Instructions of the **Grazepix** Java Program version 2

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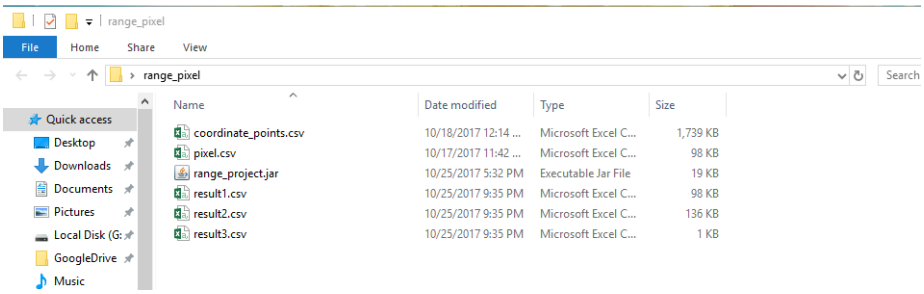
1 Introduction

This tutorial presents how to extract presumed grazing locations using animal velocity between two consecutive points, then these extracted grazing points were used to calculate percent grazed pixels, and pixel residence time, revisit rate (visits on different days), and return interval (interval between visits when cows visited the same pixel for more than once) for each animal.

2 Put the files into the folder

1) Create a new folder in your Desktop or where you desire to put the **Grazepix** program. 2) Name the created folder to "range_pixel". 3) Put the jar file "range_project.jar" into the folder. 4) Put the coordinate file and pixel file into the folder, which default name is *coordinate_points.csv* and *pixel.csv* respectively.



The format of the file is showed as following:

1) Convert your GPS data into the CSV format and use the comma as the delimiter. In total, the CSV file should have **6** columns of basic information. They are: **id, CowID, date, time, northing, easting.** The **id** is the unique id of the GPS data record. The **CowID** is the unique id of each cow. It's could

be an integer or a string of text. The format of **Date** is yyyy-MM-dd. The format of **time** is HH:mm:dd. The **northing** and **easting** are float numbers that represents the location of the cow at the time.

One thing needs to be noticed, the given id of GPS record need to be organized very carefully. **All of the calculation is based on two consecutive records.** Here is an example how the GPS coordination file is organized: *The cow1 has 10 GPS records on the first day, so the GPS record ids of the cow1 in the first day should be from 1 to 10. The GPS records of the same cow1 on the second day should start with 11. Assume the cow1 totally has 100 GPS records, the id of the GPS records of the next cow should start with 101.*

