

**Table S1. Statistical parameters derived from linear mixed-effects models demonstrating the statistical importance of various fixed effects. Values in bold illustrate fixed effects that significantly influence each respective response variable.**

Response variable	Fixed effect	Estimate	Standard Error	<i>t</i> value	<i>F</i> value	<i>P</i> value
Peak braking force <i>CV</i> *	(Intercept)	1.28	0.17	-	-	-
	Golgi tendon organ morphology	0.58	0.09	6.56	37.19	< <b>0.001</b>
	Substrate	0.27	0.08	3.43	10.24	<b>0.002</b>
	Dimensionless speed	-0.04	0.14	-0.27	0.02	0.892
	Count	0.00	0.00	1.26	1.71	0.195
	Dimensionless speed <i>CV</i> *	0.12	0.07	1.71	2.41	0.123
	Mass	-0.08	0.05	-1.55	2.16	0.148
Peak propulsive force <i>CV</i> *	(Intercept)	1.11	0.14	-	-	-
	Golgi tendon organ morphology	0.44	0.08	5.45	29.72	< <b>0.001</b>
	Substrate	0.10	0.07	1.37	1.87	0.178
	Dimensionless speed	0.00	0.13	0.03	0.00	0.979
	Count	0.00	0.00	1.72	2.97	0.088
	Dimensionless speed <i>CV</i> *	0.15	0.05	2.78	7.72	<b>0.006</b>
	Mass	-0.05	0.04	-1.03	1.07	0.306
Peak medial force <i>CV</i> *	(Intercept)	1.53	0.16	-	-	-
	Golgi tendon organ morphology	0.24	0.08	2.96	8.74	<b>0.005</b>
	Substrate	-0.07	0.07	-0.95	0.90	0.349
	Dimensionless speed	0.07	0.13	0.53	0.28	0.597
	Count	0.01	0.00	3.08	9.50	<b>0.003</b>
	Dimensionless speed <i>CV</i> *	0.07	0.06	1.18	1.38	0.241
	Mass	0.06	0.05	1.23	1.50	0.227
Peak lateral force <i>CV</i> *	(Intercept)	1.59	0.14	-	-	-
	Golgi tendon organ morphology	0.16	0.08	2.04	4.17	<b>0.047</b>

	Substrate	0.32	0.07	4.74	22.49	< <b>0.001</b>
	Dimensionless speed	0.25	0.12	2.05	4.20	<b>0.046</b>
	Count	0.01	0.00	2.94	8.66	<b>0.004</b>
	Dimensionless speed <i>CV</i> *	0.03	0.06	0.59	0.35	0.555
	Mass	-0.09	0.05	-1.90	3.60	0.063
	Contact time	0.38	0.16	2.35	5.52	<b>0.022</b>
	(Intercept)	0.72	0.15	-	-	-
Peak vertical force <i>CV</i> *	Golgi tendon organ morphology	0.24	0.09	2.56	6.57	<b>0.014</b>
	Substrate	-0.12	0.08	-1.48	2.18	0.147
	Dimensionless speed	0.11	0.14	0.75	0.56	0.458
	Count	0.00	0.00	1.59	2.54	0.114
	Dimensionless speed <i>CV</i> *	0.26	0.05	4.77	22.72	< <b>0.001</b>
	Mass	-0.04	0.05	-0.83	0.68	0.413
	Contact time	-0.10	0.19	-0.51	0.26	0.609
Timing of peak braking force <i>CV</i> *	(Intercept)	1.43	0.12	-	-	-
	Golgi tendon organ morphology	0.33	0.08	4.39	19.27	< <b>0.001</b>
	Substrate	0.17	0.07	2.49	6.22	<b>0.016</b>
	Dimensionless speed	-0.06	0.11	-0.57	0.32	0.573
	Count	0.00	0.00	0.69	0.48	0.491
	Dimensionless speed <i>CV</i> *	0.09	0.04	2.17	4.70	<b>0.032</b>
	Mass	-0.14	0.04	-3.17	10.08	<b>0.002</b>
Contact time	0.24	0.15	1.59	2.52	0.116	
Timing of braking to propulsive transition <i>CV</i> *	(Intercept)	1.12	0.12	-	-	-
	Golgi tendon organ morphology	0.39	0.07	5.49	27.62	< <b>0.001</b>
	Substrate	0.40	0.06	6.25	34.45	< <b>0.001</b>
	Dimensionless speed	-0.19	0.11	-1.73	2.67	0.11
	Count	0.00	0.00	0.48	0.29	0.59
	Dimensionless speed <i>CV</i> *	0.05	0.04	1.26	1.77	0.19
	Mass	-0.17	0.04	-4.03	13.81	< <b>0.001</b>
Contact time	0.09	0.15	-0.61	0.28	0.60	
Timing of peak	(Intercept)	0.78	0.13	-	-	-
	Golgi tendon organ morphology	0.40	0.07	5.84	34.09	< <b>0.001</b>

