Supplemental information:
A Network of Intrinsic Oscillators Can Drive Forward Locomotion in *C. elegans*

S1: Method to calculate wavelength, antero-posterior curvature profile and trajectory curvature

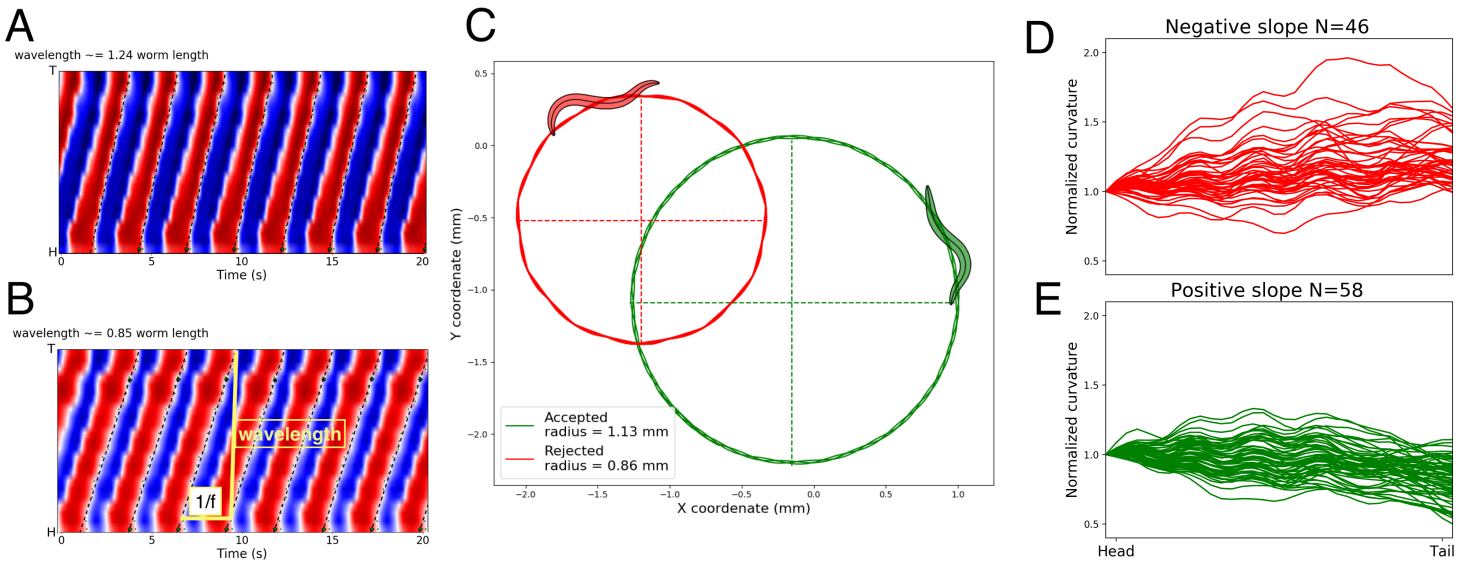

Fig 1. Examples of accepted and rejected models after the filtering process. [A]Rejected model due to a high bending wavelength, dotted lines depicted the linear regression for the bending against time. [B] Accepted model showing a wavelength of 0.85 body length. [C] accepted (green) and rejected (red) models due to trajectory curvature bias. Threshold of rejection was set to 1 mm. Mean body curvature along the body axis [D] 46 solutions were rejected for their trend to bend more in the tail than in the head. [E] 58 solutions presents stronger bending in the head than the tail, as observed in crawling worms.

S2: Movies of forward locomotion

Movies for the 15 filtered solutions can be found on
https://drive.google.com/open?id=14FDIk02MbfvjapdeSoy-yYYtuf4bckv.

