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2019
MCM/ICM
Summary Sheet

In the 21st centuries, entertainment industry level up their movie production game. Before, the assumption of character's habit and movement merely based on director's imagination. But now, they try to not only use the imagination but also take the law of physics into an account. In this paper we presented a computerized model for analyzing Game of Thrones dragon's characteristics such as behaviour, habits, diet, and its interaction with the environment. Our model takes simulation into consideration as a significant determiner of Drogon, Rhegan and Viserion - Daenerys dragon's daily life.

We first make several assumptions about a dragon initial weight and body width based on their appearance on the movie. By analyzing the data, we can see that they follow the Gompertz Law. To follow the law, the growth parameter need to be estimated. To do so, the least square Levenberg–Marquardt algorithm is used to find the fitted model parameter. From this point on, we set this function as a dragon's ideal weight and body width over time. Now that we know the ideal measurement, we are interested in the actual dragon's measurement based on the growth factors that can be translated into differential equations. The growth factors are affected by caloric intake, energy expenditure, and growth hormones. To create a fitted model, we estimate the interaction factor between yield and growth hormone also the yield rate parameter using the same least square Lavenberg-Marquardt algorithm. In the previous study of the National Academy of Sports Medicine, the amount of calories a person need varies from one to the other. We assume that this also applied for a dragon. Therefore, we create a function of time that can act as the standard rule of daily calories intake. This function was build using the Artificial Neural Network with ideal body weight, width, and age at the time as the input. In the last step of our modeling process, we build an hourly dragon's movement simulation that is inspired by the application of Cellular Automaton. After running the simulation, it tells us what does a dragon needs in order to grow at a desirable rate. Dragon needs vary from the amount of sleep needed until the area of living. Moreover, this also tells us about dragon's behavior over time and the influence of the surrounding environment to its growth.

We believe with small adjustment our model can also be useful to provide insight into different problems. For the example, this mathematical model can be applied to determine the amount of bald eagle if there is a certain amount of food available around them. With bigger adjustment, we can simulate the dynamics of forest ecosystem where it contains more than one kind of animal. By running this simulation, we can have a better understanding of the ideal chain of food that can avoid one species extinction in the long run.

Contents

Cellular Automaton Simulation and Artificial Neural Network: A Way to Bring Dragon's to Live

1 Introduction

A great story like *Game of Thrones* (GoT) oftentimes drown our mind into imagination land. Existence of mythical creature like dragon was felt so real that we start to dig deeper about how much they eat, sleep, how they interact with each other, and so forth. This may seems silly but in the 21st centuries, entertainment industry is taking their movie production more seriously. For example, Disney has created a mathematical model that can perfect the princess's hair movement [1]. This is so the production house can create more realistic movie in the future. In order to do that, of course we have to imagine that we are part of the story and everything is real.

In this paper we presented a computerized model for analyzing dragon's characteristics such as behaviour, habits, diet, and its interaction with the environment. Our model takes simulation into consideration as a significant determiner of Drogon, Rhegan and Viserion - Daenerys dragon's daily life. Our simulation consider not only the movement, but also the weight and body width growth, the possibility of them fighting each other, and the availability of food resources. The concept of Cellular Automaton, Gompertz function [3], and Artificial Neural Networks were used to support our model. There are seven section of this paper. In section 2, we describe our assumption that is being used to develop the model that will be explained in section 3. Sensitivity analysis, case conclusion

1.1 Outline of Our Approach

In order to reach our objectives, we divided our work into 5 big categories, which are :

- **Develop the statistical model** to fit the known dragon's weight and body width data
- **Develop the ideal daily calories model** using the artificial neural network method
- **Develop the deterministic model** to calculate prediction of daily dragon's weight and body width
- **Develop a dragon simulation** to show the daily life movement and growth prediction.
- **Analyze dragon's behaviour**
- **Sensitivity analysis test** to see the parameter effects on the model

1.2 Assumption

Due to the high level of uncertainty in life, we have to make several assumptions to keep our model up and running. They are :

