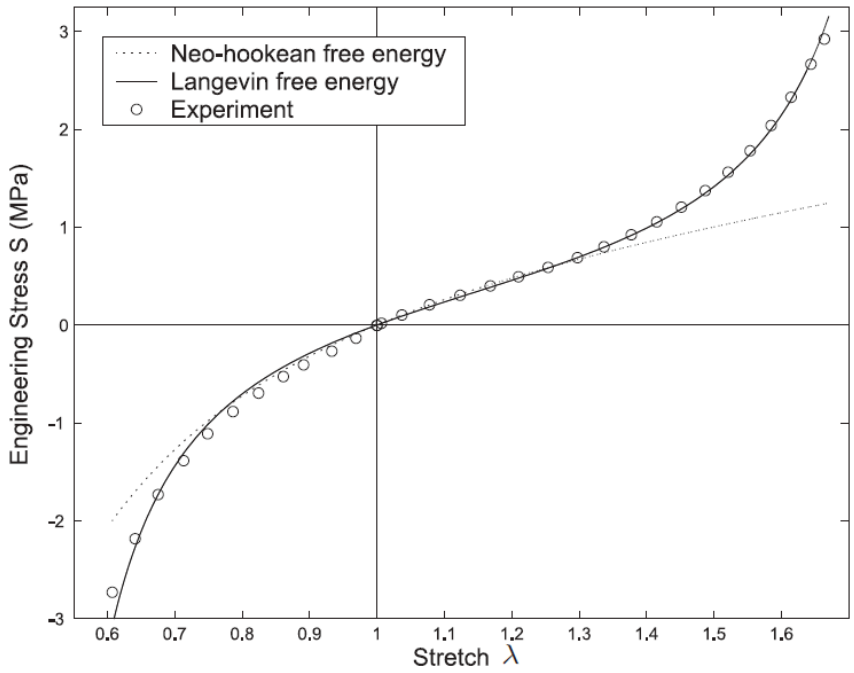
Team Adidas
Team Deliverable #2

Materials Sub Team

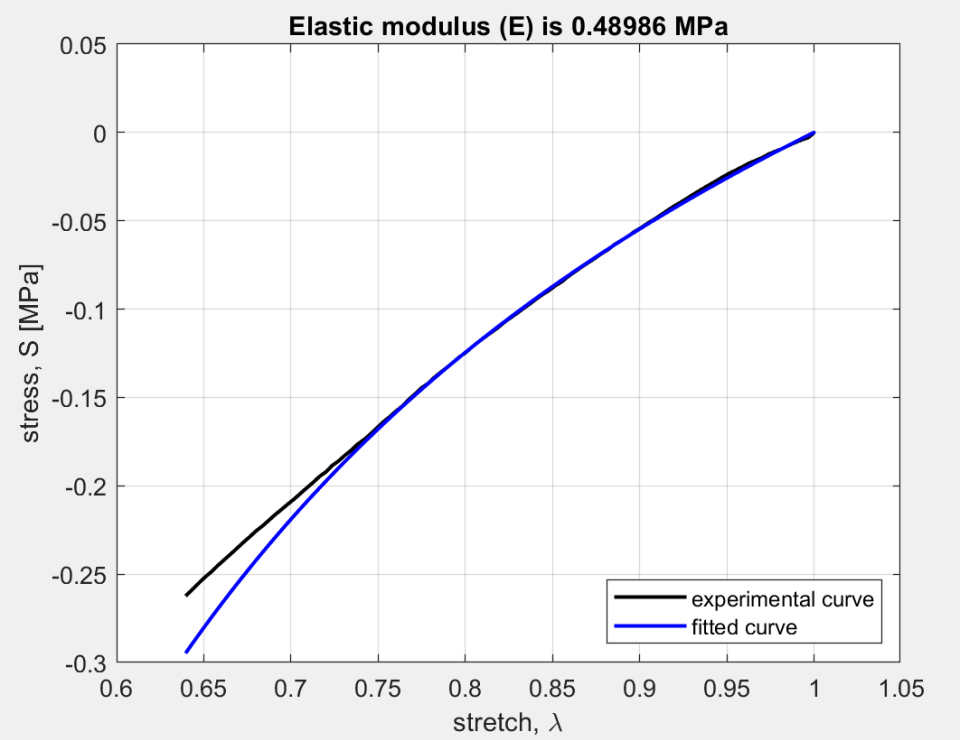
1. Background on Neo-hookean Model



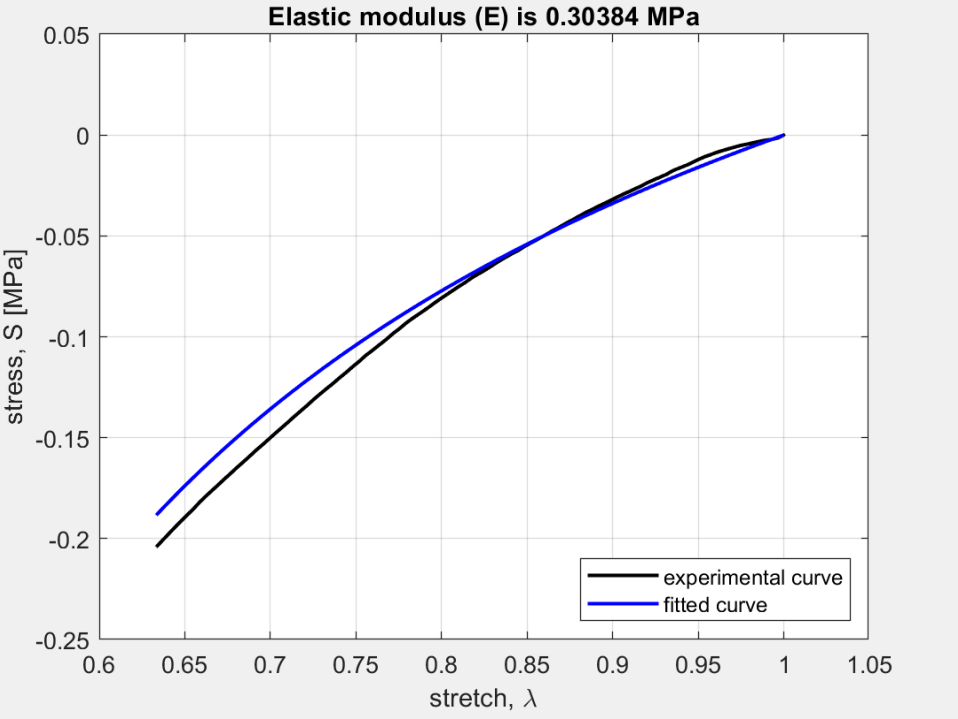
"A neo-Hookean solid is a hyperelastic material model, similar to Hooke's law, that can be used for predicting the nonlinear stress-strain behavior of materials undergoing large deformations[1]" After taking the data from the different Adidas materials that Keith sent to us and converting the load and position values to equivalent engineering stress and stretch values, we decided that the Neo-hookean model best represented the experimental data. Fitted results and associated material moduli can be seen below. It is important to note that the model fits best with the experimental data between stretch values of 0.8 and 1.0.