S3: Parameters combinations in the filtered solutions

individual index	4	5	9	21	23	30	37	42
Bias AS	2.28	-7.02	1.76	2.24	5.44	1.77	1.94	-9.02
Bias DA	14.98	4.80	7.07	-9.51	12.08	7.20	0.92	-8.78
Bias DB	3.36	-4.29	9.13	-7.64	8.19	2.52	-0.67	4.78
Bias DD	-4.73	-9.45	-13.66	3.62	-6.38	5.01	5.45	-6.40
Bias VD	-6.02	8.66	-5.64	5.80	-7.34	-0.55	6.66	1.79
Bias VB	-0.40	0.85	9.04	-13.13	11.72	4.35	-2.86	-0.57
Bias VA	-14.80	-11.82	2.32	12.03	6.04	3.66	-1.34	-2.48
Tau AS	0.63	0.26	0.69	1.30	1.11	0.25	0.16	0.18
Tau DA	1.77	0.55	1.04	0.11	1.58	0.63	1.24	0.55
Tau DB	0.10	0.58	0.10	0.66	0.15	0.22	0.15	0.28
Tau DD	0.78	0.20	1.54	0.56	1.27	0.63	1.41	2.30
Tau VD	0.65	0.91	1.30	0.32	0.11	1.26	0.14	1.05
Tau VB	0.39	1.41	1.31	0.16	0.19	0.12	0.64	0.79
Tau VA	0.98	0.31	0.18	0.88	0.38	0.46	1.15	2.30
Self conn AS	7.09	6.73	9.68	0.14	4.36	12.28	-1.67	-5.37
Self conn DA	-14.44	3.74	-0.14	7.82	-10.79	-14.69	9.39	14.37
Self conn DB	9.38	0.89	3.76	0.05	5.25	4.20	8.99	6.57
Self conn DD	-11.75	-0.92	-1.82	1.52	0.78	-6.01	1.60	6.04
Self conn VD	-0.44	-4.37	-7.51	14.80	-3.70	-13.16	-3.37	-14.45
Self conn VB	4.19	0.99	-9.48	9.15	-10.00	0.34	4.90	4.98
Self conn VA	2.38	10.81	-0.60	1.05	1.63	6.98	9.54	-4.75
AS $\rightarrow$ DA	-13.16	-14.75	-13.37	14.63	-13.57	-13.86	-13.37	14.96
AS $\rightarrow$ VD	12.54	-14.06	14.96	0.05	14.66	15.00	-14.87	7.94
DA $\rightarrow$ DB	-15.00	15.00	-14.88	9.91	-15.00	-14.42	-14.55	-14.90
DB $\rightarrow$ AS	-14.89	15.00	-13.29	-14.08	-14.84	-12.20	-14.07	14.66
VD $\rightarrow$ VA	-5.19	13.93	-6.72	7.39	-13.95	-15.00	10.53	14.81
VD $\rightarrow$ VB	6.86	-10.21	-8.13	11.57	-12.58	-8.24	8.98	3.46
DA $\rightarrow$ DD	11.80	6.70	-1.95	-8.99	3.68	-0.35	14.72	-8.36
VB $\rightarrow$ DD	1.90	-5.48	9.83	-7.73	2.19	-4.62	-2.73	4.81
VA $\rightarrow$ DD	-13.91	-10.73	4.77	-6.72	0.90	15.00	5.52	-10.89
VD $\dashv$ DD	0.22	0.50	0.44	1.71	0.27	0.46	1.60	0.40
NMJ weigth AS	0.83	0.45	0.00	0.76	0.13	1.20	0.58	0.67
NMJ weigth DA	0.23	0.63	0.20	0.51	0.27	1.13	0.29	0.00
NMJ weigth DB	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
NMJ weigth DD	-1.10	-0.26	-0.90	-0.79	-0.10	-0.81	-1.20	-0.50
NMJ weigth VD	-0.92	-0.37	-0.86	-0.46	-0.79	-0.27	-1.19	-0.83
NMJ weigth VB	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
NMJ weigth VA	0.96	0.14	0.81	0.43	0.30	0.29	0.57	0.39
A/P gain	0.67	0.62	0.61	0.35	0.36	0.92	0.72	0.79
DB $\rightarrow$ DDnext	-7.90	-14.18	-14.94	-8.14	9.19	3.43	-5.60	-0.26
VAnext $\rightarrow$ DD	-7.17	-7.90	12.03	4.34	-0.30	9.93	-13.99	4.71
AS $\dashv$ VAnext	0.77	1.76	0.81	0.96	0.08	1.41	0.48	0.02
DA $\dashv$ ASnext	0.05	0.00	0.02	0.20	0.47	0.08	0.17	1.26
VB $\dashv$ DBnext	0.53	1.44	0.84	0.66	1.18	0.62	1.03	0.60

