An Efficient and Accurate Formulation of the Surface Deflection Matrix in Elastohydrodynamic Point Contacts

J. M. de Mul and J. J. Kalker

The discussers can recommend the basic approach taken by the author to reduce the computational work involved with calculating the matrix of influence coefficients for a bounded rectangular grid on the surface of a half space loaded by stresses that are uniform over each element. The crux of the matter is to avoid the lengthy integration that appears in the formulation of the influence coefficients by approximation of the integrand to a constant value for each element. This principle has already been used by the discussers since 1981 and was published by de Mul et al., reference [D], Appendix 1, equation (13).

However, to obtain sufficient accuracy, they proceed in a different way. Rather than adopting an ad hoc decrease of the “influence distance” as is done by the author, they employ the rationale of retaining exact integration in the region of major influence, i.e., at and close to the loading element under consideration, reference [D], Appendix 1, equation (12).

Concerning the relationship of the computational effort with the total number of surface elements in the mesh, \( N \), the author states that this effort is proportional to \( N^2 \). Although this does indeed apply to a general, irregular grid of surface elements (which are still rectangular each), the discussers would like to point out the advantage that can be gained with a regular grid of identical rectangular elements. With such a mesh symmetry relations can be exploited and the computational work is then about proportional to \( N \). For the special case of a square patch of identical square elements a further reduction of around 50 percent occurs.

Additional Reference


Author’s Closure

The author would like to thank Drs. de Mul and Kalker for their interest in this paper. His response to their comments is as follows.

The author acknowledges that the principle formulation presented in this paper is essentially the same as that used in reference [D]. However, the assumption of uniform pressure over each rectangular element, which is made in reference [D], is unnecessary.

At a later time, the author recognized, and could not agree more with, the idea that an analytical integration should be carried out over the region surrounding the singularity. This is the most reliable way to achieve high accuracy without loss of computational efficiency.

The author is fully aware of the computational and storage advantages of using identical rectangular elements. Unfortunately, the disadvantages of using such a discretization scheme in solving EHD problems can often outweigh the advantages. This topic is beyond the scope of this paper.

Micro Elastohydrodynamic Lubrication of an Elliptical Contact With Transverse and Three Dimensional Sinusoidal Roughness

William R. D. Wilson

The elegant analysis presented by the authors sheds more light on the murky problem of the lubrication of rough surfaces in highly loaded conjunctions. Their finding that asperities are essentially “flattened” by hydrodynamic action seems to contradict the widely accepted idea that asperities penetrate the lubricant film with potential for metal-to-metal contact. However, it does fit in with the idea proposed by Dyson (1976) that failure will not occur if the lubricant around the asperities is sufficiently pressurized to increase its viscosity significantly.

The analysis presented is for simple sliding. Presumably there would be less tendency to flatten asperities in cases ap-