2. Fitted Results

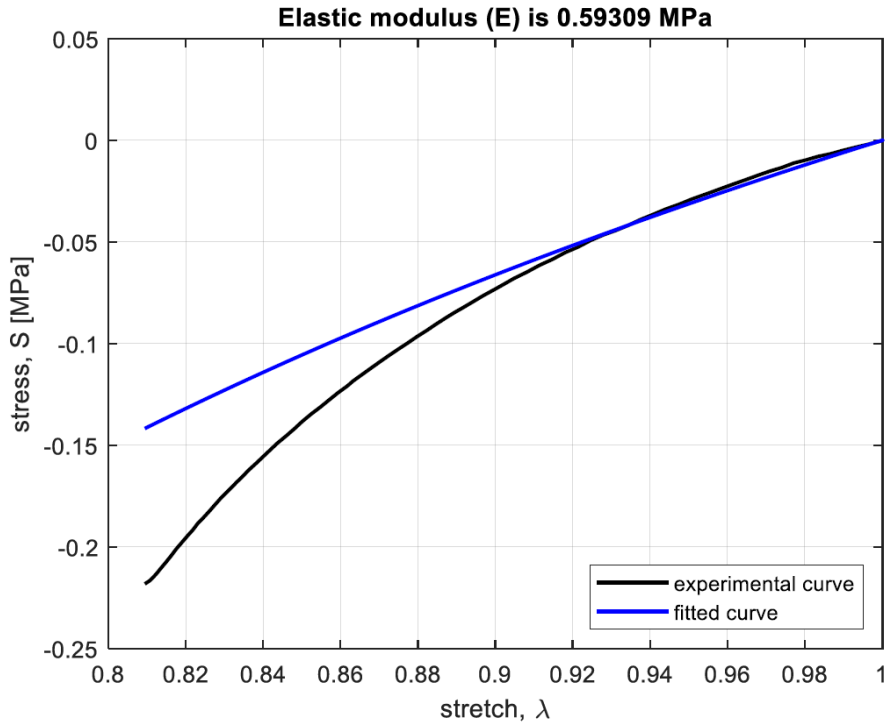
1_EVA_50C



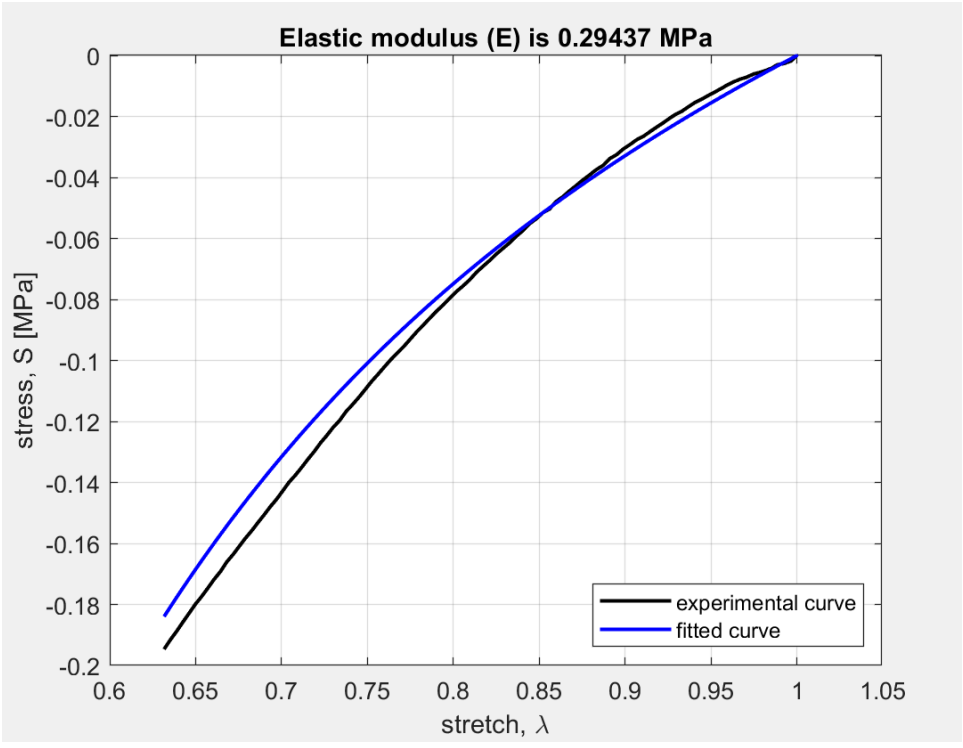
3_Foam_E



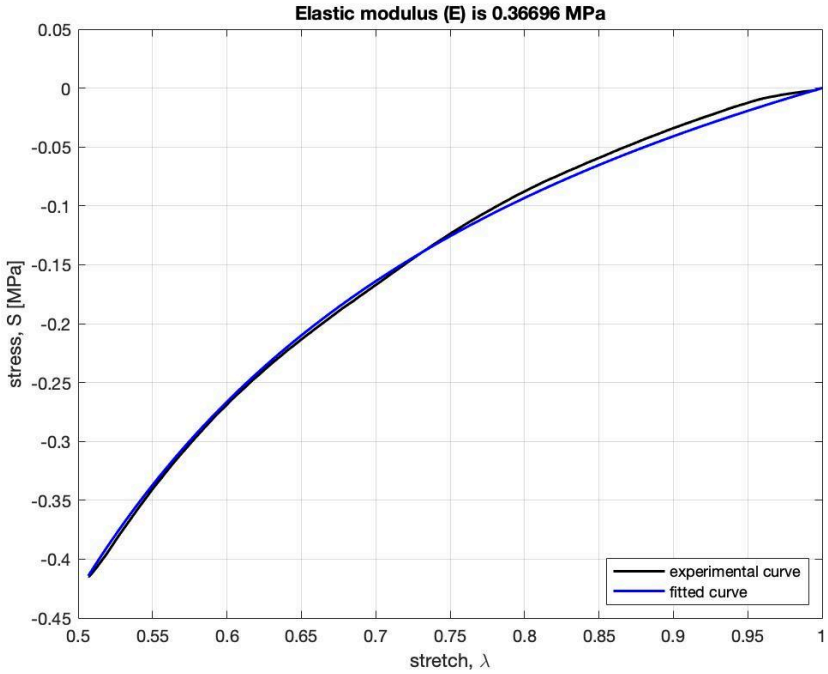
6_PU


Elastic modulus (E) is 0.59309 MPa
stress, S [MPa]
stretch, λ
experimental curve
fitted curve
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
