Analytical Derivation for Infinitesimal Elastic Response of Rounded Components

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Abstract

We develop a new analytical framework, verified via the simulations, for obtaining the stiffness behavior of the components with radial geometry, during their linear elastic behavior. Due to curved contact geometry, the interface and inner region respond differently to the applied load, and hence we decompose the deflection into two terms of surface and bulk deformation. The cumulative force-deflection behavior of the component is analyzed and verified with the finite element simulations. The obtained stiffness framework could be utilized as a simplified and practical tool for predicting the compliance behavior of the components with circular shapes.

Keywords: Rounded geometry, contact mechanics, stiffness, elastic behavior.

Nomenclature

Symbol	Description
$\delta_{TOT}, \delta_S, \delta_B$	Total/Surface/Bulk deflection (m)
$A\,(\delta_S)$	Flattened area (m^2)
b	In-plane thickness (m)
R	Radius (m)
E	Elastic modulus (Pa)
x, y	horizontal, vertical variables

Symbol	Description
$\epsilon_{TOT}, \epsilon_S, \epsilon_B$	Total/Surface/Bulk strain
ϵ_y	Yield strain
θ	Angle from vertical axis (rad)
F	Applied force (N)
ν	Poisson ratio
σ_y	Yield stress (Pa)

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