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2 **Supplementary Information for**

3 **Nonlinear elasticity and damping govern ultrafast dynamics in click beetles**

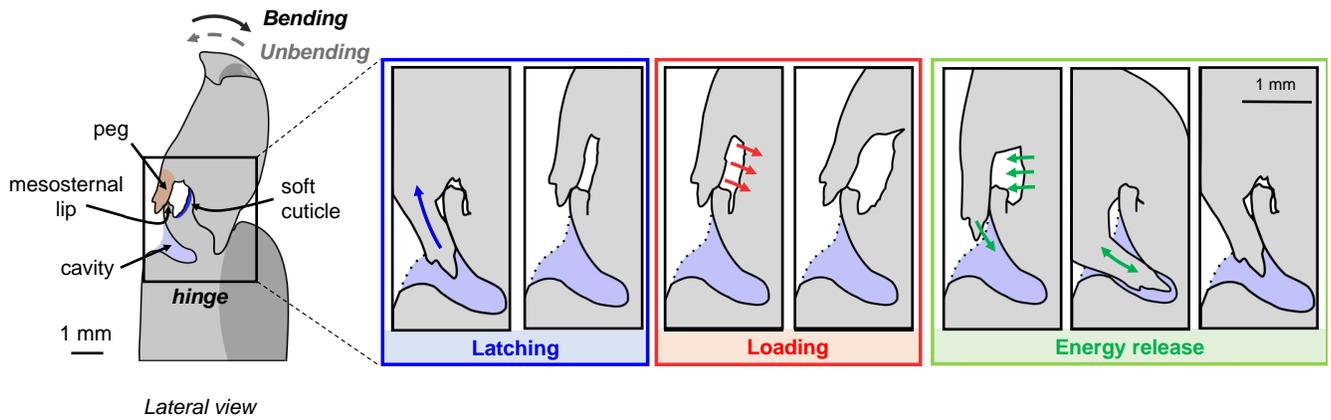
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5 **This PDF file includes:**

- 6 Figs. S1 to S2
- 7 Tables S1 to S2
- 8 Legends for Movies S1 to S2

9 **Other supplementary materials for this manuscript include the following:**

- 10 Movies S1 to S2



Lateral view

Fig. S1. Trace out of the lateral x-ray images extracted from the recordings during the three phases of the clicking motion.

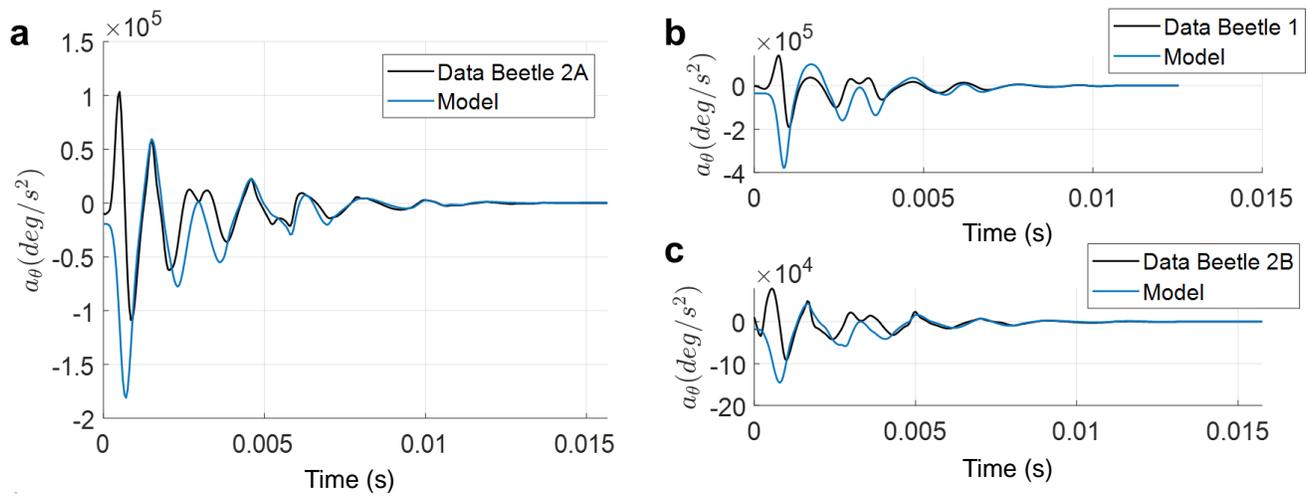


Fig. S2. Predicted circumferential acceleration for specimen 2 release A (Beetle 2A) (a), specimen 1 (Beetle 1)(b) and specimen 2 release B (Beetle 2B) (c). The model results, shown in blue, are calculated using Eq. 1, and G and F, outputted by the system identification analysis for Beetle 2A. Experimental data is shown in black for each release.

Table S1. Body length, mass, and high speed recording information of the four click beetles specimen studied. A full click includes the latching, loading and release phases.

Specimen	Body length (mm)	Mass (mg)	High speed synchrotron x-ray recordings
1	17.1	109	1 full click recorded at 30,000 fps
2	16.7	114	1 full click and 1 release recorded at 20,000 fps
3	19.4	197	7 full clicks recorded at 1,000 fps
4	16.6	123	8 full clicks recorded at 1,000 fps

Table S2. Maximum speed, acceleration, normalized speed, and normalized acceleration for all the clicks recorded. The speed is normalized with respect to the peg length and the acceleration with respect to the gravitational acceleration.

Click number	V_{max} (mm/s)	A_{max} (mm/s^2)	V_{max}/l (s^{-1})	A_{max}/g
Specimen 1 click A	$1.8 * 10^3$	$4.1 * 10^6$	$9.9 * 10^2$	420
Specimen 2 click A	$1.5 * 10^3$	$5.2 * 10^6$	$8.5 * 10^2$	530
Specimen 2 click B	$1.4 * 10^3$	$4.7 * 10^6$	$7.7 * 10^2$	480

- ¹¹ **Movie S1.** X-ray video of the hinge of specimen 1 during the clicking motion (latching, loading and energy
¹² release phases). Video recorded at 30,000 fps. Playback speed: 1598 fps.
- ¹³ **Movie S2.** X-ray video of the hinge of specimen 1 during the energy release phase. Video recorded at 30,000
¹⁴ fps. Playback speed: 20 fps.