propulsive force CV*	Substrate	0.35	0.06	5.84	34.05	< <b>0.001</b>
	Dimensionless speed	-0.19	0.11	-1.78	3.16	0.083
	Count	0.00	0.00	-0.27	0.07	0.788
	Dimensionless speed CV*	0.14	0.05	2.69	7.25	<b>0.008</b>
	Mass	-0.12	0.04	-2.94	8.66	<b>0.005</b>
	Contact time	0.05	0.15	0.36	0.13	0.722
Timing of peak medial force CV*	(Intercept)	1.80	0.16	-	-	-
	Golgi tendon organ morphology	0.22	0.10	2.31	5.32	<b>0.025</b>
	Substrate	0.03	0.09	0.33	0.11	0.743
	Dimensionless speed	-0.06	0.15	-0.43	0.19	0.668
	Count	0.00	0.00	0.98	0.96	0.329
	Dimensionless speed CV*	-0.11	0.06	-1.88	3.53	0.062
	Mass	0.02	0.06	0.30	0.09	0.762
	Contact time	0.01	0.20	0.04	0.00	0.967
Timing of peak lateral force CV*	(Intercept)	1.97	0.12	-	-	-
	Golgi tendon organ morphology	-0.10	0.06	-1.75	3.06	0.087
	Substrate	0.33	0.05	6.24	38.95	< <b>0.001</b>
	Dimensionless speed	0.07	0.09	0.79	0.63	0.433
	Count	0.00	0.00	2.53	6.38	<b>0.015</b>
	Dimensionless speed CV*	-0.13	0.05	-2.72	7.42	<b>0.007</b>
	Mass	-0.07	0.04	-1.85	3.42	0.071
	Contact time	0.48	0.13	3.77	14.20	< <b>0.001</b>
Timing of peak vertical force CV*	(Intercept)	1.59	0.15	-	-	-
	Golgi tendon organ morphology	0.01	0.09	0.13	0.02	0.896
	Substrate	-0.09	0.08	-1.11	1.23	0.273
	Dimensionless speed	0.06	0.14	0.41	0.17	0.682
	Count	0.00	0.00	1.09	1.18	0.280
	Dimensionless speed CV*	-0.03	0.05	-0.60	0.36	0.547
	Mass	-0.13	0.05	-2.56	6.53	<b>0.013</b>
	Contact time	0.24	0.18	1.36	1.84	0.179

Information not pertinent.

**Table S2: Evolutionary models fit to log<sub>10</sub> limb loading and stride cycle CV\* with intraspecific sampling included in the model.** Bolded models have the most support. Values presented are mean ± standard deviation based on running the analysis on 100 trees to account for phylogenetic uncertainty. Variables defined as follows:  $\sigma^2$  = Brownian motion rate parameter,  $\alpha$  = strength of pull towards trait optimum under OU model,  $T_{1/2}$  = phylogenetic half-life,  $\theta$  = trait optima. Models as follows: BM1 = single rate Brownian motion, BM-M = two rate Brownian motion, OU-1 = single optimum Ornstein-Uhlenbeck, OU-M = two optima Ornstein-Uhlenbeck.

