

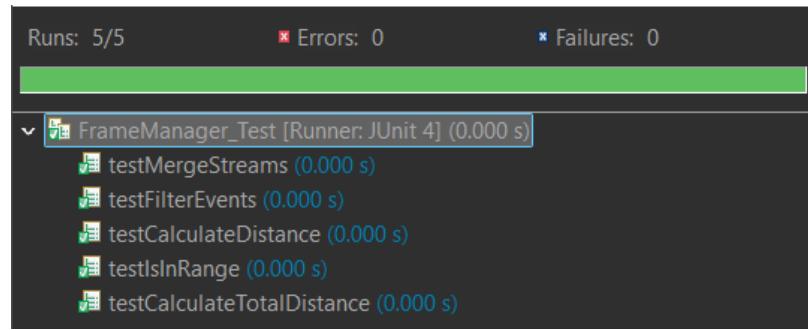
## Run the program

1. Place sodium.jar, swidgets.jar, org.hamcrest\_3.0.0.jar and org.junit\_4.13.2.v20240929-1000.jar in the root folder
2. Place a src/ folder in the root folder
3. Place all the .java into the src/ folder
4. Execute command  
`javac -d bin -cp ".;org.hamcrest_3.0.0.jar;sodium-1.2.0.jar;swidgets.jar;org.junit_4.13.2.v20240929-1000.jar"  
src\*.java`  
in the root folder in the terminal
5. A bin folder will be created in the root folder
6. Execute command  
`java -cp ".;org.hamcrest_3.0.0.jar;bin;sodium-1.2.0.jar;swidgets.jar;org.junit_4.13.2.v20240929-1000.jar"  
Main`  
to run the application in the root folder in the terminal
7. Execute command
8. `java -cp ".;org.hamcrest_3.0.0.jar;bin;sodium-1.2.0.jar;swidgets.jar;org.junit_4.13.2.v20240929-1000.jar"  
org.junit.runner.JUnitCore FrameManager Test`  
to run the unit test in the root folder in the terminal

## Testing

There are some logical function tests to validate the computational and reactive parts of the program. Some components, such as real-time display updates or GUI responsiveness, cannot be fully tested through Junit as the application includes a GUI built with Swing and Sodium FRP. Therefore, those features needed to be tested manually by using screen capture in this report.

## Junit



### testMergeStreams

This test verifies that the mergeStreams function can combine multiple Sodium Stream<GpsEvent> objects into a single stream. It can ensure that updates from all sources propagate correctly.

### testFilterEvents

Ensure the filterEvents function can successfully filter a list of GPS events and return only the event if they are in range (within the given latitude and longitude boundaries)

### testCalculateDistance

To confirm the calculateDistance function correctly computes the distance between two GPS coordinates with three values (latitude, longitude and altitude).

### testIsInRange

Verifies that the isInRange function determines whether a GPS event's latitude and longitude fall within a specified range correctly.

### testCalculateTotalDistance

Check if the calculateTotalDistance function calculates the sum of total travel distance between a list of consecutive GPS events.

## Manually Test with Screen Capture

### 1. Ten Tracker Simplified Display

Tracker 0 lat:39.986546 lon:116.326802	Tracker 1 lat:39.980733 lon:116.329168	Tracker 2 lat:39.982158 lon:116.310517	Tracker 3 lat:39.966373 lon:116.358813	Tracker 4 lat:7.883777 lon:98.392853
Tracker 5 lat:40.0211066 lon:116.3842083	Tracker 6 lat:39.8517949 lon:116.2772149	Tracker 7 lat:30.4833583 lon:114.3334666	Tracker 8 lat:39.212625 lon:113.595529	Tracker 9 lat:39.987734285 lon:116.427985688

The application GUI displays ten trackers, and their latitude and longitude are updated in real time when new data is received. The altitude value is removed from display.

## 2. Most Recent Event Display

Latest Event	Tracker7   lat:30.49339 lon:114.3341733 alt:118.1
Latest Event	Tracker0   lat:39.991212 lon:116.327028 alt:146.0
Latest Event	Tracker6   lat:39.8292416 lon:116.2912733 alt:134.5

The latest event panel shows the most recently received data from gps.dat using the merged stream. It keeps updating when new data is received, and only displays the latest event.

