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CSCI4314

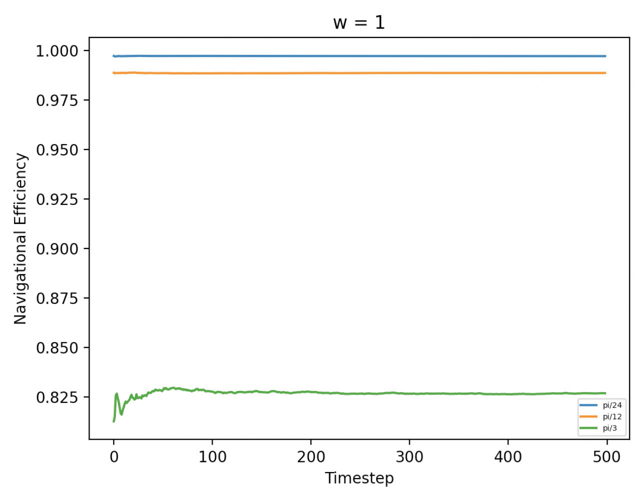
Part A: Navigational Efficiency

Terminal Output for final navigational efficiency values for each w and angle distribution =>

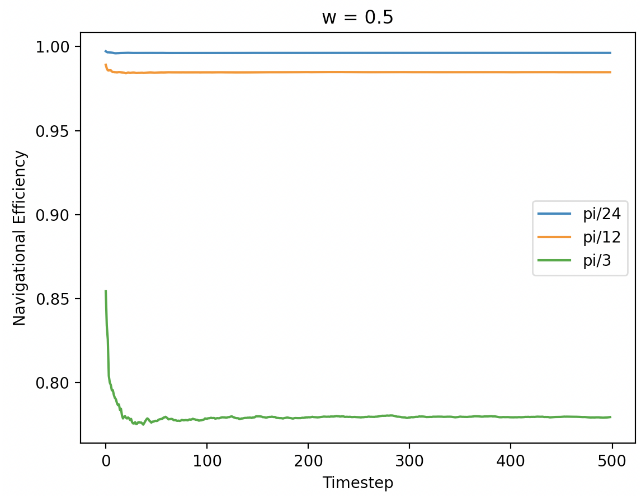
```
Navigational efficiency at 0.1309 for 0.0 is: 0.5113658057795828
Navigational efficiency at 0.2618 for 0.0 is: 0.1345120528948955
Navigational efficiency at 1.0472 for 0.0 is: 0.03775202722683325
Navigational efficiency at 0.1309 for 0.5 is: 0.99420704223632
Navigational efficiency at 0.2618 for 0.5 is: 0.9830628423204462
Navigational efficiency at 1.0472 for 0.5 is: 0.7778893738269563
Navigational efficiency at 0.1309 for 1.0 is: 0.9951440343009289
Navigational efficiency at 0.2618 for 1.0 is: 0.986711025266829
Navigational efficiency at 1.0472 for 1.0 is: 0.8247265737016048
```

Based on the output in the console above, the following shows the final navigational efficiency for each random walk using the turning angle distribution variances. Below I show the **plot** of the mean navigational efficiency for 50 realizations over 500 time steps. The final values for these efficiencies after the simulation are also written.

A. *Pure Biased Random Walk (**w = 1**)*
   a. *$\theta^* = \pi/24$, Final* Navigational Efficiency = 0.995
   b. *$\theta^* = \pi/12$, Final* Navigational Efficiency = 0.986
   c. *$\theta^* = \pi/3$, Final* Navigational Efficiency = 0.824



B. *Balanced CRW and BRW (**w = 0.5**)*
   a. *$\theta^* = \pi/24$, Final* Navigational Efficiency = 0.994
   b. *$\theta^* = \pi/12$, Final* Navigational Efficiency = 0.983
   c. *$\theta^* = \pi/3$, Final* Navigational Efficiency = 0.777