Variable	Model	$\sigma$	$\alpha$	$T_{1/2}$	$\theta$	Akaike's information criterion	Akaike Weights
Peak braking force CV*	BM1	1.7e-04±6.4e-07			1.5±0.00	78.1±0.02	0.21±0.00
	<b>BM-M</b>	<b>1.5e-11±3.1e-11</b> <b>5.0e-04±2.9e-06</b>			<b>1.7±0.00</b>	<b>77.1±0.04</b>	<b>0.34±0.00</b>
	OU-1	6.0e-04±2.6e-06	0.0077±0.00003	90	1.5±0.00	79.0±0.03	0.13±0.00
	OU-M	3.9e-04±2.1e-06	0.0110±0.00005	63	1.7±0.00 1.2±0.00	77.2±0.01	0.32±0.00
Peak propulsive force CV*	<b>BM1</b>	<b>9.5e-19±9.4e-18</b>			<b>1.5±0.00</b>	<b>48.3±0.00</b>	<b>0.56±0.00</b>
	BM-M	1.7e-16±6.6e-16 1.9e-15±1.1e-14			1.5±0.00	50.5±0.00	0.18±0.00
	OU-1	5.3e-21±5.7e-21	0.0084±0.00002	83	1.5±0.00	50.5±0.00	0.18±0.00
	OU-M	3.4e-13±9.4e-13	1.2e-8±1.6e-8	5.8e7	1.5±0.00, 1.4e5±2.0e5	52.4±0.00	0.07±0.00
Peak medial force CV*	<b>BM1</b>	<b>2.5e-19±1.7e-18</b>			<b>1.7±0.00</b>	<b>64.1±0.00</b>	<b>0.57±0.00</b>
	BM-M	2.3e-15±6.9e-15 4.8e-15±1.0e-14			1.7±0.00	66.3±0.00	0.19±0.00
	OU-1	7.9e-22 ±1.6e-22	0.0073±6.0e-6	95	1.7±0.00	66.3±0.00	0.19±0.00
	OU-M	3.4e-12±7.6e-12	1.2e-8±1.8e-8	5.8e7	1.7±0.00 -3.1e5±3.8e+05	68.5±0.00	0.06±0.00
	<b>BM1</b>	<b>3.7e-17 ± 3.6e-16</b>			<b>1.6±0.00</b>	<b>55.0±0.00</b>	<b>0.57±0.00</b>