0.8
0.82
0.84
0.86
0.88
0.9
0.92
0.94
0.96
0.98
1

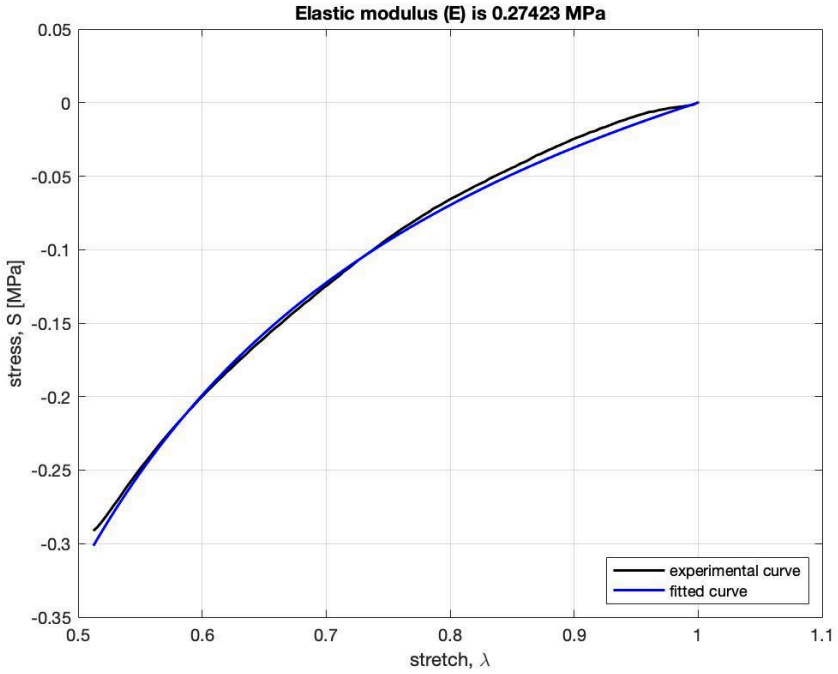
8_PF1


Elastic modulus (E) is 0.29437 MPa
stress, S [MPa]
stretch, λ
experimental curve
fitted curve
0
-0.02
-0.04
-0.06
-0.08
-0.1
-0.12
-0.14
-0.16
-0.18
-0.2
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
1.05

