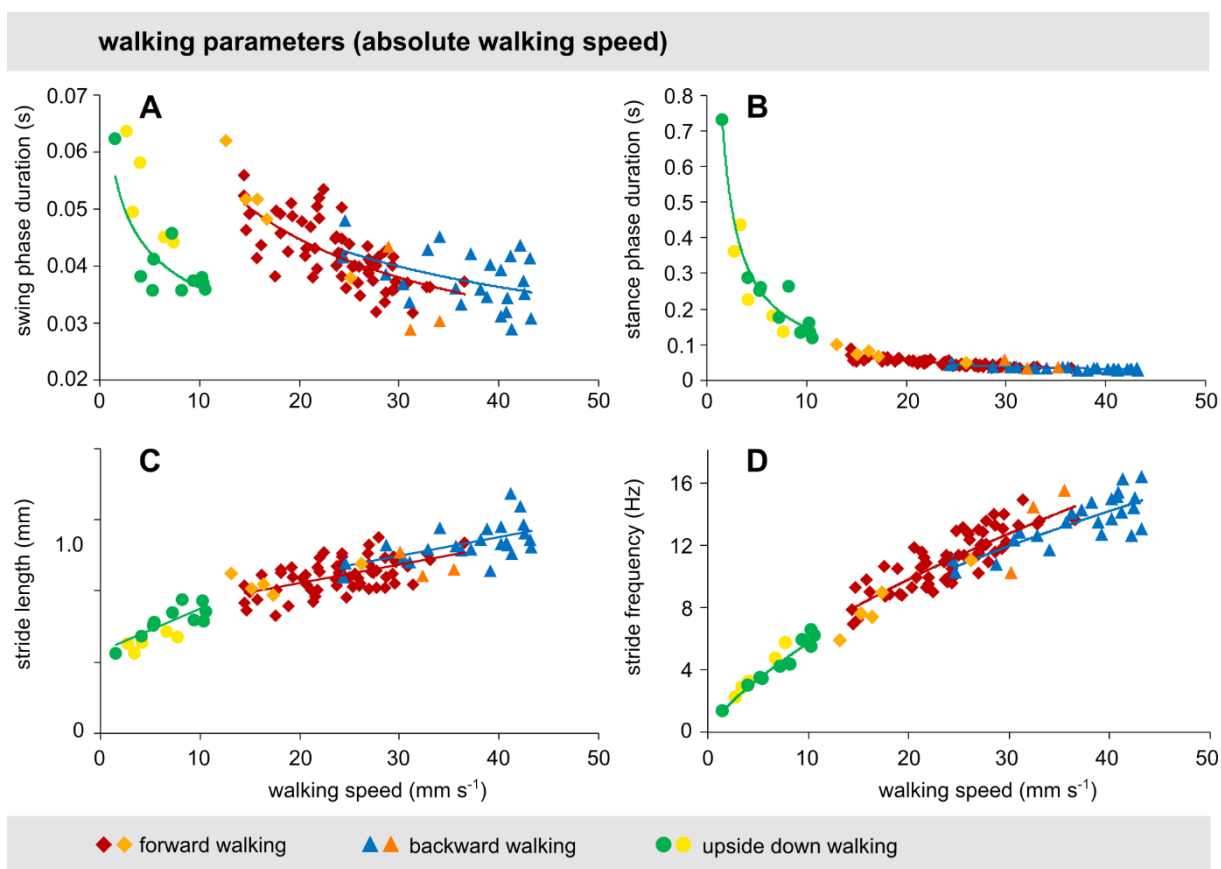


**Table S1. Detailed results of EthoVision analysis (compare Fig. 2A, B).** The movement of *C. cancroides* pseudoscorpions was tracked and analysed for 60 minutes using EthoVisionXT Software. For each of n=10 individuals, values were calculated for minimum, maximum and mean velocities; total distance covered; mobility state (mobile and immobile; mean  $\pm$  s.d. (s), frequency (observations h<sup>-1</sup>) and cumulative duration (%) for each state). Mean values are provided for all tested animals in the bottom row of the table. Immobile states were defined as periods when the percentage change in object area between video frames was below a 1.5% threshold (immobility threshold <1.5%, mobile threshold  $\geq$ 1.5%).

