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Slipper Gap Force Calculation Documentation

Overview

The SlipperCalcHolder function calculates forces acting on a slipper gap using different hold-down mechanisms. Base total force calculation: Total Force (Ftot) = Slipper Force (Fslipper) / Number of pistons (npistons)

Hold-Down Mechanisms

1. Passive Hold-Down (SlipHD = 0)

Forces are calculated based on gap height relative to maximum allowable gap. For each point i (where i = 1,2,3): If xg[i] > hmaxG: F[i] = (xg[i] - hmaxG) * HoldDownStiffness Else: F[i] = 0 Where: * xg[i] = Gap height at point i * hmaxG = Maximum allowable gap height * HoldDownStiffness = Hold-down stiffness coefficient

2. Active Hold-Down (SlipHD = 1)

Force is distributed equally: For each point i (i = 1,2,3): F[i] = Ftot / 3

3. Combined Active and Passive (SlipHD = 2)

Forces depend on maximum gap distance: hT = h + ehd - hgroove * 5e-6 maxdist = maximum(hT) - minimum(hT)

When maxdist < lower threshold (5μm):

For each point i (i = 1,2,3): F[i] = Ftot / 3

When maxdist ≥ lower threshold:

Force Components: Fu = ((upper - maxdist) / (upper - lower)) * Ftot Fp = Ftot - Fu Total Force Calculation: For each point i: F[i] = (Fu / 3) + x[i] + Additional Hold Down Force Where x[i] is solved from matrix equation Ax = b: b = [Fp, Fp*dy, -Fp*dx] Additional Hold Down Force: If xg[i] > hmaxG: = (xg[i] - hmaxG) * HoldDownStiffness Else: = 0

4. Legacy Mode (SlipHD = 3)

Spring Hold-Down (hmaxG < -999μm)

Forces based on gap distance: If maxdist < lower: Fu = Ftot Fp = 0 Else If maxdist > upper: Fp = Ftot Fu = 0 Else: Fp = (maxdist - lower) / (upper - lower) * Ftot Fu = Ftot - Fp For each point i: F[i] = (Fu / 3) + x[i] Where x[i] is solved from Ax = b: b = [Fp, Fp*dy, -Fp*dx]

Fixed Hold-Down (hmaxG ≥ -999μm)

Forces calculated using contact pressure: contact = maximum(0, hT - hmaxG) contactp = contact * (Fslipper / N) Fz = sum(contactp) Mx = sum(contactp * Ly) My = sum(-contactp * Lx) Solve Ax = b where b = [Fz, Mx, My] F[i] = x[i]

Key Parameters

Parameter Description Unit Fslipper Total slipper force N npistons Number of pistons - hmaxG Maximum allowable gap height m HoldDownStiffness Hold-down stiffness coefficient N/m upper Upper threshold 10 μm lower Lower threshold 5 μm hgroove Groove height m ehd EHD height adjustment m Lx, Ly Position coordinates m

Units and Conventions

All distances are in meters (m) unless specified in micrometers (μm) Forces are measured in Newtons (N) Stiffness is measured in Newtons per meter (N/m) Variable names match the original code for clarity Matrix equations use standard notation: Ax = b Arrays are zero-indexed

Notes

The function handles four different hold-down mechanisms Transitions between mechanisms are discrete based on SlipHD parameter Matrix A is assumed to be non-singular for all solutions Contact calculations use element-wise operations on arrays