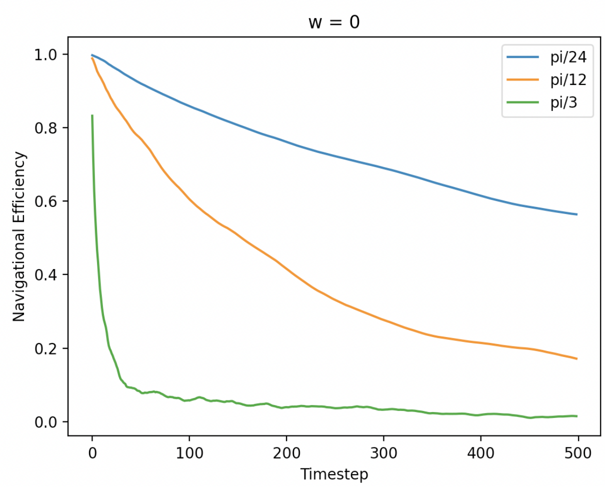


*C. Pure Correlated Random Walk (**w = 0**)*

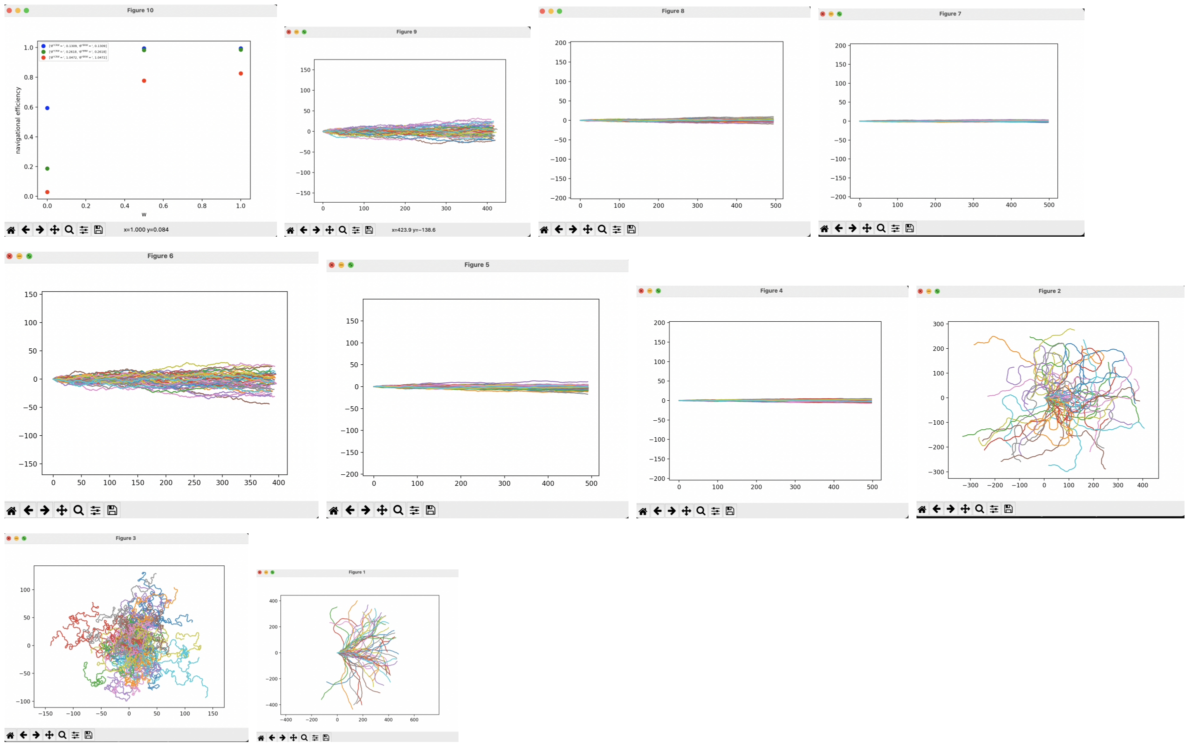
a. $\theta^* = \pi/24$, *Final* Navigational Efficiency = 0.511

b. $\theta^* = \pi/12$, *Final* Navigational Efficiency = 0.134

c. $\theta^* = \pi/3$, *Final* Navigational Efficiency = 0.0377



Here are some of the amazing outputs depicting CRW, BRW, and BCRW:



Part B: Using Different Variances

If θ*{CRW} = π/30, and θ*{BRW} = π/3, what is the value of w associated with the highest navigational efficiency?

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Max Navigational efficiency is 0.9658216929948564 at w = [0.06]
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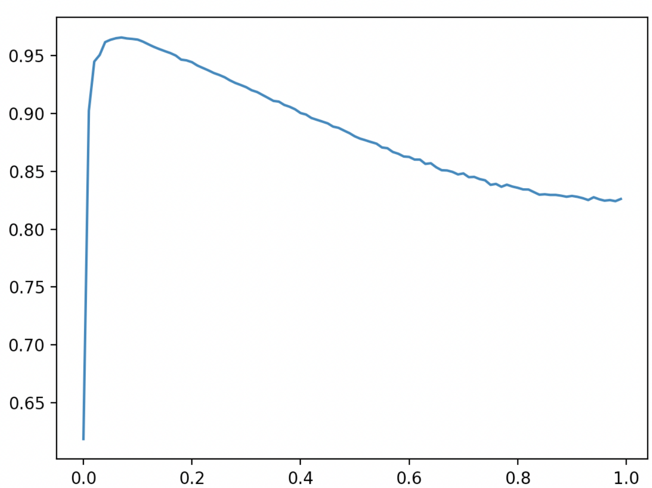
We get a max navigation efficiency of 0.966 when ***w=0.06***. We run this simulation for 100 *w* values between 0 and 1, with a step size of 0.01.