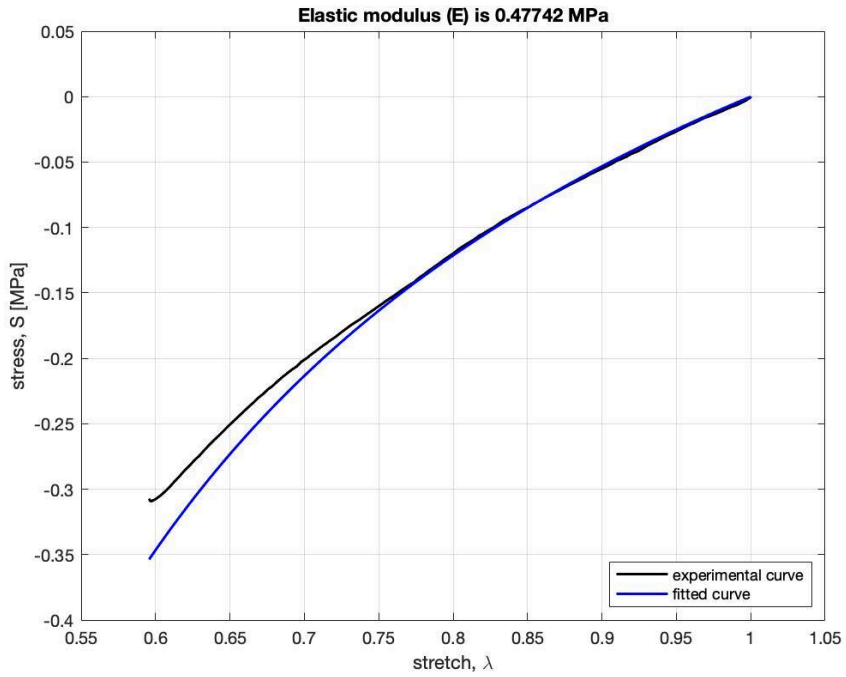
9_PF3


Elastic modulus (E) is 0.36696 MPa
stress, S [MPa]
stretch, λ
experimental curve
fitted curve

11_PF2


Elastic modulus (E) is 0.27423 MPa
stress, S [MPa]
stretch, λ
experimental curve
fitted curve

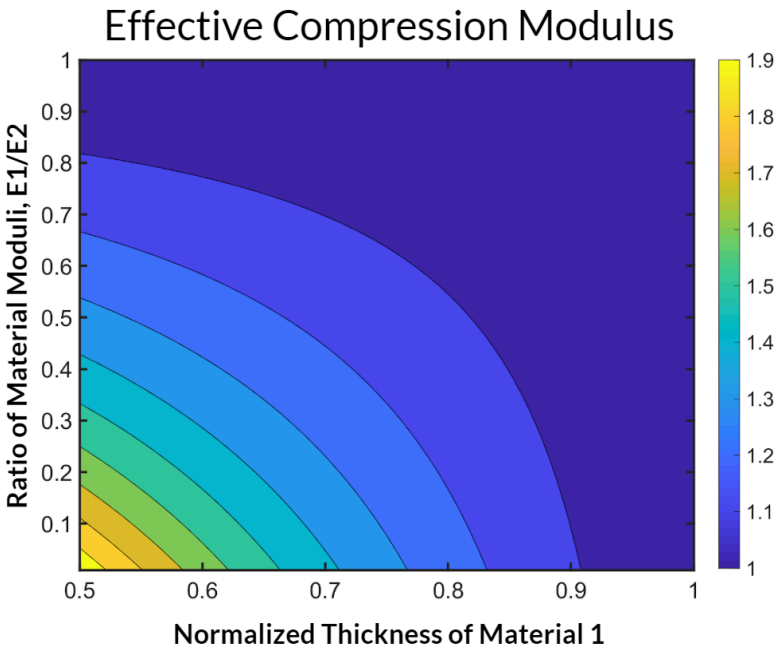
17_EVA_52C

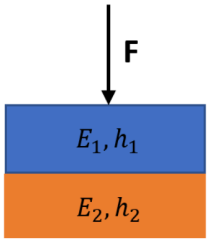


Significance of fitted curve

Given experimental data from a series of compression tests, we are able to model the material's behavior using a Neo-Hookean model. This behavior allows us to determine the effective compression modulus as a function of strain. This effective compression modulus can then be passed into the Mechanics Sub-Team's function for calculating a stack's overall effective bending modulus.

