

Batch Phototaxis Experiment Report

Date: 2026-02-22 / 2026-02-23 **Experiment:** Braitenberg type-2 vehicle with Ashby fixed-topology uniselectors **Configuration:** 6-unit homeostat, randomly selected initial weights per run **Starting position:** (4, 4), Target: (7, 7), Initial distance: 4.243

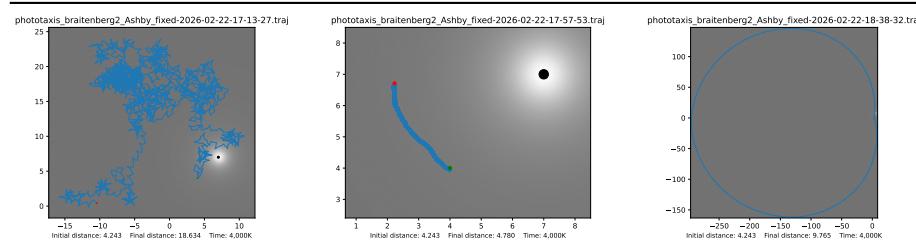
Light-Avoiding (positive light, intensity = 100)

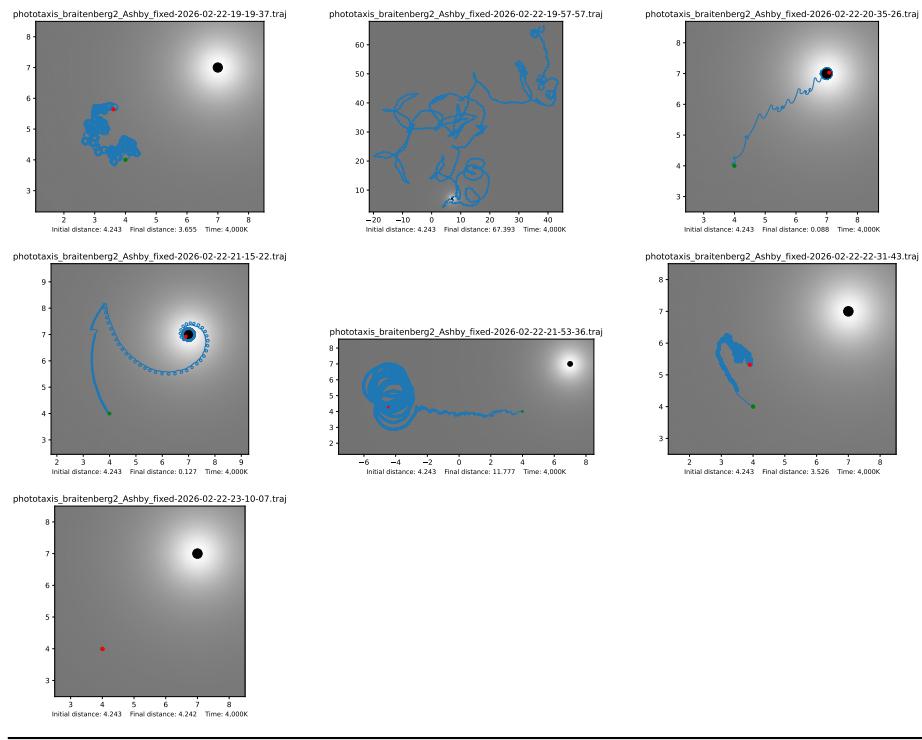
10 runs, 2,000K ticks each. The robot's sensors detect irradiance from a light source at (7,7). With positive intensity, higher sensor readings drive stronger motor output on the ipsilateral side, causing the vehicle to turn away from the light (Braitenberg type-2 avoidance).

Run	Final dist	Min dist	Min dist at	Early stop	Wall time
1	18.634	0.978	42.5K	No	44.5 min
2	4.780	4.241	0.5K	No	40.6 min
3	9.765	3.416	783.0K	No	41.1 min
4	3.655	3.501	1,994.5K	No	38.3 min
5	67.393	0.132	31.0K	No	37.5 min
6	0.088	0.001	48.0K	No	39.9 min
7	0.127	0.078	1,910.5K	No	38.2 min
8	11.777	4.243	0.0K	No	38.1 min
9	3.527	3.360	1,832.5K	No	38.4 min
10	4.242	4.241	0.5K	No	38.3 min

Summary: - Mean final distance: **12.4** (std: 19.1) - Median final distance: **4.5** - Runs converging close to target (final dist < 1): **2** (runs 6, 7) - Runs diverging far from target (final dist > 10): **3** (runs 1, 5, 8) - No early stops (none configured for this batch) - Total wall time: ~6.6 hours

