Compression of Soft Elastomers

Student: Cindi Feng

Project Sponsor: Mattia Bacca

Project Period: September 2018 – April 2019

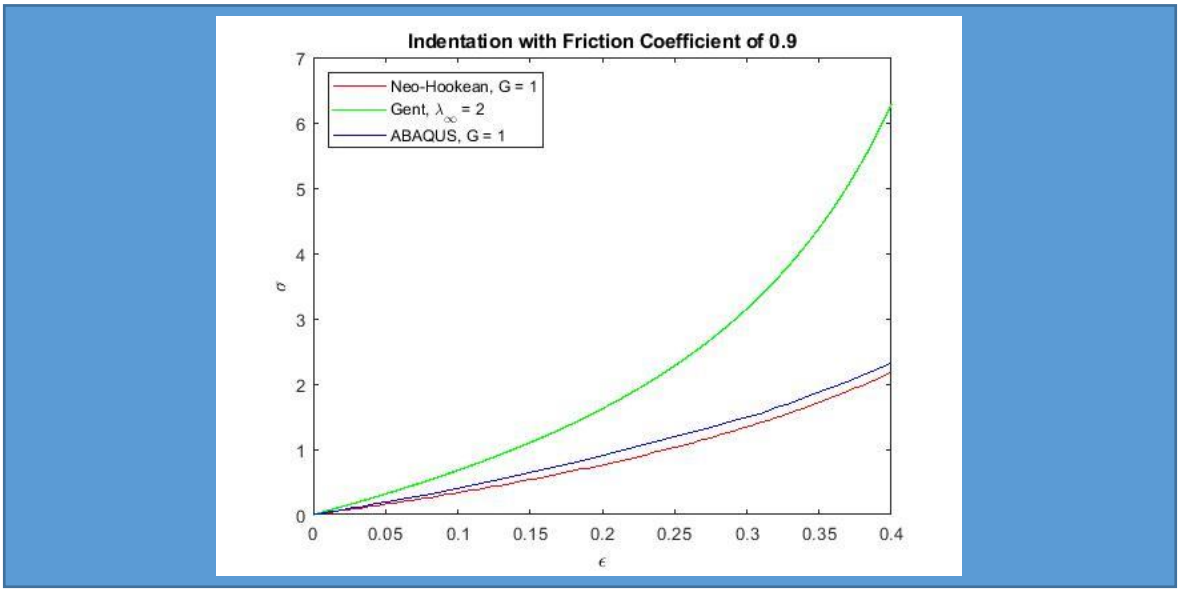

Figure 1: Semi-infinite plate compression simulation on hyperelastic material to highlight effects of friction and enthalpic stiffness.

The goal of the project is to select a soft elastomer to represent human skin and to develop a force evolution graph to relate material properties such as stiffness and fracture toughness to the critical penetration force. Silicone, a prevalent rubber used to imitate human dermis, is chosen as the test material. Prior to penetration testing, the mechanical properties of silicone, specifically, Young's modulus, need to be validated and confirmed reproducible for all silicone fabricated. Compression testing is proposed as the method for determining Young's modulus. Simulations are conducted to confirm the viability of compression testing due to the possibly large deviations caused by friction and enthapic stiffness. As shown in Figure 1, the ABAQUS model closely aligns with the Neo-Hookean model at small strains, which suggests that friction is negligible at the beginning. Effect of enthalpic stiffness is represented by the Gent model, which appears to cause significant deviation as strains increase and at small chain extensibility constraint, λ_∞. However, since λ_∞ is material dependent, the silicone needs to be tested to accurately simulate the effect of enthalpic stiffness.