

Supplementary materials

Functional significance of graded properties of insect cuticle supported by an evolutionary analysis

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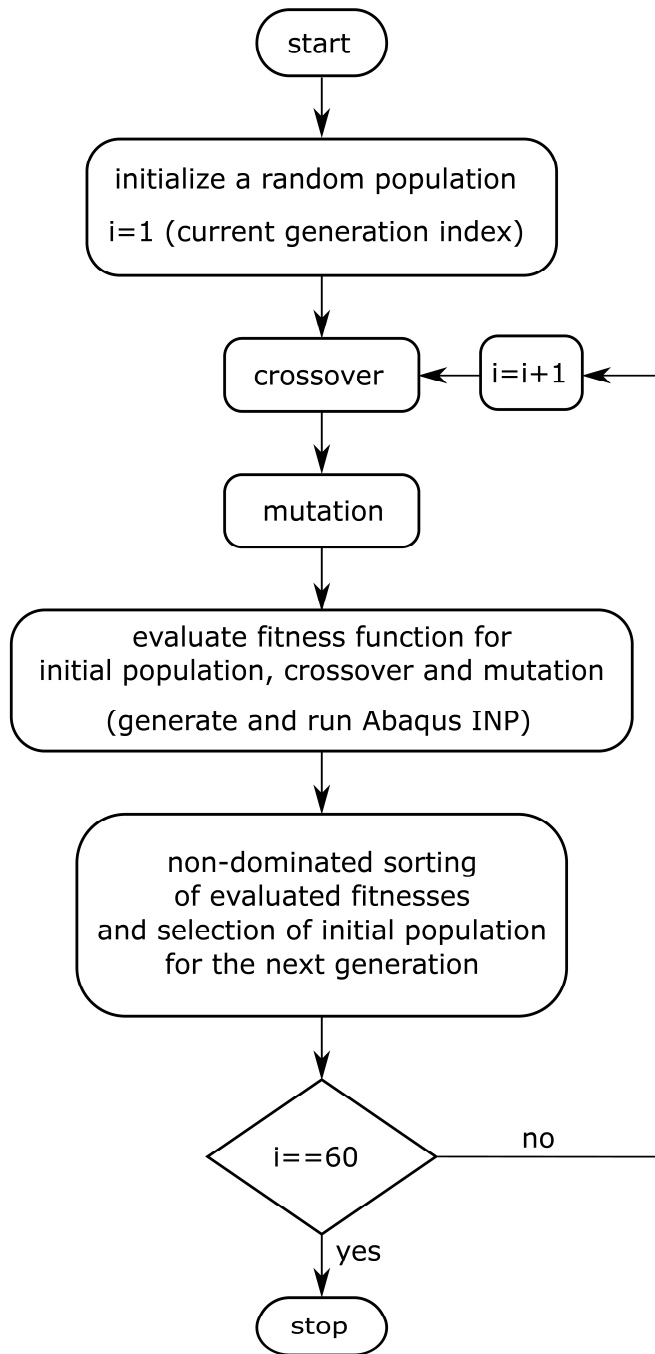


Fig. S1: Flowchart of the genetic algorithm (GA).