Latest Event	Waiting for tracker events...
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If there is no new data received after 3 seconds, the label will change to “Waiting for tracker events...”.

## 3. Filter Display by Latitude and Longitude

Latitude Min	Latitude Max	Longitude Min	Longitude Max	Set Range
Filtered Events	Current Range	Lat[-90.00~90.00], Lon[-180.00~180.00]		

There are four input fields for the user to enter the distance range. Once they enter the values, they can click the “Set Range” button to apply the range. The default range is latitude -90 to 90 and longitude -180 to 180.

Latitude Min	Latitude Max	Longitude Min	Longitude Max	Set Range
	10		120	
Filtered Events	Current Range	Lat[-90.00~10.00], Lon[-180.00~120.00]		

The current range panel value will change based on the input field.

Latitude Min	Latitude Max	Longitude Min	Longitude Max	
				Set Range
<b>Filtered Events</b>				
<b>Current Range</b>				
Lat[-90.00~90.00], Lon[-180.00~180.00]				
Tracker 0 lat:40.005631 lon:116.322671 Distance: 1094 m	Tracker 1 lat:39.980929 lon:116.329164 Distance: 68 m	Tracker 2 lat:39.996616 lon:116.331739 Distance: 1172 m	Tracker 3 lat:39.916511 lon:116.455296 Distance: 5166 m	Tracker 4 lat:7.933006 lon:98.395266 Distance: 2859 m
Tracker 5 lat:40.0976149 lon:116.4752033 Distance: 7403 m	Tracker 6 lat:39.8307783 lon:116.4177516 Distance: 7314 m	Tracker 7 lat:30.5131899 lon:114.3359116 Distance: 1843 m	Tracker 8 lat:39.093497 lon:113.640096 Distance: 5746 m	Tracker 9 lat:39.994411219 lon:116.445668034 Distance: 2006 m

Under the current panel, there is ten tracker displayed, it is as same as the “Ten Tracker Simplified Display”, but an extra “Distance” value. By default latitude and longitude, the panel display all the trackers.

Latitude Min	Latitude Max	Longitude Min	Longitude Max	
				Set Range
<b>Filtered Events</b>				
<b>Current Range</b>				
Lat[-90.00~10.00], Lon[-180.00~180.00]				
Tracker 0 Out of Range Distance: 0 m	Tracker 1 Out of Range Distance: 0 m	Tracker 2 Out of Range Distance: 0 m	Tracker 3 Out of Range Distance: 0 m	Tracker 4 lat:7.933006 lon:98.395266 Distance: 2859 m
Tracker 5 Out of Range Distance: 0 m	Tracker 6 Out of Range Distance: 0 m	Tracker 7 Out of Range Distance: 0 m	Tracker 8 Out of Range Distance: 0 m	Tracker 9 Out of Range Distance: 0 m

Latitude Min	Latitude Max	Longitude Min	Longitude Max	
				Set Range
<b>Filtered Events</b>				
<b>Current Range</b>				
Lat[35.00~90.00], Lon[116.00~180.00]				
Tracker 0 lat:40.00751 lon:116.319857 Distance: 1023 m	Tracker 1 lat:39.980776 lon:116.329194 Distance: 77 m	Tracker 2 lat:39.999213 lon:116.335929 Distance: 1024 m	Tracker 3 lat:39.913259 lon:116.454934 Distance: 2838 m	Tracker 4 Out of Range Distance: 0 m
Tracker 5 lat:40.1340183 lon:116.4773666 Distance: 7877 m	Tracker 6 lat:39.8317316 lon:116.4518716 Distance: 7111 m	Tracker 7 Out of Range Distance: 0 m	Tracker 8 Out of Range Distance: 0 m	Tracker 9 lat:39.994564458 lon:116.44559155 Distance: 1389 m

Latitude Min	Latitude Max	Longitude Min	Longitude Max	
				Set Range
<b>Filtered Events</b>				
<b>Current Range</b>				
Lat[-90.00~90.00], Lon[-180.00~116.00]				
Tracker 0 Out of Range Distance: 0 m	Tracker 1 Out of Range Distance: 0 m	Tracker 2 Out of Range Distance: 0 m	Tracker 3 Out of Range Distance: 0 m	Tracker 4 lat:7.933006 lon:98.395266 Distance: 2859 m
Tracker 5 Out of Range Distance: 0 m	Tracker 6 Out of Range Distance: 0 m	Tracker 7 lat:30.5189633 lon:114.3290233 Distance: 1437 m	Tracker 8 lat:39.081662 lon:113.65049 Distance: 4584 m	Tracker 9 Out of Range Distance: 0 m

The filtered ten tracker panel will show the information only if they are in range. Otherwise, their label will be marked as out of range.

