# Partial Slip in Contact of an Elastic Quarter-Space

Qiang Li

*Institute of Mechanics, Technische Universität Berlin, 10623, Germany*

In contact mechanics, many classical elastic contact theories, such as Hertzian theory, are based on half-space assumptions and therefore do not account for boundary-induced edge effects. However, in many engineering applications—such as gears, bearings, and indentations near specimen edges—contact frequently occurs in the vicinity of free surfaces, where stress and deformation fields are strongly influenced by nearby boundaries. The elastic quarter-space, a semi-infinite body bounded by two orthogonal free surfaces, provides a fundamental model for analyzing such edge effects. While recent studies have addressed normal contact on elastic quarter-spaces, both with and without adhesion [1–3], tangential contact remains relatively unexplored.

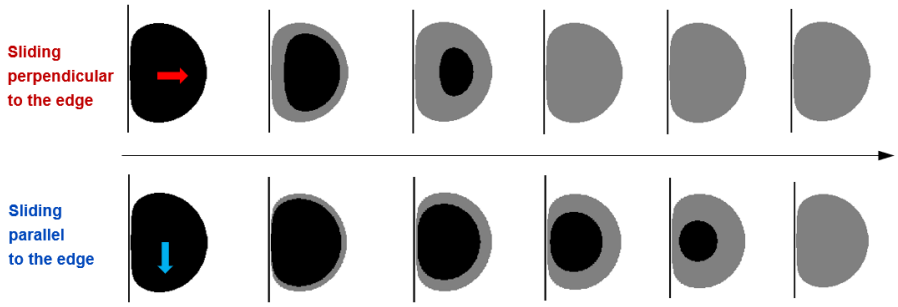


Figure 1: Evolution of stick (black) and slip (gray) region during sliding. Above: Sliding perpendicular to the edge; below: sliding parallel to the edge.

In this work, we investigate the partial-slip behavior of a rigid parabolic indenter in contact with an elastic quarter-space. Heténi's method of overlapping two elastic half-spaces is extended to incorporate tangential loading applied to both the top and side surfaces. Equivalent stress distributions on the half-spaces are derived and used to evaluate contact tractions and subsurface stress fields. The method is then applied to analyze partial slip under Coulomb friction, with particular emphasis on the influence of edge proximity on stick–slip transitions.

In this presentation, we focus on a simplified contact configuration in which the side surface is not completely free, but its displacement in the direction perpendicular to the edge is constrained. Under this boundary condition, the contact solution can be obtained in a straightforward manner. Two sliding directions are considered, as illustrated in Figure 1, to examine the effect of indenter location. It is found that the maximum tangential displacement until the gross sliding is nearly independent of the indenter position when sliding occurs parallel to the edge. In contrast, when sliding is perpendicular to the edge, the critical displacement is reduced and becomes strongly location-dependent. The limitations of the proposed model will also be discussed.

*References*

[1] Q. Li, P. Edge effect and indentation depth-dependent contact behavior in contact of an elastic quarter-space, *Int. J. Solids Struct.*, 285: 112552, 2023.

[2] Q. Li, V.L. Popov, Non-adhesive and adhesive contacts of an elastic quarter-or eighth-space with freely sliding sides, *Friction*, 12: 2052–2063, 2024.

[3] Q. Li, S. Jiang, V.L. Popov, Edge Effects in Adhesive and Non-Adhesive Indentation: Experimental and Numerical Insights, *Eur. J. Mech. A/Solids*., 116: 105891, 2025.