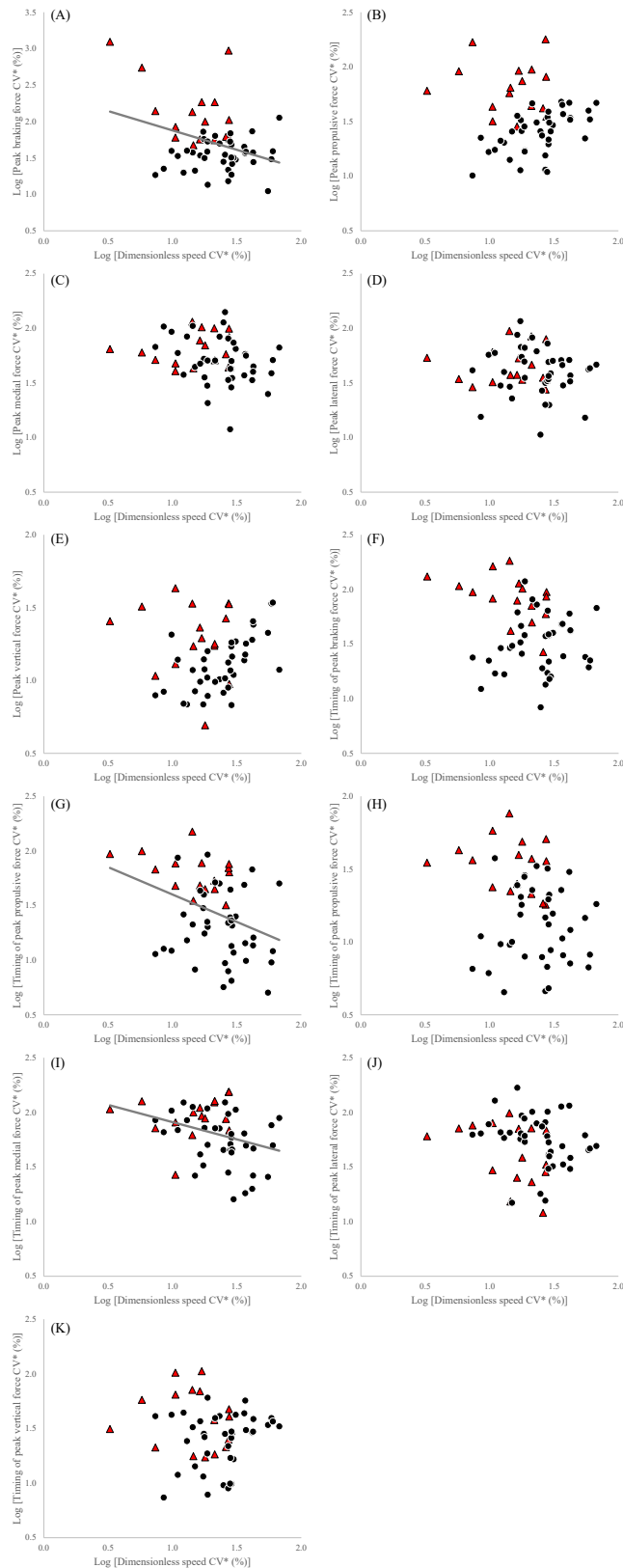
Peak lateral force CV*	BM-M	6.2e-16 ±2.3e-15 7.3e-16 ±1.8e-15			1.6±0.00	57.3±0.00	0.19±0.00
	OU-1	4.1e-20 ±2.9e-20	0.0074±3.8e-6	94	1.6±0.00	57.3±0.00	0.19±0.00
	OU-M	3.8e-13±2.1e-12	9.5e-9±8.7e-9	7.2e7	1.7±0.00, -1.9e5±2.2e5	59.5±0.00	0.06±0.00
Peak vertical force CV*	BM1	5.6e-05±4.3e-07			1.1±0.00	29.5±0.03	0.23±0.00
	<b>BM-M</b>	<b>5.2e-12±9.5e-12</b> <b>3.0e-04±3.6e-06</b>			<b>1.0±0.00</b>	<b>28.0±0.06</b>	<b>0.50±0.01</b>
	OU-1	5.6e-05±3.2e-07	2.2e-6±3.8e-6	3.2e5	1.1±0.00	31.7±0.03	0.08±0.00
	OU-M	1.5e-10±2.3e-10	1.4e-8±2.5e-8	5.0e7	0.7±0.00, 1.7e6±1.9e6	29.9±0.00	0.19±0.00
Timing of peak braking force CV*	BM1	3.8e-05±2.1e-07			1.5±0.00	65.5±0.01	0.33±0.00
	BM-M	3.6e-13±1.7e-12 1.4e-04±4.9e-06			1.6±0.00	67.5±0.05	0.12±0.00
	OU-1	2.6e-04±8.4e-06	0.0099±0.150	70	1.5±0.00	67.1±0.02	0.15±0.00
	<b>OU-M</b>	<b>2.1e-10±1.5e-09</b>	<b>0.0003±0.012</b>	<b>2.3e3</b>	<b>1.7±0.00, 1.4±0.00</b>	<b>65.1±0.00</b>	<b>0.40±0.00</b>