Mechanics Sub Team



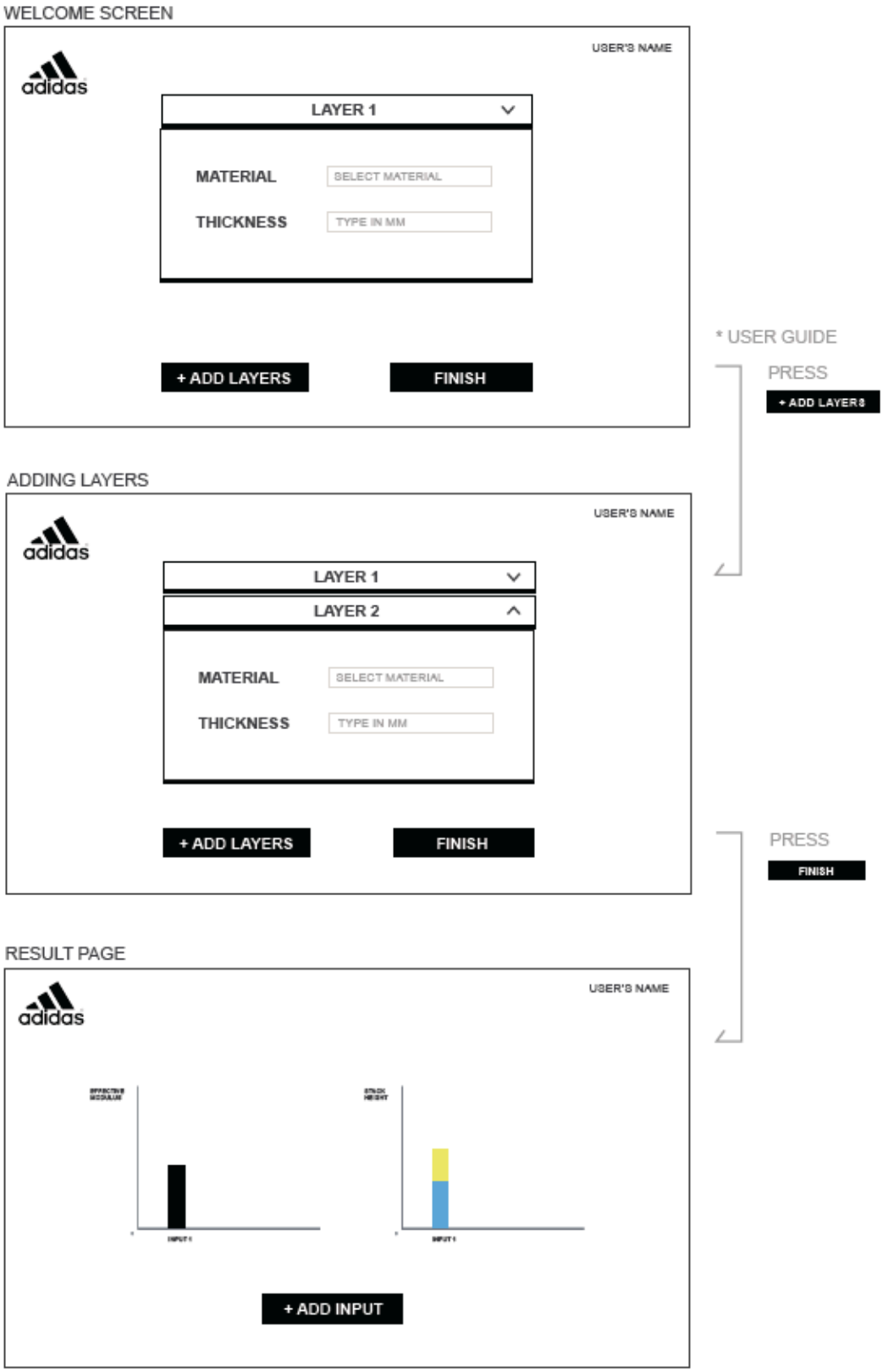


$$\widehat{E_{eff}} = \frac{1}{h_1^{eff} + E_R h_2^{eff}}$$

$$\widehat{E_{eff}} = \frac{E_{eff}}{E_1}, h_1^{eff} = \frac{h_1}{h_{total}}, h_2^{eff} = \frac{h_2}{h_{total}}, E_R = \frac{E_1}{E_2}$$

Using the computed moduli from the fitted curves, we can compute the effective bending modulus for two materials