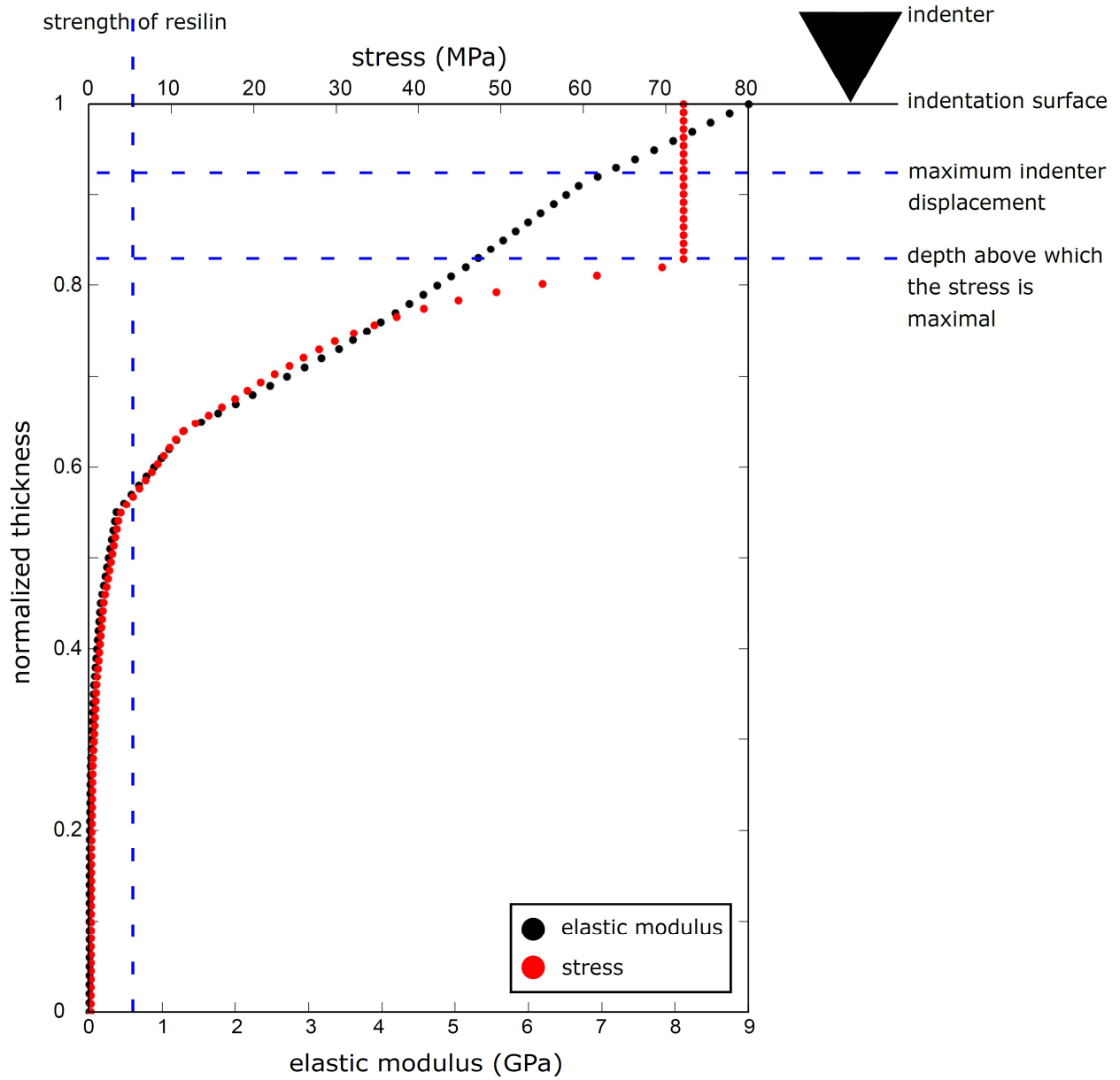


Fig. S2: Variation of the stress with depth in a representative optimal model. The stress is the greatest in a region beneath the indenter and quickly drops below the strength of constituent components.

Table S1: Normalized root mean square error (NRMSE) of standard functions in prediction of optimal gradients. C-EXP, continuous exponential function; C-LG, continuous logistic function; C-LIN, continuous linear function; DC-CST, discontinuous constant function; DC-EXP, discontinuous exponential function; DC-LIN, discontinuous linear function; s.d., standard deviation.

model	NRMSE	
	mean	s.d.
C-LIN	0.38	0.07
C-EXP	0.14	0.07
C-LG	0.20	0.03
DC-LIN	0.07	0.02
DC-EXP	0.04	0.02
DC-CST	0.10	0.04

Table S2: Normalized root mean square error (NRMSE) of standard functions in prediction of the mean values of the optimal gradients. C-EXP, continuous exponential function; C-LG, continuous logistic function; C-LIN, continuous linear function; DC-CST, discontinuous constant function; DC-EXP, discontinuous exponential function; DC-LIN, discontinuous linear function.

model	NRMSE	
	mean	
C-LIN	0.36	
C-EXP	0.08	
C-LG	0.19	
DC-LIN	0.06	
DC-EXP	0.03	
DC-CST	0.11	

Video S1: Loading and unloading on a representative model. The video shows the deformation of the model and the stress within it during loading and after unloading.

Data S1: Results of the GA. The excel file contains optimization objectives, optimization variables, and thickness of the layers of the optimal cuticles.

Data S2: ABAQUS *.inp* file. The file contains details of a representative optimal model.