- T-rex is a reptile that has a similar body form with a dragon. A full-grown t-rex with body width 6.1 m will weight 15 ton. In GoT, the observer said that the dragon seen in season 7 with body width 64 m. Therefore, we assume that dragon's full grown weight is 157.37 ton.
- Dragon's rate of flying speed is 240 km/hour.
- Dragon needs oxygen to run their body metabolism. The more active they are, the higher the amount of oxygen needed. Therefore, when they sleep dragon burn half of the calories that they burn during day time. Moreover, when they are fighting with each other, they burn twice more calories than usual.
- There is no interaction between human and dragon.
- A dragon in the *Wyrmling* stage ages from 0 to 5. This is the stage when a dragon grows until their full grown size. Later when they turn 6, a dragon now considered as an adult.
- Dragon's body width can't decrease whereas its weight can.
- The weight and body growth is proportional.
- Dragon will turn all of its daily calories intake into energy to do daily activity.
- There are food resources spread across the world. The food location remain the same throughout the time.
- Dragon is able to fly great distances, breath fire, and resist tremendous trauma.
- Dragon can live in any kind of environment, however the surrounding environment affects dragon's sleep time.
- Dragon's growth hormone is activated slowly and be on its peak when a dragon enters the Adult age.
- A dragon has a lair which is located in its intitial position.
- In this timeline, we assume that one month equals to 30 days.

2 Method Description

2.1 Statistical Model

Based on the information that we obtain, we know that a baby dragon weight 10 kg. Unlike human, a dragon grows very fast. They triple their body weight in the count of one year. The crazy high growing rate doesn't end there. It just

```
begin
  k := 0;   ν := 2;   x := x_0
  A := J(x)^T J(x);   g := J(x)^T f(x)
  found := (||g||_∞ ≤ ε_1);   μ := τ * max{a_ii}
  while (not found) and (k < k_max)
    k := k+1;   Solve (A + μI)h_lm = −g
    if ||h_lm|| ≤ ε_2(||x|| + ε_2)
      found := true
    else
      x_new := x + h_lm
      ϱ := (F(x) − F(x_new))/(L(0) − L(h_lm))
      if ϱ > 0                                  {step acceptable}
        x := x_new
        A := J(x)^T J(x);   g := J(x)^T f(x)
        found := (||g||_∞ ≤ ε_1)
        μ := μ * max{1/3, 1 − (2ϱ − 1)^3};   ν := 2
      else
        μ := μ * ν;   ν := 2 * ν
end
```

Figure 1: Levenberg-Marquardt Algorithm [7]

gets faster for the next several years. In the end of year 5, a dragon will gain more than 150 ton, that is almost like gaining a full size of blue whale.

The Gompertz law is well known and widely used in many aspects of biology. It has been frequently used to describe the growth of animals and plants [2]. Let the weight of a dragon be a function of time t (day) and $weight(0) = weight_0 =$ 10 kg also $weight_\infty = weight(\infty) = 157370$ ton. By analyzing the assumed data, we can see that they follow the Gompertz Law in the first two years and follow the logistic equation afterwards. To follow the law, the growth parameter need to be estimated. The least square Levenberg–Marquardt algorithm is used to find the fitted model parameter. Let

$$\phi(t) = \begin{cases} weight_0 \cdot e^{(\frac{1}{weight_0})(1-e^{-b_1 t})}, & t \leq 720 \\ weight(720) + \frac{weight_\infty}{1+e^{b_2(t-720-1080)}} & else \end{cases} \tag{1}$$

be the fitted model with the growth parameter b_1 and b_2. Also let F be a least square function of time that can be read as

$$F(x) = \frac{1}{2}\sum_{j=1}^{m} r_j^2(x) \tag{2}$$

where $r_j(x) = \phi(x; t_j) - y_j$ is the discrepancies function between the actual and fitted value. Our objective now is to find the parameter in the model that minimize the value of (2). The Levenberg-Marquardt algorithm can be seen in figure 1. More thorough explanation of this method can be seen in [9]. After running the algorithm, the fitted parameters are $b_1 = 0.0009$ and $b_2 = 0.01$.

Let the body width of dragon also be a function of time t (day) and $bodywidth(0) = bodywidth_0 = 0.3$ m and $bodywidth_\infty = 70$ m. Using the same method, the fittest model for dragon's body width is

$$bodywidth(t) = \begin{cases} bodywidth_0 * e^{(\frac{1}{weight_0})(1-e^{-b_1 t})}, & t \leq 720 \\ bodywidth(720) + \frac{weight_\infty}{1+e^{b_2(t-720-1080)}}, & else. \end{cases} \tag{3}$$

Since our statistical model fit to the known data, we can assume that this is the ideal dragon's weight and body width over time.