Part 2: Paper Review

Evaluating random search strategies in three mammals from distinct feeding guilds

1. What do you feel the main contribution of this paper is?

This paper aims to highlight the <u>difficulty</u> in mapping real time animal searching patterns to theoretical approaches, and thus asserting that there is no universal searching pattern for animals. Auger-Methe wants other ecologists to continue this study in order to turn the inconclusive results into tangible data that can be mapped to the absolute best fit for the various searching models. Auger-Methe would like ecologists to explore whether studying the cognitive and perceptual capacities of animals will yield results that can determine which searching strategies are used in different species. Ultimately, this paper extends the study of animal movement and highlights the importance of continuing to test against the current theory, in order to learn more about how animals search.

2. What's the essential principle that the paper exploits?

This paper greatly indicates that animal movement is <u>very unpredictable</u> due to the sparse and heterogeneous environments that they live in. Auger-Methe notes that the type of random walk taken by animals with different diets are not completely different nor are they distinguishable. However, the scientist's data shows that <u>one</u> of the CCRW models used in this study best supports the searching strategy taken by caribous, grizzly bears, and polar bears (98%). Nevertheless, even this result is inconsistent among all three animals studied, especially when this model was removed from the model fitting. Thus, scientists should continue to explore animal searching patterns to determine if CCRW is a good fit for these animal movements, or if other searching movements such as BW and TLW are a better fit. In general, it is hard to determine which searching methods animals take due to changing environments, reproductive seasons, resting phases, and more importantly cognitive and perceptual capacities of animals.

3. Describe one major strength of the paper.

Auger-Methe does a great job of explaining <u>how</u> their results illustrate that searching patterns taken by animals are difficult to analyze due to the increasing variability of the environment, as well as the unpredictability of single-behavior strategy versus two-behavior strategy and the intensive versus extensive phases of a CCRW. This paper understands that the methods used will lack conclusive results because it does not take into account memory-based searching and percepts. For instance, the discussion of this paper interprets the inconclusive results in a meaningful way, such that future works can use these interpretations in order to construct better experiments.

4. **Describe weakness of the paper.**

This paper replaces the abstract with a scattered summary, which defines two of the four search strategies that were explored, but does not define the other two, which were Brownian Walk and CRW. This introduction may confuse the reader on which animal search strategies were truly explored. The results section does not specify which model for CCRW was the best fit, only that one of them was, and this may hinder the ability for future works to implement the correct model.

5. **Describe one future work direction you think should be followed**

One great approach to explore this work in the future is to study animal searching patterns on homogenous terrain. This study mainly focused on environments that were heterogeneous, but this randomness may have been the reason for their inconclusive results. By studying animal movement patterns in homogeneous environments, ecologists may be able to understand the cognitive and perceptual capacities of animals better.

Notes:

- Multiphasic movement strategy -> CCRW (two behavior model)
- " Our results indicate a need to develop movement models that incorporate factors such as the perceptual and cognitive capacities of animals."
    - Movement patterns more complicated than expected
- Assessing theoretical search patterns versus actual search patterns
- Difficult to differentiate movement patterns -> what defines a movement pattern then?
- When resource availability is unpredictable, then we expect more random movement
- Levy walk useful for food searches
- Sparse, heterogeneous environments call for Levy Walk and CCRW because it allows the animal to remain in patches while food is available. This does not take into account the animal's perceptual boundaries
- Caribous
    - Winter study, random walk more likely
    - CCRW and Levy Walk, sorta inconclusive
- Grizzly bear
    - Live in sparse, heterogeneous, unpredictable environments

- Polar bears
  - Use memory based search strategies
  - May use random search strategies
  - Environmental changes, ice !! Induce random walks more
- Transforming sampled steps into biologically relevant steps is among the most difficult challenges of using GPS data in ecology
  - Local turn method
    - Leads to misidentification of Levy Walks and CCRW
    - can impact the test of absolute fit based on turning angle distribution
    - We also limited the time series to those with a minimum of 50 steps