Multiple Inhomogeneous Inclusions under Mixed Lubricated Contact

Q. Dong¹, K. Zhou¹, and Leon M. Keer²

¹School of Mechanical and Aerospace Engineering, Nanyang Technological University, 50 Nanyang Avenue, Singapore 639798, Singapore.
²Department of Mechanical Engineering, Northwestern University, 2145 Sheridan Road Tech A319 Evanston, IL 60208-3109, USA.

Most machine components are operated in the mixed lubricated region, which consists of solid direct contact and fluid-solid contact. This lubrication regime is termed as mixed elastohydrodynamic lubrication (EHL). Generally, materials of components in lubricated contact are assumed to be homogeneous. However, the materials are naturally inhomogeneous, consisting of micro-defects, such as inclusions and voids. This study develops a semi-analytical solution to simulate multiple inhomogeneous inclusions in a half-space with lubricants between contacting surfaces. In formulating the governing equation, each inhomogeneous inclusion embedded under the contacting surfaces is modeled as a homogeneous inclusion with initial eigenstrains plus unknown equivalent eigenstrains by employing Eshelby's equivalent inclusion method. With such a treatment, the interactions between the lubricant and the structure and interactions among all inhomogeneous inclusions on the fluid pressure and lubricant film thickness profiles of EHL contact, and the subsurface stresses are analyzed to evaluate the tribological performance for contacting components.

Keywords: Mixed elastohydrodynamic lubrication (EHL), inhomogeneous inclusions, equivalent inclusion method, contact