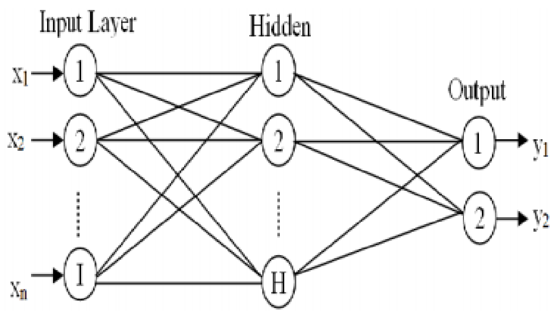

Figure 2: A typical ANN structure with three layers (Input, hidden and output) [7]

2.2 Ideal Daily Calories

In this section we will determine how much calories a dragon takes to do general activity, sleep and combat. A dragon considered in doing a general activity when they are eating, playing, and flying. In the recent study of National Academy of Sports Medicine, it said that the amount of calories a person needs varies from one to the other [5]. Let's assume it also applies for a dragon. In general, the higher the intensity of the activity, the more calories are burned. Ultimately, this depends on their weight, body width measurements, and age.

We will predict the ideal calories intake for each dragon using Artificial Neural Network, a computing system that has been inspired by how the human brain works. The neural network is not an algorithm, but rather a framework filled with a machine learning algorithm to process large complex data input.

In Artificial Neural Network, the neurons or nodes are grouped in several layers called input, output and one or several hidden layers [7]. A three-layer artificial neural network is shown in Figure 2.

The number of artificial neuron in the input layer is decided by the number of independent variables that we want to use to predict the value of the dependent variable. While in the output layer is decided by the number of dependent variables. Now the hidden layer can consist of many layers and each layer can consist of a number of artificial neurons depends on the user choice and "learning" methods. Each of the artificial neurons in each layer is connected by synapses and each of these synapses have their own weight. When the value in the input layer is transmitted to the next layer by this synapses, the value is multiplied by the weight of that synapses. By the time its arrived in the next artificial neuron, all the values received are added and then went through activation function to prevent the linear result. This process went on until it arrives in the output layer. This process is called forward propagation.

In the artificial neural network that we build, the neural network consists of 4 layers; the input layer, 2 hidden layers, and the output layer. The input layer has 3 artificial neurons. These 3 artificial neurons represent the independent variable. Each of the hidden layers consists of 2 artificial neurons. They are weight, age, and height of the dragons. The output layer has 1 artificial neuron, which is the predicted daily calories needs. We use the rectifier linear unit function for the activation function in the first and second hidden layer. For the loss function, we use a quadratic loss function. The weights are updated every 5 data train went through the model. The number of maximum iteration is 400 cycle, we use this number to let the model "learn" as much as it can. And finally we got a model with a mean absolute error of 66.93002, which is so small so we can tolerate them.

Caloric expenditure can be measured directly, which requires the measurement of the heat released by the body, or indirectly by measuring ventilation and the exchange of oxygen and carbon dioxide by the body. These methods are termed direct calorimetry and indirect calorimetry, respectively, and the research and validation of these methods date back to the late 1890's [6]. Since we assume that a dragon will turn all of its daily calories intake into energy to do daily activity, the amount of calories burn within an hour t_1 when a dragon does a general activity ($idx = 1$) is

$$generalactivity(t_1) = dailycalories(t)/24. \tag{4}$$

When an animal sleep, they tend to breath less than when they are doing a general activity. So, the amount of calories burn when a dragon sleeps for an hour t_1 ($idx = 2$) is

$$sleep(t_1) = generalactivity(t_1)/2. \tag{5}$$

Moreover, if we observe an animal when they fight with each other, you can see that they breath more often than usual. This is so they can catalyst their body metabolism in order to create more energy to fight their enemy. Using this assumption, the amount of calories burn when a dragon in a combat mode for an hour t_1 ($idx = 3$) is

$$combat(t_1) = generalactivity(t_1) * 2. \tag{6}$$

Therefore, if $Activity(t_1)$ is the function of calories burn per hour, it can be read as

$$Activity(t_1) = \begin{cases} generalactivity(t_1), & idx = 1 \\ sleep(t_1), & idx = 2 \\ combat(t_1), & idx = 3. \end{cases} \tag{7}$$

2.3 Deterministic Model

Even though we already have ideal dragon's weight and body width over time, we are still interested in knowing the individual actual measurement based on the amount of food consumed, energy expenditure and growth hormone.

