Smooth and linear surface interpolations applied to three dimensional boundary elements

A three dimensional boundary integral formulation which models linearly varying displacement and traction, without requiring surface meshing, is presented. The location of the nodes is determined by the geometry and the physical modeling requirements, not a heuristic mesh improvement algorithm. Two dimensional interpolants which are both smooth and linear can be applied to the flat surfaces of a three dimensional element. The geometry of the surface determines the shape of the two dimensional element, no additional tessellation or meshing is required. Even indented, or concave, boundaries can be described by the interpolation functions. Additional points can be included at any point on the surface without re-computing the boundary related interpolations. The behavior of the interior element is computed using a boundary integral method. The suitability of the formulation is tested by its application to the modeling of a cell loaded using an atomic force microscope. The soft cell specimen deforms significantly during the course of the indentation test. The large deformations are greatly detrimental to the efficiency of finite element models. The small-scale, or nano-scale, forces are not yet included in the model.