with the relation above. The contour plot can help in choosing an optimal combination of materials and stack heights given a desired effective bending modulus.

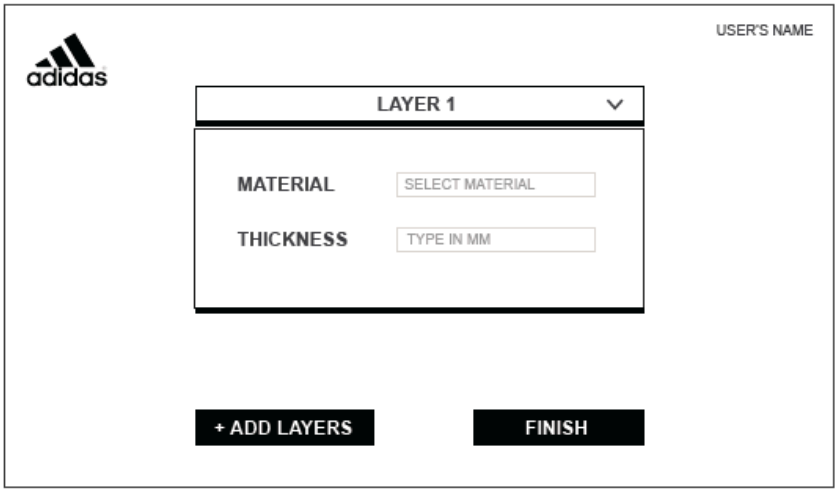
User Interface Sub Team



PRESS

+ ADD INPUT

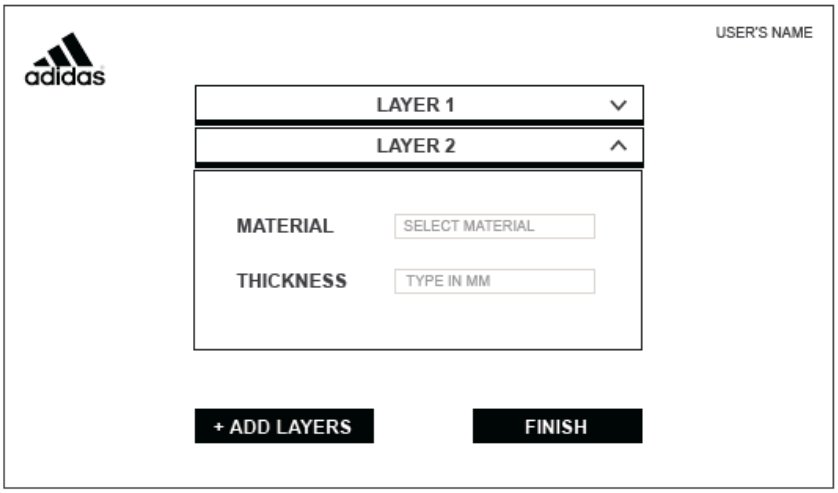
BACK TO INPUTS



PRESS

+ ADD LAYERS

ADDING INPUTS



PRESS

FINISH

GRAPHS IN COMPARISON