To be able to create a deterministic model, consider GoT map in Figure **??** (top) that later we convert into $51x61$ grid (middle). The difference in color grid represent a different region. The white grid is the Arctic region, the green grid is the land region, the brown grid is the dessert, the grey grid is the mountain area, and the blue grid is the sea. A grid with color red represent Drogon, the navy blue grid represent Viserion, and the black grid represent Rhegal. Each grid represent $150x150$ square miles in real GoT world. As a carnivore, a dragon only eat raw meats such as lamb, horse, wolves, big tuna fish, cow and bull. Based on *www.nutritionix.com* website, the calories contained in different type of food sources can be seen in Table 1. In other words, a dragon eats a total of

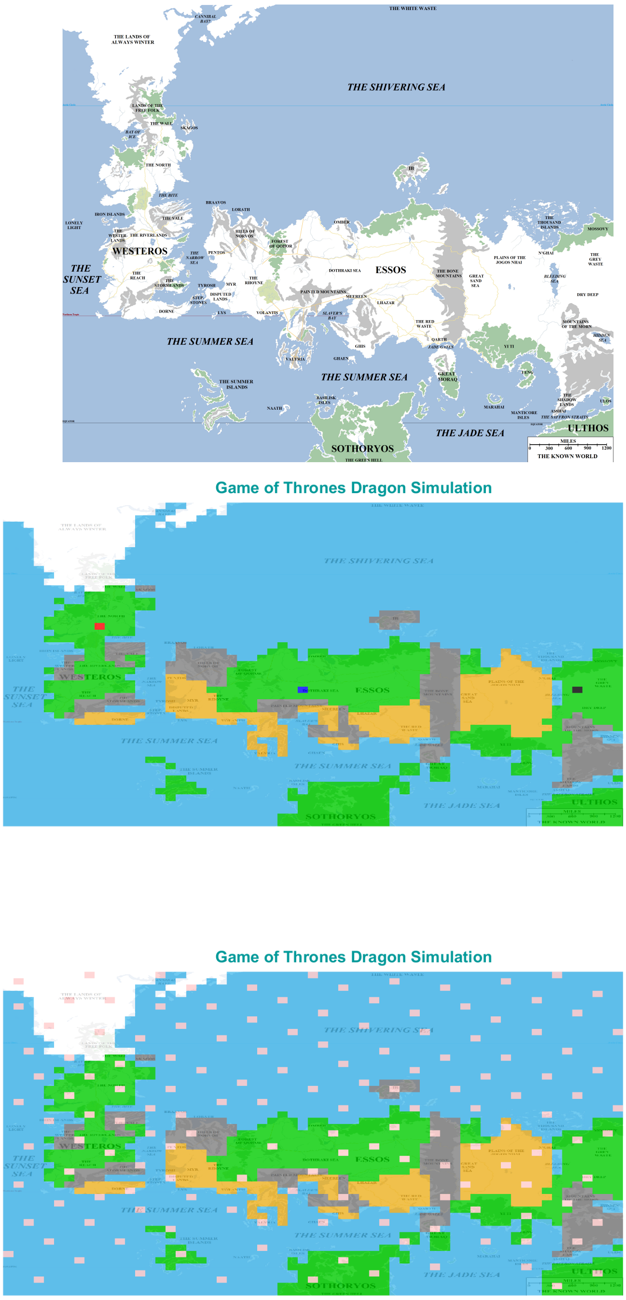

Figure 3: (top) GoT world map, (middle) GoT world pixelated, (bottom) GoT food resources distribution.