#	velocity minimum (mm s <sup>-1</sup> )	velocity maximum (mm s <sup>-1</sup> )	velocity mean (mm s <sup>-1</sup> )	total distance (mm)	mobility state: mobile			mobility state: immobile		
					mean $\pm$ s.d. (s)	frequency	duration cum. (%)	mean $\pm$ s.d. (s)	frequency	duration cum. (%)
1	0	44.99	4.83	17265	0.72 $\pm$ 0.91	3350	67.45	0.35 $\pm$ 0.92	3350	32.53
2	0	44.68	3.62	12916	0.60 $\pm$ 0.56	3694	61.80	0.37 $\pm$ 0.88	3692	38.18
3	0	44.91	4.49	16052	0.78 $\pm$ 0.59	3130	68.67	0.36 $\pm$ 0.82	3130	31.32
4	0	44.34	2.16	7569	0.72 $\pm$ 0.76	1863	37.73	1.17 $\pm$ 6.71	1864	61.40
5	0	44.25	4.60	16087	0.82 $\pm$ 0.63	2673	61.92	0.50 $\pm$ 3.90	2645	37.37
6	0	43.75	3.80	13156	0.75 $\pm$ 0.63	2993	63.03	0.42 $\pm$ 2.24	2976	35.43
7	0	44.43	5.45	18284	0.76 $\pm$ 0.69	3299	70.94	0.27 $\pm$ 0.46	3266	25.42
8	0	42.87	4.09	14269	0.71 $\pm$ 0.49	3236	64.81	0.38 $\pm$ 0.84	3237	34.81
9	0	43.91	2.56	8767	0.57 $\pm$ 0.48	3399	53.22	0.45 $\pm$ 1.23	3394	41.80
10	0	44.79	3.21	11552	0.69 $\pm$ 0.53	3001	57.13	0.51 $\pm$ 1.21	3011	42.68
<b>mean</b>	<b>0</b>	<b>44.59</b>	<b>3.88</b>	<b>13592.15</b>	<b>0.71 <math>\pm</math>0.63</b>	<b>3064</b>	<b>60.67</b>	<b>0.48 <math>\pm</math>1.92</b>	<b>3066</b>	<b>38.09</b>

**Table S2. Detailed results of high-speed video tracking (compare Fig. 2C).** Movements of forward walking *C. cancroides* pseudoscorpions were tracked and analysed over time periods of 2-6 seconds (corresponding to 20-30 step cycles) using EthoVisionXT Software. For each of n=17 individuals, values were calculated for minimum, maximum and mean velocities; total distance covered; mobility state (mobile and immobile; mean  $\pm$  s.d. (s), frequency (observations h<sup>-1</sup>) and cumulative duration (%) for each state). Mean values are provided for all tested animals in the bottom row of the table. Immobile states (microstops) were defined here as periods where no body- and COM-movement was observed. Individuals corresponding to the examples shown in Fig. 2C (i-iv) are marked in bold.