Timing of braking to propulsive transition CV*	BM1	7.3e-05 ±7.7e-07			1.3±0.00	64.1±0.03	0.19±0.00
	BM-M	6.1e-05±5.0e-05 1.2e-04±1.2e-04			1.3±0.03	66.0±0.33	0.07±0.01
	OU-1	8.1e-02 ±1.8e-01	1.2±2.7	0.6	1.2±0.00	63.3±0.03	0.28±0.00
	<b>OU-M</b>	<b>6.2e-02±1.3e-01</b>	<b>1.1±2.4</b>	<b>0.6</b>	<b>1.4±0.00, 1.2±0.00</b>	<b>62.3±0.01</b>	<b>0.45±0.01</b>
Timing of peak propulsive force CV*	BM1	0.00057±1.6e-05			1.2±0.00	71.1±0.59	0.00±0.00
	BM-M	0.00009±3.1e-06 0.00097±3.6e-05			1.2±0.00	68.7±0.55	0.01±0.00
	OU-1	0.17000±3.1e-01	1.4±2.6	0.5	1.1±0.00	60.0±0.19	0.48±0.01
	<b>OU-M</b>	<b>0.33000±8.3e-01</b>	<b>3.0±7.4</b>	<b>0.2</b>	<b>1.3±0.00, 1.1±0.00</b>	<b>59.9±0.15</b>	<b>0.51±0.01</b>
Timing of peak medial force CV*	<b>BM1</b>	<b>1.5e-19±1.4e-18</b>			<b>1.7±0.00</b>	<b>76.3±0.00</b>	<b>0.54±0.02</b>
	BM-M	1.4e-11± 3.4e-11 1.1e-05± 1.0e-05			1.7±0.00	78.5±0.01	0.18±0.02
	OU-1	4.9e-18 ±8.1e-18	0.008±0.00001	87	1.7±0.00	78.5±0.00	0.18±0.00
	OU-M	3.2e-10±1.8e-09	0.120±0.018	6	1.8±0.00, 1.7±0.00	79.6±0.00	0.11±0.00