Index (i)	Type of Food	Food Weight (Kg)	Calories(i)
1	Lamb	100	268052
2	Horse, Wolves, Big Tuna Fish	635	844550
3	Cow	700	1001000
4	Bull	1000	1430000

Table 1: Calories Intake

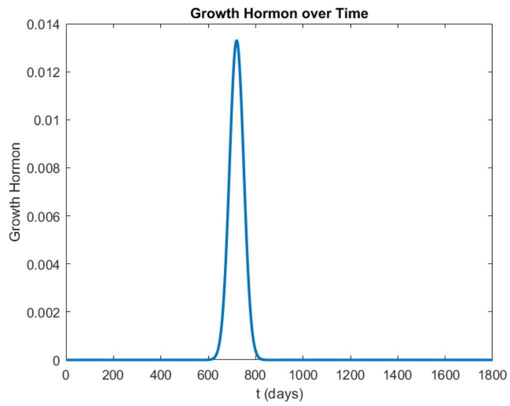

Figure 4: Growth hormones over time

$calin(t) = \sum_{i=0}^{24} Calories(i)$ calories and burn $energyexp(t) = \sum_{i=0}^{24} Activity(i)$ calories.

Besides food intake and energy expenditure, a dragon's growth is also affected by several hormones. Let's called all of the hormones that contributed to dragon's growth as the growth hormone. Because growth hormone is activated slowly and be on its peak when a dragon enters the Adult age and slows down afterward, we can think the daily growth hormone's effect as a Gaussian function that can be written as

$$growth(t) = \frac{1}{\sigma\sqrt{2*\pi}} e^{-\frac{1}{2}(\frac{x-\mu}{\sigma})^2} \tag{8}$$

where we expect them to hit "puberty" at the age of $\mu = 720$ days with tolerance $\sigma = 30$ days.

masukin grafik growth function

Let $yield(t)$ be a function of everyday discrepancies between dragon's calories intake and energy expenditure

$$yield(t_1) = calin(t_1) - energyexp(t_1).$$

Therefore, a dragon's growth rate can be written as

$$\frac{dweight}{dt} = yield(t)(\alpha + \beta * growth(t)) \tag{9}$$

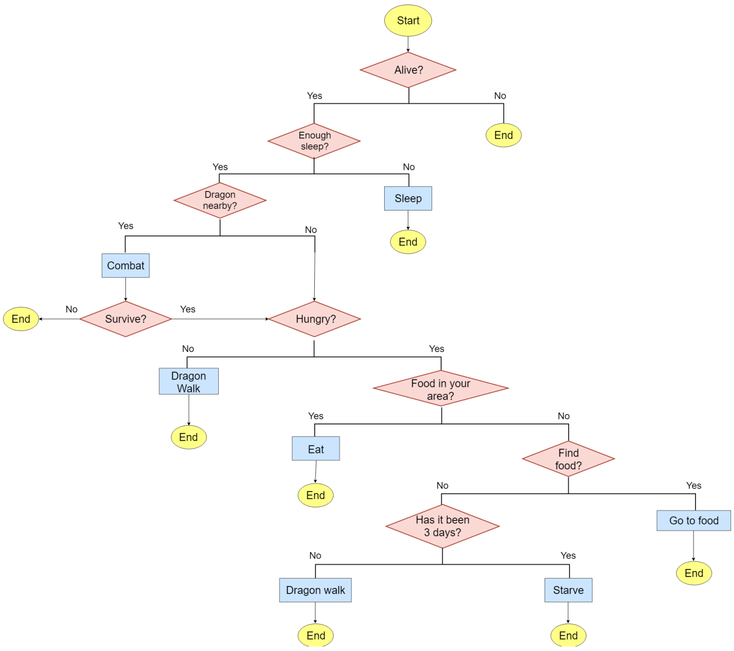

Figure 5: Flow chart of dragon's simulation

where $\alpha = 8 \ldots 10^{-4}$ is the yield rate and $\beta = 0.02$ is the interaction factor between yield and growth hormone. The value of α and β is obtained by running the same Levenberg-Method that has been explained before. If we integrate both sides in terms of t, we will have

$$weight(t) = \sum_{i=1}^{t} yield(i)(\alpha t + \beta\phi(\frac{t-\mu}{\sigma}) \tag{10}$$

where ϕ is the cumulative distribution function of standard normal distribution.

Since we assume that the dragon's weight is proportional to the dragon's body width, using the same method we have

$$bodywidth(t) = \sum_{i=1}^{t} yield(i)(\gamma t + \delta\phi(\frac{t-\mu}{\sigma}) \tag{11}$$

where $\gamma = 10^{-7}$ and $\delta = 10^{-3}$.