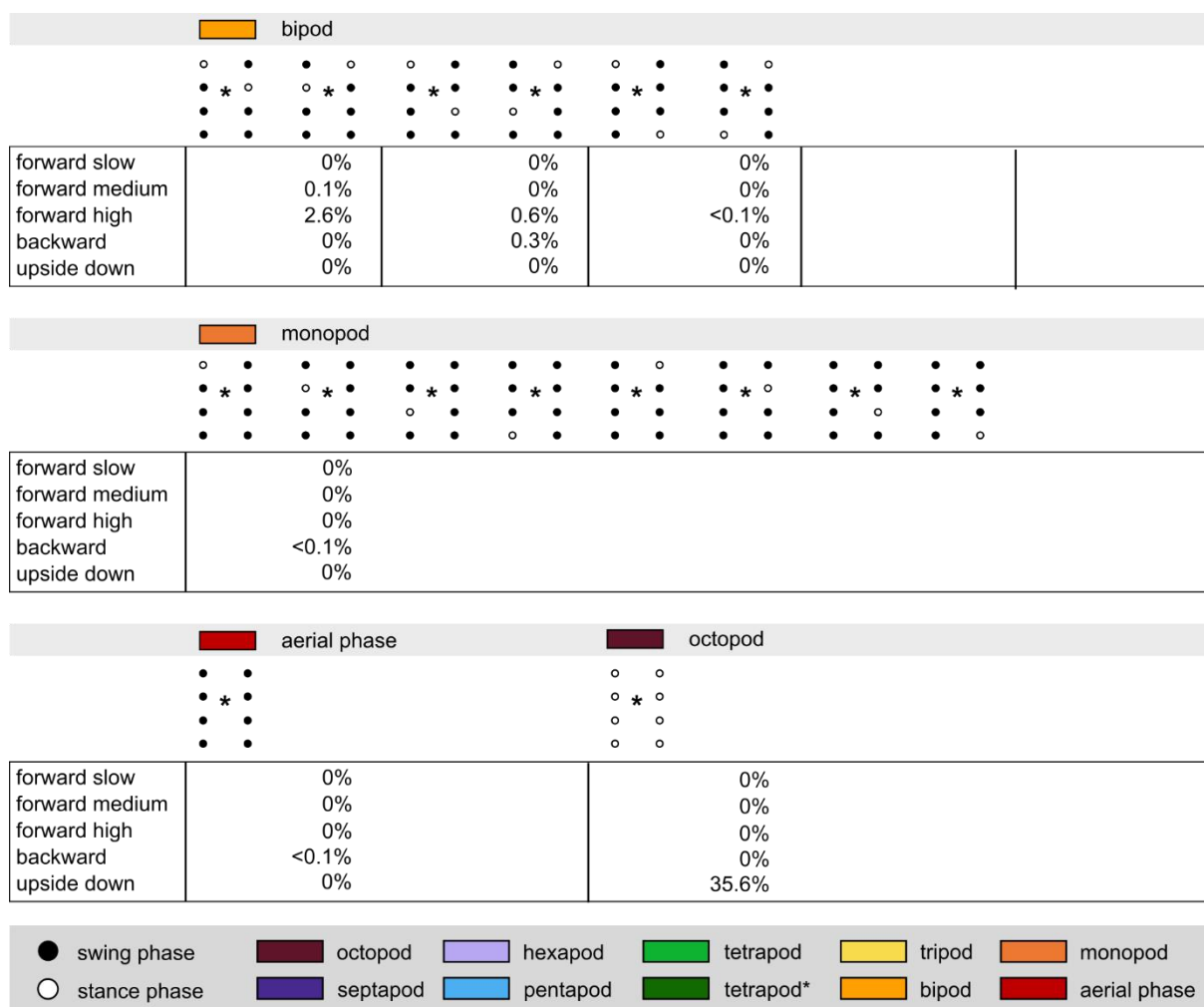
#	velocity minimum (mm s <sup>-1</sup> )	velocity maximum (mm s <sup>-1</sup> )	velocity mean (mm s <sup>-1</sup> )	total distance (mm)	mobility state: mobile			mobility state: immobile		
					mean $\pm$ s.d. (s)	frequency	duration cum. (%)	mean $\pm$ s.d. (s)	frequency	duration cum. (%)
1	0	45.32	22.06	54.44	2.51 $\pm$ 0.00	1	100.00	0.00 $\pm$ 0.00	0	0.00
2	0	56.12	13.77	39.12	1.36 $\pm$ 0.38	1	90.10	0.14 $\pm$ 0.00	1	9.90
3	0	44.06	12.11	30.39	1.69 $\pm$ 1.00	3	92.60	0.27 $\pm$ 0.19	2	7.40
<b>4</b>	<b>0</b>	<b>28.10</b>	<b>12.35</b>	<b>62.74</b>	<b>0.61 <math>\pm</math>0.39</b>	<b>7</b>	<b>86.37</b>	0.14 $\pm$ 0.02	<b>6</b>	<b>13.63</b>
5	0	64.56	21.17	91.56	0.49 $\pm$ 0.29	6	81.01	0.21 $\pm$ 0.10	5	18.99
<b>6</b>	<b>0</b>	<b>34.28</b>	<b>17.21</b>	<b>92.95</b>	<b>0.88 <math>\pm</math>0.64</b>	<b>7</b>	<b>70.46</b>	0.19 $\pm$ 0.08	<b>7</b>	<b>29.54</b>
7	0	72.05	15.90	41.51	0.42 $\pm$ 0.19	4	82.15	0.10 $\pm$ 0.02	4	17.85
8	0	53.53	14.17	56.30	0.46 $\pm$ 0.38	6	75.82	0.11 $\pm$ 0.03	5	24.18
9	0	42.17	11.71	51.61	0.35 $\pm$ 0.25	5	68.21	0.19 $\pm$ 0.06	5	31.79
10	0	56.91	20.02	100.23	3.96 $\pm$ 0.00	1	100.00	0.00 $\pm$ 0.00	0	0.00
11	0	76.52	23.25	56.68	0.62 $\pm$ 0.26	5	79.86	0.12 $\pm$ 0.07	5	20.14
<b>12</b>	<b>0</b>	<b>52.06</b>	<b>17.28</b>	<b>47.70</b>	<b>0.57 <math>\pm</math>0.41</b>	<b>3</b>	<b>80.73</b>	0.14 $\pm$ 0.03	<b>3</b>	<b>19.27</b>
13	0	63.33	22.30	58.77	0.84 $\pm$ 0.41	3	90.19	0.09 $\pm$ 0.01	2	9.81
14	0	60.40	19.32	37.41	0.94 $\pm$ 1.06	1	90.45	0.10 $\pm$ 0.00	1	9.55
15	0	66.26	22.27	58.51	0.88 $\pm$ 0.69	1	91.63	0.08 $\pm$ 0.00	2	8.37
<b>16</b>	<b>0</b>	<b>56.24</b>	<b>26.05</b>	<b>101.59</b>	<b>0.26 <math>\pm</math>0.16</b>	<b>8</b>	<b>70.96</b>	0.11 $\pm$ 0.05	<b>8</b>	<b>29.04</b>
<b>17</b>	<b>0</b>	<b>52.82</b>	<b>25.23</b>	<b>57.42</b>	<b>1.58 <math>\pm</math>0.00</b>	<b>1</b>	<b>86.83</b>	0.24 $\pm$ 0.00	<b>1</b>	<b>13.17</b>
<b>mean</b>	<b>0</b>	<b>52.28</b>	<b>17.73</b>	<b>56.41</b>	<b>1.18 <math>\pm</math>0.38</b>	<b>3.58</b>	<b>83.65</b>	<b>0.16 <math>\pm</math>0.04</b>	<b>3.35</b>	<b>16.35</b>