Trajectories





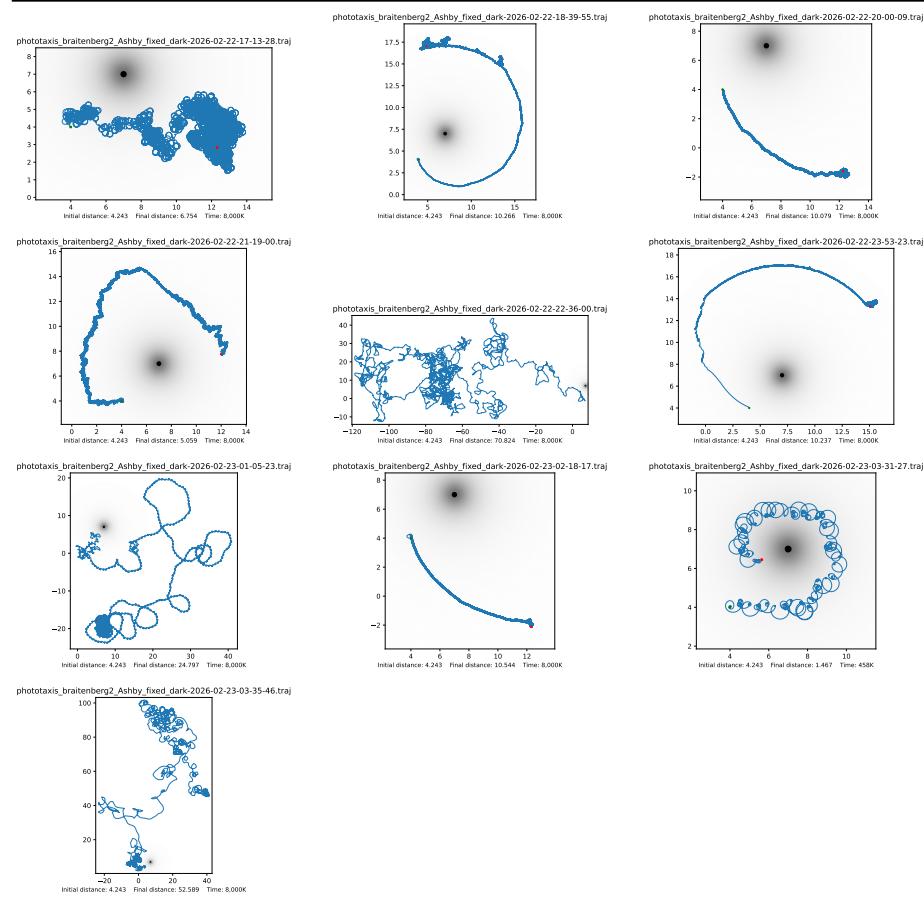
Darkness-Seeking (negative light, intensity = -100)

10 runs, 4,000K ticks each (with early stop at distance < 1.5). With negative intensity, the sensor readings are inverted: proximity to the source produces lower readings, causing the vehicle to steer toward the darkness source (seeking behaviour).

Run	Final dist	Min dist	Min dist at	Early stop	Wall time
1	6.754	2.392	425.0K	No	86.5 min
2	10.266	4.243	0.0K	No	80.2 min
3	10.079	4.243	0.0K	No	78.9 min
4	5.059	4.056	9.5K	No	77.0 min
5	70.824	4.243	0.0K	No	77.4 min
6	10.237	4.231	4.0K	No	72.0 min
7	24.797	2.367	10.5K	No	72.9 min
8	10.544	4.114	3.5K	No	73.2 min
9	1.467	1.467	229.0K	Yes	4.3 min
10	52.589	3.657	6.5K	No	73.8 min

Summary: - Mean final distance: **20.3** (std: 21.9) - Median final distance: **10.2** - Runs converging close to target (final dist < 5): **1** (run 9, early-stopped)
 - Runs diverging far from target (final dist > 10): **5** (runs 2, 3, 5, 7, 10) - Early stops: **1** (run 9 at 229K ticks, final distance 1.467) - Total wall time: ~11.3 hours

Trajectories



Comparison

	Light-Avoiding	Darkness-Seeking
Ticks per run	2,000K	4,000K
Mean final distance	12.4	20.3

	Light-Avoiding	Darkness-Seeking
Median final distance	4.5	10.2
Std dev	19.1	21.9
Converged (< 1.0)	2 / 10	0 / 10
Close (< 5.0)	5 / 10	1 / 10
Diverged (> 10.0)	3 / 10	5 / 10
Early stops	0 / 10	1 / 10

Observations:

1. **Light-avoiding outperforms darkness-seeking.** Despite running for half the ticks, the light-avoiding condition produces lower median final distances (4.5 vs 10.2) and more runs that converge close to the target.
2. **High variance in both conditions.** Both distributions are heavy-tailed, with some runs converging tightly (runs 6-7 in light, run 9 in dark) while others diverge dramatically (run 5 in light at 67.4, run 5 in dark at 70.8).
3. **Random weights dominate outcomes.** The initial random weight selection appears to be the primary factor determining whether the homeostat finds a viable configuration. The Ashby fixed-topology uniselector can recover from bad initial weights (as seen in runs where min_dist is reached late), but often does not within the allotted time.
4. **Darkness-seeking is harder.** The inverted sensor signal makes it more difficult for the homeostat to find stable configurations that drive the vehicle toward the target. Only 1 of 10 dark runs got within 5 units of the target.