individual index	45	53	63	66	68	101	103
Bias AS	-0.43	-7.74	-2.31	1.88	4.82	1.44	-9.27
Bias DA	-4.91	-6.31	-8.70	3.37	4.99	1.86	-9.47
Bias DB	-3.43	9.32	-0.09	-12.45	-0.71	-10.70	6.71
Bias DD	14.99	3.79	13.36	0.35	7.84	-11.37	6.33
Bias VD	-2.80	0.69	-1.92	-5.99	12.46	-1.45	4.52
Bias VB	-0.55	-5.89	-7.43	-10.16	-4.74	-7.51	4.63
Bias VA	-9.15	-5.65	-9.03	-14.03	1.84	-8.17	-6.61
Tau AS	0.30	0.30	1.68	0.29	1.63	0.49	0.45
Tau DA	0.97	0.97	1.11	0.88	1.01	0.95	0.17
Tau DB	0.21	0.84	0.12	0.10	0.11	0.13	1.11
Tau DD	2.45	1.60	0.59	2.21	1.31	0.15	0.84
Tau VD	0.46	2.46	0.12	0.10	0.91	1.28	0.24
Tau VB	0.85	0.13	0.87	1.78	0.12	1.38	0.52
Tau VA	0.54	0.10	1.02	0.99	0.35	1.42	0.10
Self conn AS	9.62	6.03	-5.47	-11.61	-0.02	-13.39	2.29
Self conn DA	0.10	-1.35	0.72	7.15	-0.70	8.14	10.43
Self conn DB	-0.82	-2.19	4.33	13.80	5.04	9.90	1.47
Self conn DD	-15.00	-8.26	4.87	12.17	-1.53	7.41	-6.94
Self conn VD	-3.67	-14.94	5.59	0.20	-12.82	-14.96	-4.65
Self conn VB	5.79	5.48	5.57	3.77	2.94	2.40	-8.41
Self conn VA	-6.52	-11.90	-11.89	2.69	-4.78	-3.94	0.83
AS $\rightarrow$ DA	13.45	14.69	14.08	-14.24	-11.83	-11.69	14.38
AS $\rightarrow$ VD	12.18	13.81	5.08	13.89	-14.58	14.99	-14.54
DA $\rightarrow$ DB	13.41	-15.00	-10.02	13.31	-14.51	14.64	-12.49
DB $\rightarrow$ AS	-14.91	12.84	13.26	12.32	-15.00	14.63	12.47
VD $\rightarrow$ VA	-9.57	-9.67	-2.60	-10.20	10.29	-10.94	9.94
VD $\rightarrow$ VB	-10.64	11.84	10.31	14.77	15.00	14.85	13.54
DA $\rightarrow$ DD	9.90	4.29	-3.14	-9.67	-5.78	14.13	-5.96
VB $\rightarrow$ DD	-10.79	-1.96	-13.57	-4.52	-6.10	-12.94	0.29
VA $\rightarrow$ DD	-0.38	7.45	-13.98	-10.43	-14.37	-12.78	-10.81
VD $\dashv$ DD	0.13	1.81	1.18	1.64	1.47	1.82	1.41
NMJ weigth AS	1.18	0.53	1.19	1.19	0.80	0.55	0.93
NMJ weigth DA	0.60	1.20	0.54	0.29	0.03	0.00	0.67
NMJ weigth DB	1.20	1.20	1.20	1.20	1.20	1.20	1.20
NMJ weigth DD	-0.35	-0.99	-0.96	-0.70	-0.93	-0.86	-1.16
NMJ weigth VD	-0.86	-0.52	-0.12	-0.27	0.00	-0.30	-0.28
NMJ weigth VB	1.20	1.20	1.20	1.20	1.20	1.20	1.20
NMJ weigth VA	1.10	0.51	0.41	0.08	0.65	1.08	1.14
A/P gain	0.56	0.91	0.39	0.77	0.79	0.56	0.76
DB $\rightarrow$ DDnext	-14.94	-14.86	2.10	1.95	2.06	9.15	4.54
VAnext $\rightarrow$ DD	3.26	-8.15	0.22	-0.66	1.74	-2.14	14.71
AS $\dashv$ VAnext	1.13	0.30	0.51	1.86	0.93	1.03	0.33
DA $\dashv$ ASnext	1.35	0.44	0.17	0.07	0.19	0.03	0.70
VB $\dashv$ DBnext	0.99	0.02	0.34	1.52	0.62	1.42	1.19

S4: Inter-unit phase shift and method to calculate neuron phase delay.