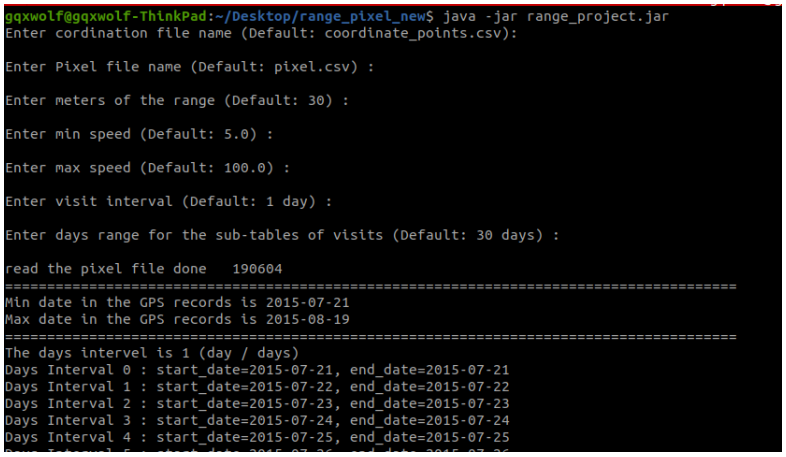
```
ID,CowID,Date,Time,Northing,Easting
1,AH8025DSG15_616_0-0,2015-07-21,0:00:26,3610299.948,336789.8104
2,AH8025DSG15_616_0-0,2015-07-21,0:10:27,3610296.209,336792.6401
3,AH8025DSG15_616_0-0,2015-07-21,0:20:27,3610317.09,336792.7754
4,AH8025DSG15_616_0-0,2015-07-21,0:30:48,3610304.48,336795.488
5,AH8025DSG15_616_0-0,2015-07-21,0:40:28,3610326.406,336811.024
6,AH8025DSG15_616_0-0,2015-07-21,0:50:24,3610321.706,336806.1509
7,AH8025DSG15_616_0-0,2015-07-21,1:00:18,3610310.362,336806.7442
8,AH8025DSG15_616_0-0,2015-07-21,1:10:31,3610310.19,336806.4035
9,AH8025DSG15_616_0-0,2015-07-21,1:20:25,3610325.982,336808.4829
10,AH8025DSG15_616_0-0,2015-07-21,1:30:30,3610289.193,336810.6214
11,AH8025DSG15_616_0-0,2015-07-21,1:40:32,3610269.741,336749.632
12,AH8025DSG15_616_0-0,2015-07-21,1:50:48,3610247.775,336746.0154
13,AH8025DSG15_616_0-0,2015-07-21,2:00:17,3610270.217,336737.4943
14,AH8025DSG15_616_0-0,2015-07-21,2:10:48,3610300.253,336777.2946
15,AH8025DSG15_616_0-0,2015-07-21,2:20:28,3610303.451,336775.7044
16,AH8025DSG15_616_0-0,2015-07-21,2:30:26,3610307.401,336774.8868
17,AH8025DSG15_616_0-0,2015-07-21,2:40:26,3610302.26,336780.697
18,AH8025DSG15_616_0-0,2015-07-21,2:50:24,3610305.179,336777.1406
19,AH8025DSG15_616_0-0,2015-07-21,3:00:26,3610305.031,336776.7252
```

2) Convert your pixel data into the CSV format and use the comma as a delimiter. In total, the CSV file could have at least 3 columns. There are three **Required columns**. They are: **pid, northing, easting**. The **pid** is a unique id for each pixel The **Northing** and the **Easting** are float numbers. Also, you could put additional information of each pixel at the end to each row, etc. vegetable class.

```
Pixel,Northing,Easting,Vegetation class
1,5132194.3,434273.6,4
2,5132209.3,434273.6,4
3,5132209.3,434288.6,4
4,5132224.3,434273.6,4
5,5132224.3,434288.6,4
6,5132224.3,434303.6,4
7,5132224.3,434318.6,4
8,5132239.3,434288.6,4
9,5132239.3,434303.6,4
10,5132239.3,434318.6,4
11,5132239.3,434333.6,4
12,5132239.3,434348.6,4
13,5132254.3,434303.6,4
14,5132254.3,434318.6,4
15,5132254.3,434333.6,4
16,5132254.3,434348.6,4
17,5132254.3,434363.6,4
18,5132254.3,434378.6,4
19,5132269.3,434303.6,4
20,5132269.3,434318.6,4
```

3 Run The Code

You could run the code from the Command line on Windows/Linux/MacOS. The results will put in the same folder as the input files and the java program.



The parameters:

- **input file of coordination data**: the GPS data, default is named *coordinate_points.csv*.
- **input file of pixel data**: the pixel data, default is named *pixel.csv*.
- **Range size**: The pixel range size in meters, the length of one side of the pixel square. Default is *30*.
- **min speed and max speed**: The range of the speed that you define the cow is walking or running. Default value is *5.0* and *100.0* respectively.
- **visit interval**: The length of the interval in days, which is used to calculate the number of visits during each interval. Default is *1 day*.
- **interval of the sub table**: The length of the interval in days, which is used to create the sub-tables of the visitation. Default is *30 days*.