2.4 Flowchart

To give a better understanding for the readers, we provide a flowchart (Figure 5) that summarize the whole dragon's simulation. As you can see from the chart above, it is a pretty complex flow. But now, we are going to break it down to make it easier for you to understand.

The simulation that we do is to evaluate how much calories intake needed, the amount of energy expenditure, and the area for a dragon. Aside from that, we are also going to evaluate their characteristic, behaviour, habit, diet, and interaction with its environment.

The simulation started by initiating the map of Game Of Throne's map into small grid with matrix in the size of $51x61$. All of those grid are mapped corresponding to the real environment on Game Of Thrones, such as grass field, mountain area, arctic, sea, and desert. We also initialize food source in the grid complete with the number of food on that grid. Now, we are going to make some parameter for the dragon.

Here are the parameters:

1. Dragon x position
2. Dragon y position
3. Direction before
4. Dragon origin x position
5. Dragon origin y position
6. Walk indicator
7. Calories intake requirement
8. Calories intake (Day)
9. Calories intake (Total)
10. Dragon indicator
11. Energy expenditure (Day)
12. Energy expenditure (Total)
13. Dragon condition
14. Sleep time
15. Total activity time
16. Sleeping indicator
17. Yield
18. Age
19. Weight
20. Length
21. Starvation

All the parameter are now well defined. The next step is to choose how long the simulation will run, which is n-th hour. For every iteration, a series of process will happen to each dragons consecutively. Those processes are available in the flowchart. Below are the explanation of the whole processes from the flowchart.

1. Based on the dragon's parameter that has been evaluated on every iteration. If yes, then the program is over for that iteration. If not, then we'll continue with the next question.
2. Does the dragon needs sleep? If yes, then the dragon went to sleep and the program is over for that iteration. If not, then the dragon will run the combat function.
3. Is there an enemy (another dragon) located in the 4 neighborhood grid? If yes, then the two dragons will battle each other and have the same death probability. If that dragon dies from the battle, then program is over for that iteration. if there is no enemy nearby, then we'll continue the process to the next question.
4. Does the n-th dragon hungry? If not, then the dragon will perform dragon movement and the program is over for that iteration. If yes, then we are going to execute eat.
5. Does the grid of the n-th dragon contains food source? If yes, then that dragon will stays on that grid and the program is finished for that iteration. If not, then we are going to the next question.
6. Is there food near the n-th dragon? If yes, then the dragon will move back to china. If not, then we are going to the next question.
7. Has the dragon been eating for the past 3 days? If yes, then we will execute starve function. If not, then it will be followed by dragon movement function. Program will end for that iteration.

2.5 Dragon's Simulation

In this last modeling step, we contribute all of our existing models to build an hourly dragon's movement simulation that is inspired by the application of Cellular Automaton. It consists of a regular grid of cells, each in one of a finite number of states, such as on and off (in contrast to a coupled map lattice) [8].

In this paper, we come up with a simulation that able to perform several different types of dragon's activities, such as

- Combat
- Eat
- Search
- Dragon movement
- Starve
- Daily Activity

Later, we call this as functions.

2.5.1 Combat Function

It is a function to handle a situation when a dragon tracks the existence of another dragon within one grid radius in four directions (up, down, left, and right). If they do detect an enemy, they will attack the other one using a basic attack or fire breathing. Each dragon can only attack once and have the potential to kill the other with probability 0.001. After the combat over, dragons will stay in the same grid.

2.5.2 Eat Function

Just like the name, eat function will handle the situation when a dragon eats. A dragon will eat if its existing grid has food resources. After eating, dragon stays in the same grid.

2.5.3 Search Function

If a dragon didn't find a food resource available on its location, they will look the neighboring grid within one grid radius in four directions. If they find a food resources there, a dragon will move towards that grid.

2.5.4 Dragon Movement Function

To travel from one grid to the other, we assume that a dragon always fly above the grid. This function especially made to determine the random flying direction of a dragon. To avoid confusion, a dragon cannot go pass the map border and there can't be two dragons in the same grid. If there is a condition when dragon A wants to move to another grid with existing dragon B or when they hit the map border, rather than forcing the move dragon A will stay on its grade and cancel the move. Moreover, a dragon cannot visit its previous location.