Timing of peak lateral force CV*	BM1	4.6e-05±8.1e-06			1.5±0.03	73.6±0.37	0.29±0.03
	BM-M	2.5e-11±5.3e-11 1.2e-04±6.7e-07			1.5±0.00	74.8±0.01	0.16±0.01
	OU-1	7.1e-04±4.8e-05	0.030±0.002	23	1.5±0.00	74.8±0.01	0.16±0.01
	<b>OU-M</b>	<b>6.3e-04±6.4e-06</b>	<b>0.002±0.001</b>	<b>347</b>	<b>1.9±0.00, 1.5±0.00</b>	<b>73.0±0.00</b>	<b>0.39±0.02</b>
Timing of peak vertical force CV*	<b>BM1</b>	<b>3.1e-05±3.1e-07</b>			<b>1.3±0.00</b>	<b>52.3±0.02</b>	<b>0.52±0.00</b>
	BM-M	7.8e-12 ±1.8e-11 1.3e-04 ±2.1e-06			1.3±0.00	53.7±0.07	0.25±0.00
	OU-1	5.6e-05±4.1e-06	0.0021±0.0003	330	1.3±0.00	54.5±0.03	0.17±0.00
	OU-M	5.6e-05±4.1e-06	0.0020±0.0003	347	1.3±0.00, 1.3±0.01	56.8±0.03	0.05±0.00
Stride cycle duration CV*	BM1	1.7e-04±1.3e-06			1.1±0.00	29.8±0.14	0.15±0.01
	BM-M	8.3e-05±8.0e-07 3.4e-04±4.0e-06			1.1±0.00	29.3±0.14	0.20±0.01
	<b>OU-1</b>	<b>9.0e-04±6.8e-05</b>	<b>0.015±0.001</b>	<b>46</b>	<b>1.2±0.00</b>	<b>28.3±0.13</b>	<b>0.34±0.01</b>
	OU-M	1.2e-03±1.3e-03	0.024±0.028	29	1.1±0.00, 1.2±0.00	28.5±0.14	0.30±0.01

**Table S3: Type I error and, statistical power computed from simulations based on the OU-M models fit to each variable.** Selection opportunity ( $\eta$ ), the discriminability ratio ( $\phi$ ) and the signal to noise ratio (SNR) were computed using equations from Cressler et al. (2015).

