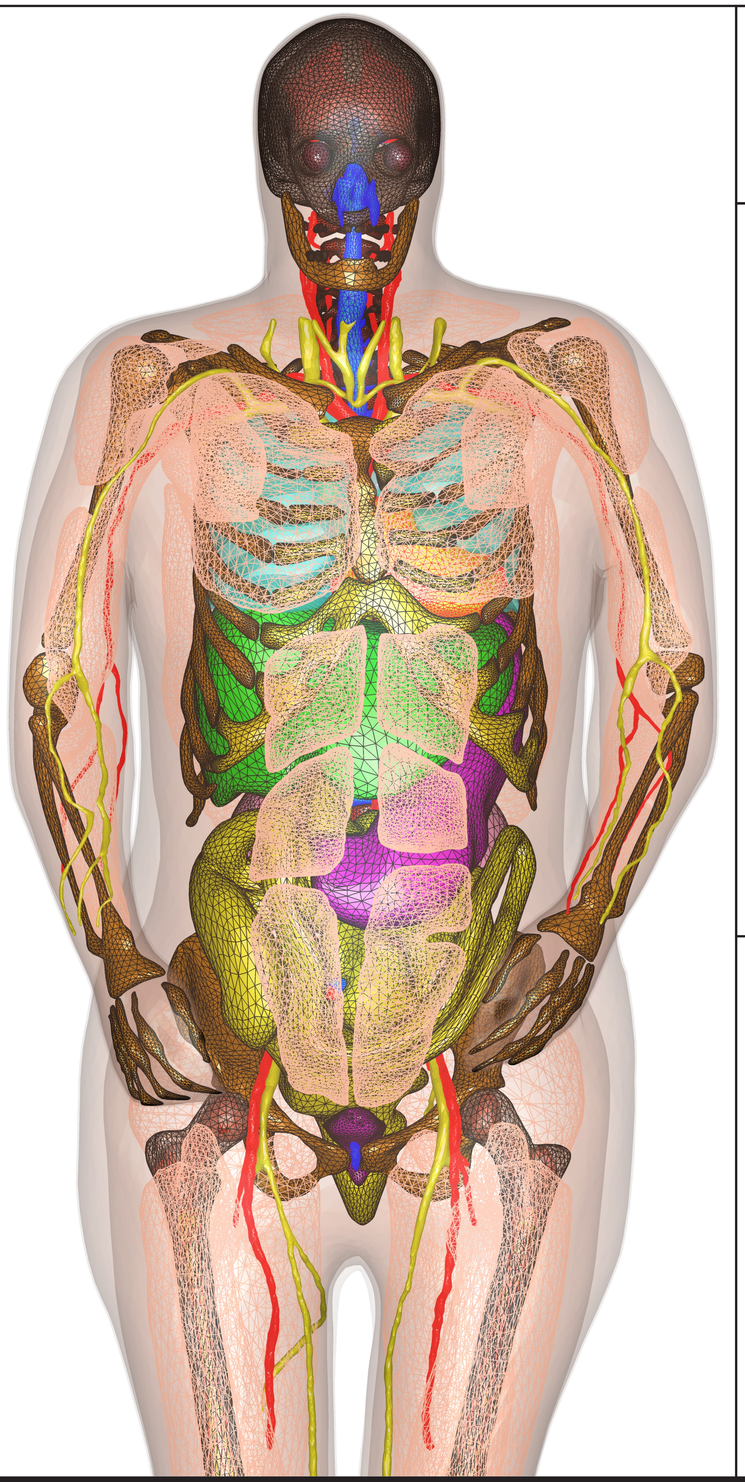
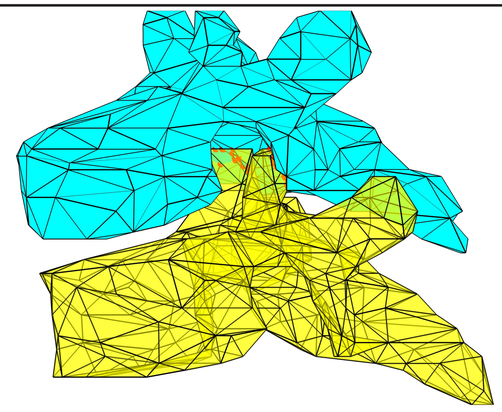
VHP-Female v3.0 FEM/BEM Computational Human Phantom