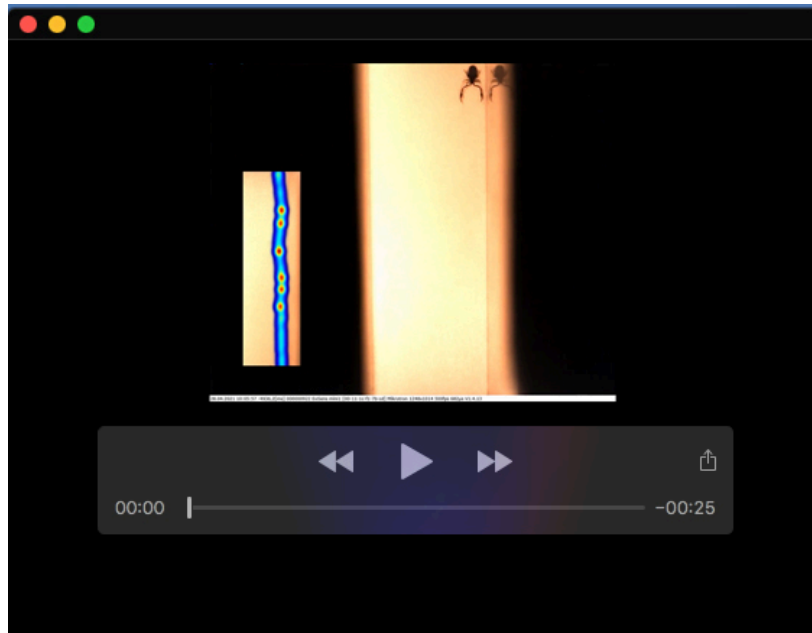
**Fig. S1. Walking parameters.** Characteristic walking parameters of *C. cancrivora* during forward, backward and upside-down walking plotted as functions of absolute speed ( $\text{mm s}^{-1}$ ) (forward:  $n=30$  individuals,  $n=63$  runs, red diamonds; backward:  $n=15$  individuals,  $n=24$  runs, blue triangles; upside down:  $n=9$  individuals,  $n=10$  runs, green circles). Each data point represents the mean value of the four leg pairs of *C. cancrivora* in one video. **(A)** swing phase duration (power functions: forward:  $y=0.15x^{-0.40}$ ,  $R^2=0.46$ , backward:  $y=0.12x^{-0.33}$ ,  $R^2=0.17$ , upside down:  $y=0.06x^{-0.23}$ ,  $R^2=0.65$ ). **(B)** Stance phase duration (power functions: forward:  $y=0.54x^{-0.78}$ ,  $R^2=0.73$ , backward:  $y=0.44x^{-0.72}$ ,  $R^2=0.70$ , upside down:  $y=1.04x^{-0.85}$ ,  $R^2=0.90$ ). **(C)** Stride length (linear regressions: forward:  $y=0.03x+1.59$ ,  $R^2=0.31$ , backward:  $y=0.03x+1.69$ ,  $R^2=0.33$ , upside down:  $y=0.06x+1.19$ ,  $R^2=0.65$ ). **(D)** Stride frequency (power functions: forward:  $y=1.41x^{0.65}$ ,  $R^2=0.71$ , backward:  $y=1.56x^{0.60}$ ,  $R^2=0.67$ , upside down:  $y=0.99x^{0.76}$ ,  $R^2=0.98$ ). In order to scrutinise potential influences of the different walking substrates (print paper and plastic sheet), high-speed recordings of forward (light orange diamonds) and backward (dark orange triangles) walks on a plastic sheet and of upside down walks (light yellow circles) on print paper were evaluated.