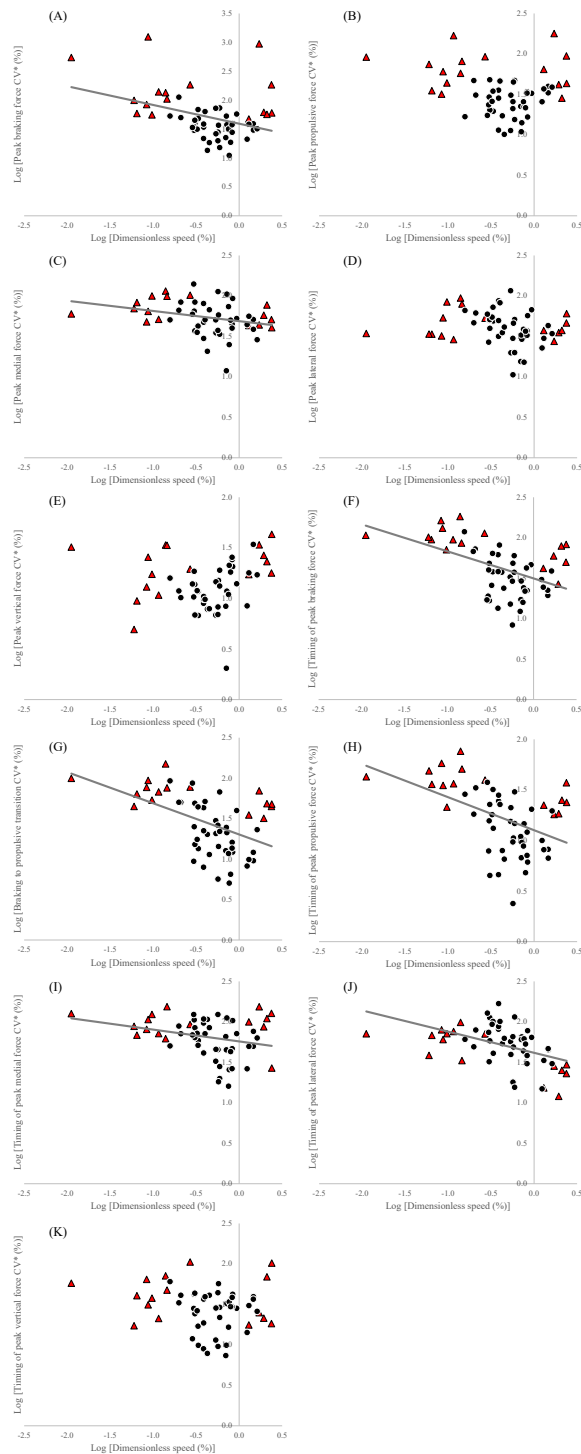
		Type I error	Power	$\eta$	$\phi$	SNR
Raw with standard error included	Peak Brake	0.15	1.00	3.9E+00	1.9E+02	3.7E+02
	Peak Accel	0.17	1.00	4.2E-06	6.4E+13	1.3E+11
	Peak Vertical	0.05	1.00	3.3E-06	6.9E+13	1.3E+11
	Peak Lateral	0.1	1.00	4.2E-06	1.4E+13	2.9E+10
	Peak Medial	0.12	1.00	4.9E-06	1.9E+12	4.2E+09
	Time Brake	0.26	1.00	3.9E+02	4.8E+00	9.4E+01
	Time Accel	0.15	1.00	1.1E-01	3.5E+07	1.1E+07
	Time Vertical	0.22	1.00	7.0E-01	4.0E+01	3.4E+01
	Time Lateral	0.17	1.00	4.2E+01	1.5E+08	9.9E+08
	Time Medial	0.22	1.00	7.0E-01	0.0E+00	0.0E+00
	Time BP	0.13	1.00	1.1E+03	1.5E+00	4.8E+01
	Cycle	0.24	1.00	8.4E+00	1.8E+01	5.3E+01
Residual without standard error	Peak Brake	0.16	0.99	2.1E+00	7.1E+01	1.0E+02
	Peak Accel	0.25	1.00	7.4E+00	4.7E+01	1.3E+02
	Peak Vertical	0.17	1.00	5.6E+01	7.0E+00	5.2E+01
	Peak Lateral	0.15	1.00	2.5E+01	3.3E+00	1.7E+01
	Peak Medial	0.17	1.00	7.0E+00	1.1E+01	3.0E+01
	Time Brake	0.19	1.00	9.9E+00	2.3E+01	7.2E+01
	Time Accel	0.06	1.00	1.9E+02	8.7E-01	1.2E+01
	Time Vertical	0.23	1.00	4.9E+00	1.1E+01	2.5E+01
	Time Lateral	0.22	1.00	2.2E+01	1.9E+00	9.0E+00
	Time Medial	0.18	1.00	8.1E+00	5.2E-01	1.5E+00
	Time BP	0.21	1.00	1.2E+01	1.4E+01	4.9E+01
	Cycle	0.15	1.00	3.5E+03	1.4E+00	3.9E+00