4 Results of the Code

The **result1** is the statistics. For each cow and each pixel calculate how many ***intervals*** this cow visit back to this pixel. The interval is controlled by the parameter **visit interval**.

- Cow ID.
- Pixel ID.
- Times of visiting back to pixel, calculated based on the unit of **interval**. For example, if the number is 2, it means the cow visited this pixel in two **intervals**. If value of the **interval** is 2 days. No matter how many times

this cow visited this pixel in these two days, it only count it **1 time**. The interval is controlled by the parameter **visit interval**.

- Interval days, The # of days between the date of the first time the cow come in this pixel and the date of the last time the cow access pixel.
- visited back dates list, List of the dates when the cow visited back this pixel.
- Additional information of the pixel, such as vegetable class of this pixel.
- Northing, The northing value of location of this pixel.
- Easting, The easting value of the location of this pixel.

The **result2** is the statistics. For each year, each cow and each pixel calculate how many days this cow visit back to this pixel.

- Cow ID.
- Years.
- Pixel ID.
- Times of visiting back to pixel, calculated based on the unit of day. For example, if the number is 2, it means the cow visited this pixel in two **intervals**. If value of the **interval** is 2 days. No matter how many times this cow visited this pixel in these two days, it only count it **1 time**. The interval is controlled by the parameter **visit interval**.
- Period value, The # of average **intervals** of the year the cow visit the this pixel.
- Additional information of the pixel, such as vegetable class of this pixel.
- Northing, The northing value of location of this pixel.
- Easting, The easting value of the location of this pixel.

The **result3** is the statistics. For each year, each cow and each pixel calculate the average of the number of days this cow visit back to this pixel. According to their code, it only count the pixel that the period value is not "\N" in result2.

- Cow ID.
- Years.
- Number of Pixels, number of the total pixels that the cow visited in that year.
- Number of **intervals** the cow visited in each pixel in this year.
- average **intervals** the cow visited back in each pixel.

The **result4** is the statistics. The number of times and time spent of each cow in each pixel.

- Cow ID.
- Pixel ID.
- Number of **GPS records** the cows visited this pixel. For example, if the value is 2, it means there are **two GPS records** shows that one cow visited this pixel over all of the GPS records.

- Time spent of the cow in this pixel. The time is calculated by two consecutive GPS records. For example, there are two consecutive GPS records, *a and b*, the time spent at *a.pixel* is $|b - a|$.
- Additional information of the pixel, such as vegetable class of this pixel
- Northing, The northing value of location of this pixel.
- Easting, The easting value of the location of this pixel.

The **result5** is the statistics of the number of **intervals** of each cow in each pixel. It consist of one master table and several sub-tables. The content of the master and sub-tables are same. Each row is the number of visited **intervals** of each cows. The master table shows the statistic over all the date that is provide by the GPS data. The each sub-table is shows the statistic over the date in one sub-table interval which is controlled by the parameter - **interval of the sub table**.

For example, the GPS file includes the records form 09/01/2015 to 10/15/2015. The master table contains the statistic result from 09/01/2015 to 10/15/2015. If the parameter **interval of the sub table** is equal to **30** days, there should be two sub-tables, one contains the information from 09/01/2015 to 09/30/2015, another table contains the information 10/01/2015 to 10/15/2015. The name of the sub-table is *result5_subtable_{start_data}_{end_date}.csv*.

The **result6** is the statistics of the number of pixels that is visited by cows with different counts (e.g. how many pixels are visited only once/twice/three times, and etc) in one **interval**.

Need to pay an attention, except the statistic of the visitation for each cow, there is one more column that is named *"all"* which calculates for all cows. But its value is not equal to the summation of all the cows in one count. For example: There are two cows. One pixel **p** is visited by one cow cow_1 in two intervals (v_1 and v_2) and another cow cow_2 in one interval (v_2). So, the number of time that the pixel is visited for the column *"all"* is still ***two*** intervals (v_1 and v_2), not ***three***.