2.5.5 Starve Function

A dragon will die after not eating in the consecutive 7 days. To avoid this, after a dragon not eating in the consecutive 4 days, it will find the fastest way to its lair (the initial position).

2.5.6 Daily Function

This function will evaluate the dragon's calories intake, energy expenditures, yield, weight, height, age, sleep duration, and starvation condition. For food supplies, we will also evaluate its availability and we create a system that can restock the sup lies every three months.

3 Dragon's Behaviour

In this section, the scheme is implemented to simulate dragon's daily movement. Since our simulation include random variable in the dragon movement function, we always get different results in each simulation even the parameters remain the same. Therefore, we need to run several simulations to find the tendencies of dragon's behaviour.

In the first simulation, we want to see dragon's behaviour since they were born until they are 1 months old (30 days). Snapshots of dragon's movement can be seen in figure 6

To support the growth of a dragon, they will need to eat a lot. We try to find the least number of food resources in one place by trial and error. The result shows that the most optimum number is 20 for horse, wolves, big tuna fish, cow, and bull, whereas it is 7 for a lamb. In every 3 months, the food resources needs to be restocked $\frac{1}{4}$ of the optimum number. This is to avoid the food bank from running out of food.

We know that a dragon needs to eat a lot in order to grow to its full size. As carnivores, they only will to eat raw meats that they got from food hunting in the wild. A study shows that beef is highly inefficient to produce because only 1% of the portion is converted to calories [10]. Moreover, this inefficiency turns out to increase the global warming rate. In the other words, dragon's existence is actually harming the environment slowly but sure.

You may now think that we better of without their existence in this world. However, if we have dragons for a long time and they become extinct suddenly, there will be a food of chain collapse. The population of dragon's prey such as cow, fish, and lamb will explode immediately. If we put human variable into the situation, there will be a slight chaos because now we probably will see more stray animal in front of us. But after a while, the mother nature will find its new balance. Either by the gradual decrease of the exploding prey population, or there is a new set food chain that is being used.

Based on our simulation, if there is enough food around a dragon, they tend to circulate on the same area. This happened even though we have coded them to not be able to go back to its previous time location. On the other hand, if there is not enough food around them, they tend to roam around and discovering new locations.

Climate condition is very important to our analysis. This is because the region affects the dragon sleeping time. Being in the mountain and arctic region will decrease the dragon's sleep need, whereas being in the desert region will increase dragon's sleep need. If the sleep need decrease, dragon will be more active during the day that creates lower yield than usual. In the long run, a dragon that lived in the deserted area will tend to weight more than the one who lived in the arctic area. In conclusion, the region affects dragon's measurement.

4 Sensitivity Analysis

We do the sensitivity analysis to check the effect of our parameters in our model. As it can be seen in figure 7, when we increase the parameter, it will result higher dragon's measurement.

5 Application in Different Problems

Our mathematical model can be used to model the movement of big carnivore bird, such as eagle and vulture. With this, we can perform a simulation of their movement and learn their behavior, habit, diet, and interaction with their environment. Moreover, by learning the behavior and habit of an eagle in the