**Supplementary Figures:**

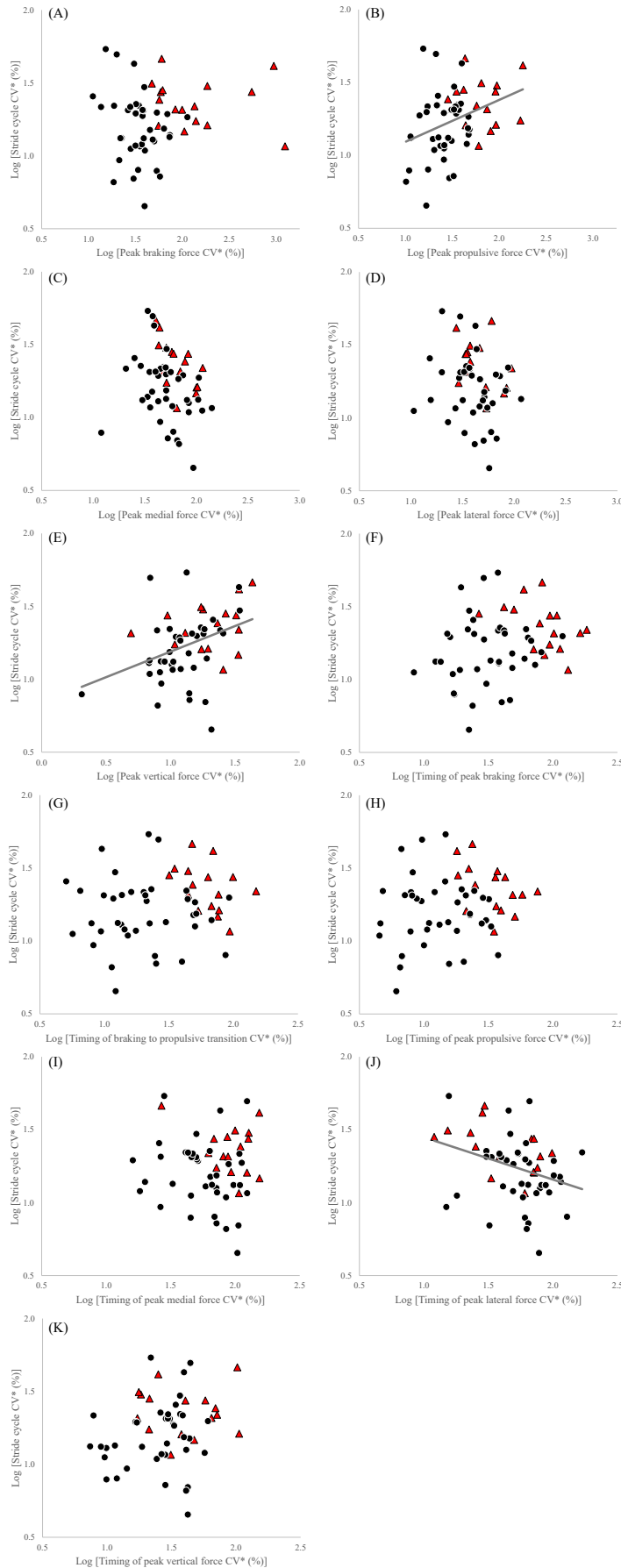


**Supplemental Fig. 1. Scatterplots of the species-mean log-transformed coefficient of variation ( $CV^*$ ) of (A) braking peak force, (B) propulsive peak force, (C) medial peak force, (D) lateral peak force, (E) vertical peak force, (F) timing of braking peak force, (G) timing of the braking to propulsive transition, (H) timing of propulsive peak force, (I) timing of medial peak force, (J) timing of lateral peak force, and (K) timing of vertical peak force as a function of species-mean log-transformed dimensionless speed  $CV^*$  (%). There is a significant negative relationship between species-mean log-transformed dimensionless speed  $CV^*$  (m/s) and peak braking force  $CV^*$  ( $y = -0.53x + 2.41$ ;  $P = 0.008$ ), the braking to propulsive transition  $CV^*$  ( $y = -0.50x + 2.10$ ;  $P = 0.007$ ) and the timing of peak medial force  $CV^*$  ( $y = -0.31x + 2.22$ ;  $P = 0.011$ ). Species with encapsulated Golgi tendon organs (GTO) are illustrated as black circles and species with unencapsulated GTOs are red triangles.**





**Supplemental Fig. 2. Scatterplots of the species-mean log-transformed coefficient of variation ( $CV^*$ ) of (A) braking peak force, (B) propulsive peak force, (C) medial peak force, (D) lateral peak force, (E) vertical peak force, (F) timing of braking peak force, (G) timing of the braking to propulsive transition, (H) timing of propulsive peak force, (I) timing of medial peak force, (J) timing of lateral peak force, and (K) timing of vertical peak force as a function of species-mean log-transformed dimensionless speed. There is a significant negative relationship between species-mean log-transformed dimensionless speed (m/s) and peak braking force  $CV^*$  ( $y = -0.32x + 1.59$ ;  $P = 0.005$ ), peak medial force  $CV^*$  ( $y = -0.13x + 1.69$ ;  $P = 0.035$ ), the timing of peak braking force  $CV^*$  ( $y = -0.33x + 1.50$ ;  $P < 0.001$ ), the braking to , propulsive transition  $CV^*$  ( $y = -0.39x + 1.30$ ;  $P < 0.001$ ), the timing of peak propulsive force  $CV^*$  ( $y = -0.33x + 1.10$ ;  $P < 0.001$ ), the timing of peak medial force  $CV^*$  ( $y = -0.15x + 1.76$ ;  $P = 0.041$ ), and the timing of peak lateral force  $CV^*$  ( $y = -0.26x + 1.62$ ;  $P < 0.001$ ). Species with encapsulated Golgi tendon organs (GTO) are illustrated as black circles and species with unencapsulated GTOs are red triangles.**



**Supplemental Fig. 3. Scatterplots of the log-transformed species-mean coefficient of variation ( $CV^*$ ) of stride cycle duration as a function of log-transformed  $CV^*$  of (A) braking peak force, (B) propulsive peak force, (C) medial peak force, (D) lateral peak force, (E) vertical peak force, (F) timing of braking peak force, (G) timing of the braking to propulsive transition, (H) timing of propulsive peak force, (I) timing of medial peak force, (J) timing of lateral peak force, and (K) timing of vertical peak force. There is a significant relationship between  $CV^*$  of stride cycle duration and peak propulsive force  $CV^*$  ( $y = 0.29x + 0.81$ ;  $P = 0.009$ ), peak vertical force  $CV^*$  ( $y = 0.35x + 0.84$ ;  $P = 0.005$ ) and the timing of peak lateral force  $CV^*$  ( $y = -0.29x + 1.74$ ;  $P = 0.016$ ). The solid line in each graph represents the best fit line. Species with encapsulated Golgi tendon organs (GTO) are illustrated as black circles and species with unencapsulated GTOs are red triangles.**