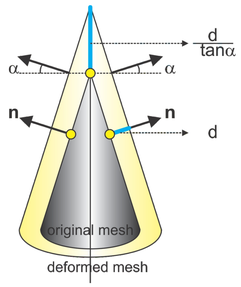
G.Noetscher[a,b], J. Yanamadala[a], M. Kozlov[c], S. Louie[d], A. Nazarian[e], and S. Makarov[a,b]

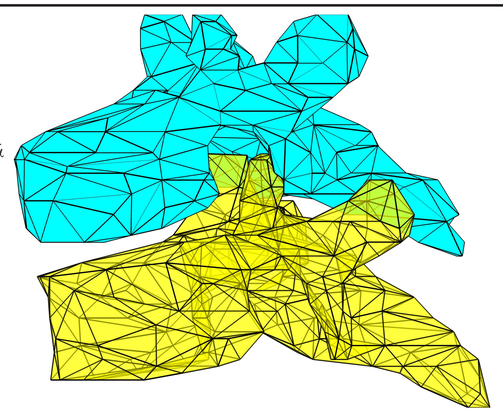
[a]ECE Dept. Worcester Polytechnic Institute, Worcester, MA 01609
[b]NEVA Electromagnetics, LLC, Yarmouth Port, MA, 02675,USA
[c]Dept. of Neurophysics, Max Plank Inst. for Human Cognitive and Brain Sciences, Leipzig, Germany
[d]ANSYS, Inc., Canonsburg, PA, 153317, USA
[e]Beth Israel Deaconess Medical Center, Harvard Medical School, 330 Brookline Ave., Boston, MA 02215, USA



The Visible Human Project (VHP)-Female v3.0 computational phantom, a platform-independent full-body FEM-compatible model consisting of 231 strict 2-manifold meshes and 25 distinct materials, has been developed at two resolutions: BASE and ACCURATE. Fine meshes may be used for detailed simulations in localized body areas while coarse meshes are suitable for more global applications

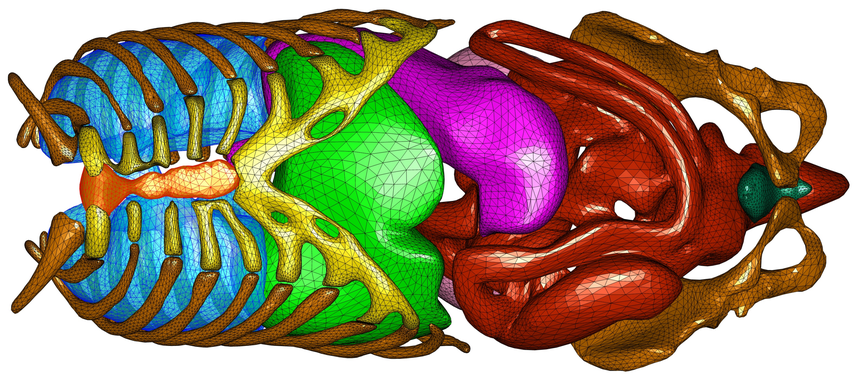


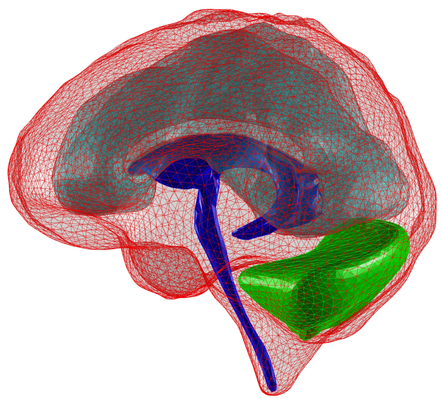




After image segmentation, smoothing of coarse meshes is conducted and 'shallow' intersections between neighboring tissues will exist. These are resolved by identifying intersecting edges and iteratively deforming boundaries in the direction of each node's ***normal vector given local curvature*** - this process is automatable

$$\mathbf{n}_0 = \sum_{i=1}^{N} A_i^{-1}\mathbf{n}_i \Big/ \left|\sum_{i=1}^{N} A_i^{-1}\right| \qquad \mathbf{p}_i = \mathbf{p}_i + d\frac{\mathbf{n}_0}{|\mathbf{n}_0|^2}$$





This process results in smooth, highly resolved, independent meshes suitable for localized simulation of electromagnetic phenomena including microwave imaging, calculation of specific absorption rate, and medical device/system performance.