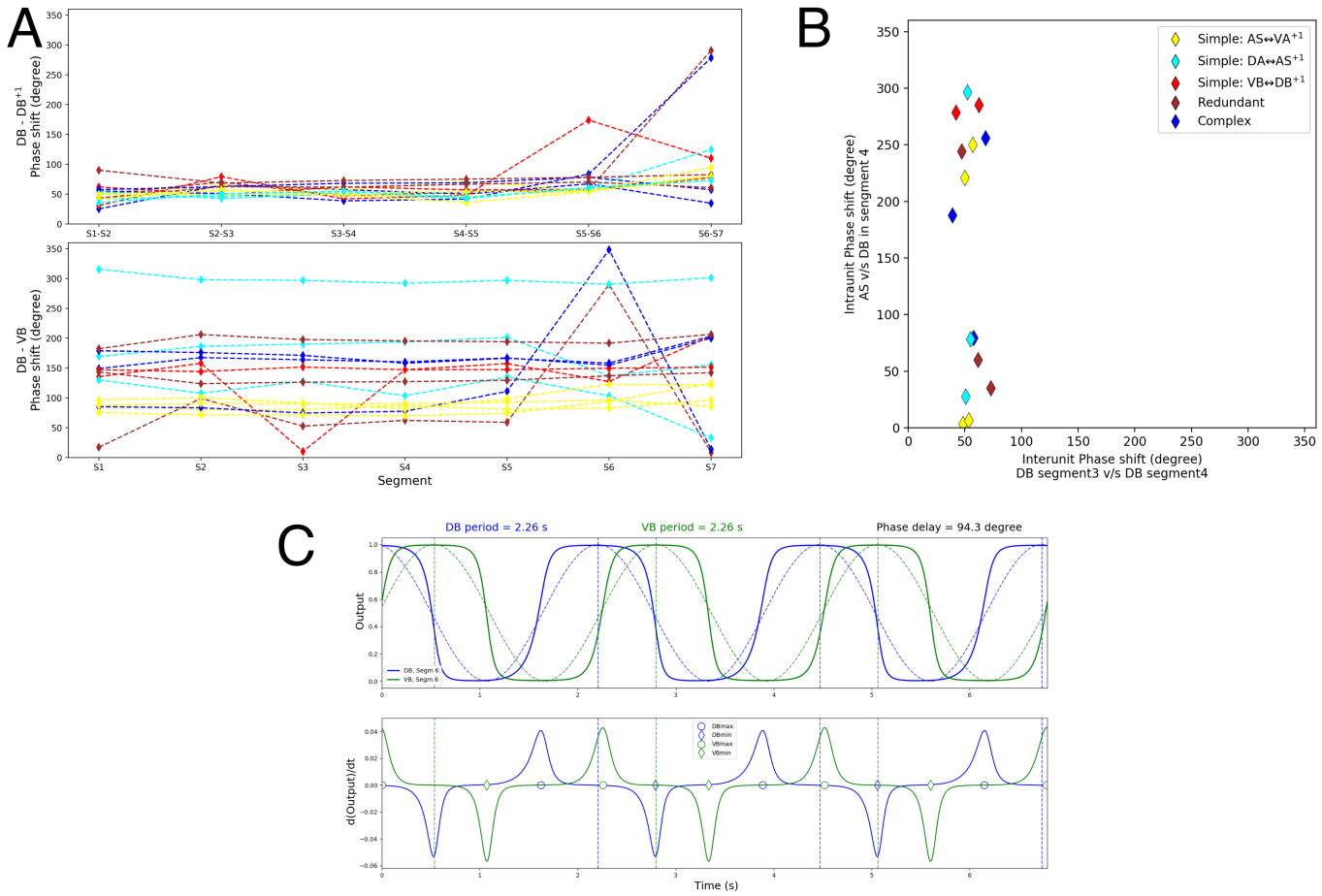

Fig 2. Phase shift in the ensemble show low intrerunit and large intraunit variability. [A] Top, phase shift measured between DB neurons of adjacent unit. Bottom, intraunit phase shift measured between neurons DB and VB. [B] There is no correlation between model classification and phase shift, colors indicate the classification due to the interunit connection necessary and sufficient to drive locomotion. [C] One example for the algorithm used to calculate phase shift. Top, solid lines correspond to neural activity, dashed lines show algorithm sinusoidal reconstruction, vertical lines show phase calculation. Bottom, derivative for neural traces shown on top. Circles and diamonds show algorithm detection of maximal and minimal derivative in the neural trace.