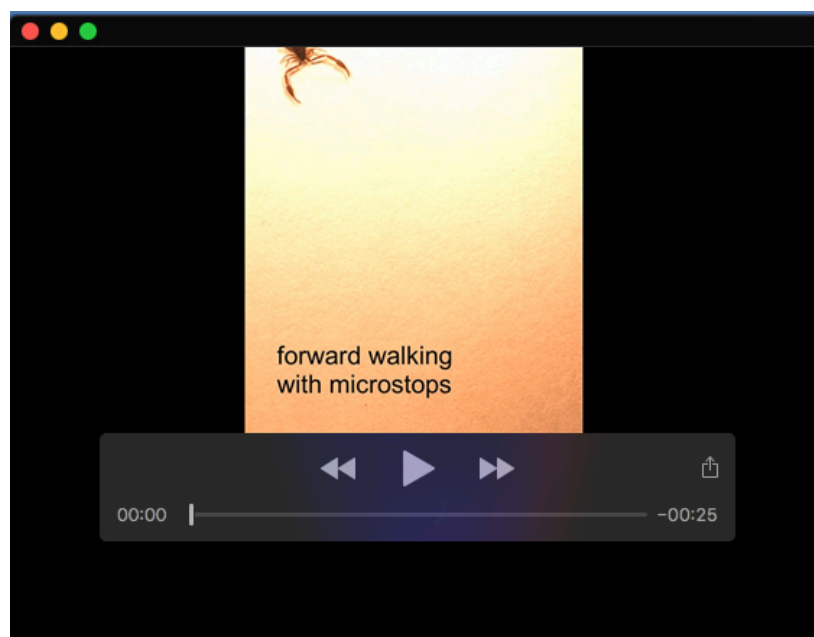




**Fig. S3. Selected inter-leg coordination patterns with percentages of these combinations during forward, backward and upside-down walking of *C. cancroides*.** Many more combinations of concrete leg coordinations exist in eight-legged animals. We thus selected the more commonly observed combinations for the current scrutiny that would also appear biomechanically useful. Every video frame was assigned a (momentary) inter-leg coordination pattern, according to a particular combination of the eight legs in swing and stance phase (swing phases: black circles, stance phases: white circles; body marked with an asterisk). If none of the selected combinations was applicable, the frame was assigned 'undefined' (grey, see Fig. S2). Note that walking patterns are defined by a certain combination of leg states and not just by the absolute number of legs in swing or stance. Percentages of the respective inter-leg combinations are given for the different speed bins during forward, backward and upside-down walks (compare Figs 8, S2). Mirrored combinations are pooled. The comparably high percentages of the third tetrapod\* pattern (2.6, 8.2, 4.0%) and the first (2.8, 5.4, 7.0%) and second tripod patterns (0.6, 2.7, 11.8%) were notable during forward locomotion, as well as the comparably low tetrapod fraction during backward (26.5%) and upside-down (7.1%) walking. The high percentage of the third tripod pattern during backward locomotion (12.3%) coincides with the general inversion of the tetrapod scheme, as this pattern is the horizontal mirror image of the first tripod pattern. Note that inter-leg coordination patterns are mainly defined for forward locomotion, explaining the high undefined fraction of around 40% during backward locomotion. Intriguingly, octopod coordination (stance) could mainly be observed during upside-down locomotion.



**Movie 1. *C. cancrivorus* forward locomotion with microstops.** Sample high-speed recording illustrating brief stationary episodes (microstops) during forward locomotion at an intermediate walking speed of  $12.4 \text{ mm s}^{-1}$  (original speed, slow motion (x0.5); with associated heat map). High-speed videos were recorded at a sampling rate of 500 frames per second (for detailed analysis see Table S2: #4, and Fig. 2C i).



**Movie 2. Walking in *C. cancrivorus*.** Example high-speed recordings of *C. cancrivorus* during forward, backward and upside down locomotion (slow motion (x0.0625)). High-speed videos were recorded at a sampling rate of 500 frames per second.