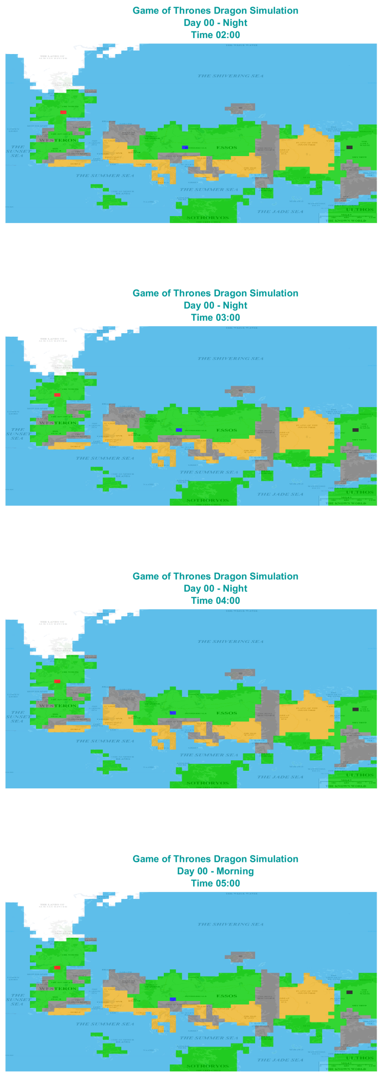

Figure 6: Snapshots of dragon movements over time

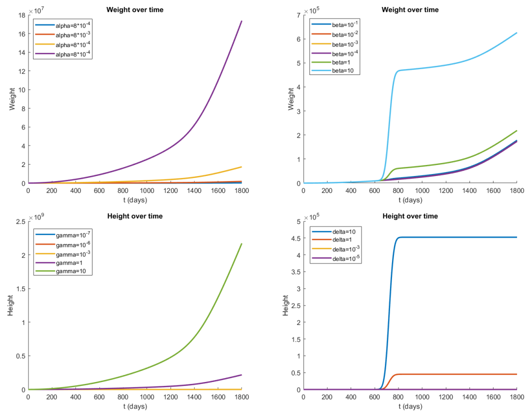

Figure 7: Sensitivity test of parameter (top left) α, (top right) β, (bottom left) $gamma$, (bottom right) $delta$

simulation, we can also predict their whereabouts. Imagine if we apply this model to some of the endangered animal species. By learning their behavior and habit, we can locate and save them from the danger of the wild. Long story short, we just prevent the extinction of a species. By learning how they interact with their environment, there are two ways to use this information. The first one is to make artificial ecosystem on the wildlife reserve as close as the actual ecosystem in the wild in order to make a better environment for the animal. The second one is we can make a better ecological relation between wildlife in that ecosystem. Maybe that species are the one who damaged the ecosystem and bring harm to the other animal. This way we can prevent them to cause anymore harm to the ecosystem. With further modification and more data from the ecosystem, we can simulate the whole ecosystem process including food chain. Which will give us a better insight at how the ecosystem around us really works and may prevent a lot of species extinction ahead.

Hello Mr. Martin,

We are such a big fan of you! We love your work on the “A Song of Fire and Ice” and of course it’s movie adaptation “Game Of Thrones”. Drogon, Viserion, and Rhegal really caught our eager young mind. There is something about them that always amaze us in their appearance at any scene. They grew up so fast in just 5 seasons in! They must really have a very efficient body metabolism.

We all know that the 3 dragons were born in the deserted area. Ever since, they have been following Daenerys around the world, from crossing the black sea in the dying heat to fighting the white walkers in the frozen North. Your imagination is really fantastic and limitless. But maybe I have something up on my sleeves to help you improve heighten the “Game Of Thrones” experience.

We build a mathematics model to analyze the dragons behaviour, habit, diet, and its interaction with the environment. We use our model to create a simulation of how the dragons aged, from they were born to adult like in the movies. When we run our model, we get some interesting result that may caught your eyes.

First, dragons can adapt in such an extreme climate, such as savanna, desert, and even arctic as long as they can find the food resources around them. To adapt with the extreme environment, a dragon need to adjust its energy needs by sleeping in or wake up earlier. A dragon needs to sleep for 4 hours in arctic climate, 8 hours in regular tropical environment, and 10 hours in desert environment.

Besides of the sleeping adjustment, their ability to survive the extreme weather is due to its diet flexibility. Even though their calories need remain the same in different place, they don’t have to eat the same thing to satisfies their hunger. A dragon sense of survival is high, they will be able to find a food source in almost every climate possible. So, when the dragons went to arctic, they found food. Likewise, they went to dessert, they still have something to fill their tummy with. This prevent them to die from hunger.

Since they maintain their calories even in the extreme weather, this also means that they maintain their strength to combat their enemy. Therefore, a dragon always ready to fight even in the coldest day or the hottest day ever. This is very beneficial especially when you are in the war period of time. We are so sad to see Viserion to join the wrong side, but hopefully with Drogon and Rheagal’s power combined we can still claim the victory towards our enemy.

Everything that we explain to you in this letter is not violating any physics law out there. We know that you have a smarty fans that always wants to prove every little detail in your movie. We hope that these insight’s will can help you to train the dragon to be more majestic on screen. I am sure the viewers will be even more thrilled with a little more detail that you provide using our mathematical model.

Best regards,

You biggest fans from Indonesia 1924165

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