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Surface Deformation due to Loading of a Layered Elastic Half-space: Constructing the Solution for a General Polygonal Load

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Abstract

We describe an algorithm for rapidly computing the surface displacements induced by a general polygonal load on a layered, isotropic, elastic half-space. The arbitrary surface pressure field is discretized using a large number, n, of equally-sized circular loading elements. The problem is to compute the displacement at a large number, m, of points (or stations) distributed over the surface. The essence of our technique is to reorganize all but a computationally insignificant part of this calculation into an equivalent problem: compute the displacements due to a single circular loading element at a total of $m\,n$ stations (where $m\,n$ is the product $m \times n$). We solve this "parallel" problem at high computational speed by utilizing the sparse evaluation and massive interpolation (SEMI) method. Because the product $m\,n$ that arises in our parallel problem is normally very large, we take maximum possible advantage of the acceleration achieved by the SEMI algorithm.

Key words: surface loading, elastic response, isotropic, layered half-space.