## 4. Distance Calculation

Latitude Min	Latitude Max	Longitude Min	Longitude Max	
<input type="button" value="Set Range"/>				
Filtered Events Current Range				
Lat[-90.00~90.00], Lon[-180.00~180.00]				
Tracker 0 lat:40.007775 lon:116.319353 Distance: 217 m	Tracker 1 lat:39.981083 lon:116.329293 Distance: 89 m	Tracker 2 lat:40.006455 lon:116.346528 Distance: 1915 m	Tracker 3 lat:39.914418 lon:116.453853 Distance: 560 m	Tracker 4 lat:7.933006 lon:98.395266 Distance: 2859 m
Tracker 5 lat:40.2199849 lon:116.5044016 Distance: 8765 m	Tracker 6 lat:39.8692199 lon:116.4855249 Distance: 4913 m	Tracker 7 lat:30.523855 lon:114.3118566 Distance: 1870 m	Tracker 8 lat:39.073339 lon:113.666302 Distance: 3471 m	Tracker 9 lat:39.994448548 lon:116.445479765 Distance: 141 m

There is a total distance value display under the latitude and longitude value in each tracker. It will calculate the total distance with all the event within the range.

Latitude Min	Latitude Max	Longitude Min	Longitude Max	
<input type="button" value="Set Range"/>				
Filtered Events Current Range				
Lat[40.25~90.00], Lon[-180.00~180.00]				
Tracker 0 Out of Range Distance: 0 m	Tracker 1 Out of Range Distance: 0 m	Tracker 2 Out of Range Distance: 0 m	Tracker 3 Out of Range Distance: 0 m	Tracker 4 Out of Range Distance: 0 m
Tracker 5 lat:40.2494833 lon:116.5449316 Distance: 1201 m	Tracker 6 Out of Range Distance: 0 m	Tracker 7 Out of Range Distance: 0 m	Tracker 8 Out of Range Distance: 0 m	Tracker 9 Out of Range Distance: 0 m

Take Tracker 5 as an example. It only calculates the events where the latitude and longitude are within the specified range. The distance has reduced from around 8765 m to 1201 m.

<b>Tracker 8</b> <b>lat:39.061423 lon:113.669973</b> <b>Distance: 3828 m</b>	<b>Tracker 8</b> <b>lat:39.061992 lon:113.66984</b> <b>Distance: 3814 m</b>
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Also, take Tracker 8 as an example. Tracker 8's distance keeps decreasing because the distance is calculated only based on events within the last 5 minutes. Tracker 8 may either have not received new data or its new movement is smaller than the data recorded earlier within that 5-minute window.

## 5. Filtered Most Recent Event Display

Latitude Min	Latitude Max	Longitude Min	Longitude Max	
<input type="button" value="Set Range"/>				
Filtered Events Current Range				
Lat[-90.00~10.00], Lon[-180.00~180.00]				
Tracker 0 Out of Range Distance: 0 m	Tracker 1 Out of Range Distance: 0 m	Tracker 2 Out of Range Distance: 0 m	Tracker 3 Out of Range Distance: 0 m	Tracker 4 lat:8.173023 lon:98.298322 Distance: 5606 m
Tracker 5 Out of Range Distance: 0 m	Tracker 6 Out of Range Distance: 0 m	Tracker 7 Out of Range Distance: 0 m	Tracker 8 Out of Range Distance: 0 m	Tracker 9 Out of Range Distance: 0 m
Latest Filtered Event				
Tracker4   lat:8.173023 lon:98.298322 alt:3.0				

For example, it will display Tracker 4 only if the other trackers are out of range.