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The simulation of surface EMG signals is important for the indirect estimation of physiological variables (inverse problem), a deeper understanding of the physiological mechanisms, a proper choice of the detection system parameters, the interpretation of experimental results, and didactic purposes. An EMG model should describe 1) the source, 2) the volume conductor, and 3) the detection system. Analytical solutions for the description of the volume conductor can be obtained only in specific cases, while numerical methods are necessary for more complex conditions. Nevertheless, analytical solutions provide a clear description and reduce computational time. Recent advances in surface EMG analytical models allow the description of volume conductors with a variety of geometries and conductivity tensors (e.g., for describing sphincter muscles, bi-pinnate muscles, and muscles presenting local tissue in-homogeneities). An analytical solution for these cases is obtained in the spatial frequency domain. More complex situations (e.g., multi-pinnate muscles with curvilinear fibers or intramuscular blood vessels) are investigated through a numerical approach based on finite elements. "Objects" such as blood vessels introduce wave-shape changes in the surface action potentials since the system is not space-invariant in the direction of source propagation. The application of advanced modeling methods allows a deeper understanding of the surface EMG.