Several closely related methods have been proposed in recent years to smooth, denoise, edit, compress, transmit, and animate very large polygon meshes, based on topological and combinatorial methods, signal processing techniques, constrained energy minimization, and the solution of diffusion differential equations. In particular, polygon models, which are used in most graphics applications, require considerable amounts of storage, even when they only approximate precise shapes with limited accuracy. To support internet access to 3D models of complex virtual environments or assemblies for electronic shopping, collaborative CAD, multi-player video games, scientific visualization, representations of 3D shapes must be compressed by several orders of magnitude. In this talk I will provide a quick overview of the mesh signal processing approach, which I have been an early proponent of, and its relation to alternative and complementary approaches. Then I will describe in more detail some recent results and applications: Linear Anisotropic Mesh Filtering, Bi-Level Isosurface Compression, and Space-Optimized Texture Maps.