S T E A M

Space-Time Environment for Analysis of Mobility

Version 1.0

User Guide

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1. Introduction

STEAM (Space-Time Environment for Analysis of Mobility) is developed to visualize dynamic stay/move activities. It is very useful in demonstrating how humans, animals, vehicles, or other types of object, move in space over time, based on animation-based interactive visualization. The following video is a demo of its application in studying urban dynamics using mobile phone location data (make sure to enable “HD” on the bottom-right corner).

https://vimeo.com/107979465

For those who have troubles accessing video.com (e.g., users from China), please use the alternative link below:

http://www.tudou.com/programs/view/4SlnEfAs57k/

This release includes the core function: visualizing (temporal) OD flows using flowing points. Other functions demonstrated in the demo video, such as interactively query functions, will be released in the future.

2. Prerequisite

STEAM is a cross-platform program so you can run it on Windows, Mac OS, Linux, etc. All you need to install is a Java SE Runtime Environment (JRE). *STEAM* has been tested under JRE 7 and JRE 8. It is not a bad idea to use the latest version.

3. Installation

No installation is needed. Unzip the downloaded package and double-click steam.jar to launch the program.

4. Usage

STEAM provides user interface for setting up visualization parameters. After all parameters are set properly, click the "Play" button at the bottom to start visualization. This version of *STEAM* is not dedicated to error handling. It is user’s responsibility to make sure all parameters are set appropriately.

4.1 Data

STEAM can be used with with two types of data: 1) Shapefile (optional) and 2) flow file (required). In most cases, shapefiles serve as a background to display geographic features, such as city boundaries, road networks, rivers, etc. Flow files store detailed information of OD flows to be visualized.

4.1.1 Coordinate System

All data must be in WGS84 coordinate system. This release does not support visualization in other coordinate systems. *STEAM* "assumes" all coordinate values it reads from Shapefiles and flow files in WGS84. Therefore, data in a different coordinate system must be converted in advance.

4.1.2 Shapefiles

STEAM supports Esri Shapefile. Put all shapefiles needed in a folder.

4.1.3 Flow Files

STEAM can read OD flow data in csv file(s). Put all flow files in a folder. OD flows in each csv file will be visualized at the same time. Each line in a flow file represents "how many people move from a location to another", using the following format:

size,from_lat,from_lng,to_lat,to_lng

For example:

206979,42.1497,-74.9384,40.314,-74.5089

which means that 206,979 people move from location (42.1497, -74.9384) to location (40.314, -74.5089). Note that each line is comma delimited, a "," is required between data elements.

4.2 Parameters

Parameters settings in *STEAM* are organized under "Basic" and "Visualization" panels.

4.2.1 Basic

The Basic Panel includes settings for visualization window size and data directories.

Parameter	Descriptions
Width	The width (in pixels) of the visualization window.
Height	The height (in pixels) of the visualization window.
Shapefile Directory	The directory of all shapefiles.
Flow Directory	The directory of all flow files.
Flow Files List	This list is populated once the flow directory is selected. Flow files will be visualized following the same order listed

	here. For scenarios that order does matter (e.g., visualizing OD flows by time), drag-and-drop one row, or multiple rows at a time, to sort this list.

4.2.2 Visualization

The Visualization Panel includes settings for visualization itself, including its initial geographic extent, speed and appearance of flowing points, and a flow volume classification scheme.

Parameter	Descriptions
MinLat	The minimum latitude of the initial visualization.
MinLng	The minimum longitude of the initial visualization.
MaxLat	The maximum latitude of the initial visualization.
MaxLng	The maximum longitude of the initial visualization.
Flowing point speed	The moving speed of flowing points. The larger the value is, the faster flowing points move between origins and destinations.
Flowing point diameter	The diameter of flowing points (in pixels).
Flowing point color	The RGB color of flowing points. The format of this field is "red,green,blue", for instance "255,0,0" is red.
Flow classification	The classification scheme of flow volume, including the number of flowing points used to represent each class.

Please note:

1) MinLat, MinLng, MaxLat, and MaxLng only determine the initial geographic extent when the visualization launches. Setting these values as the geographic extent for the area of interest is recommended. It can be changed then by zoom-in/out, and pan).

2) Flow classification: classes are separated by semicolons. In each class, use a colon to separate the flow volume and the number of flowing points used to represent this class. For example:

100:1;200:2;300:3;400:4;500:5

which means an OD flow whose volume is 100-200 will be represented by 1 flowing point; an OD flow whose volume is 200-300 will be represented by 2 flowing points... an OD flow whose volume is larger than 500 will be represented by 5 flowing points.

4.3 Interactive Visualization

STEAM supports interactive visualization with a mouse and a keyboard. This release includes map navigation and time slider functions. However, it currently does not include other interaction capabilities, such as interactive query, as shown in the demo video.

4.3.1 Map Navigation
Zoom-in: scroll mouse wheel up or press the "z" key.
Zoom-out: scroll mouse wheel down or press the "x" key.
Pan: drag and drop on the visualization with left mouse button or press "Up", "Down", "Left", "Right" keys on the keyboard.

4.3.2 Time slider
Flow files are read and visualized in the same order as listed in the Flow Files List (see Section 4.2.1). When the visualization launches, the first flow file in the list is always visualized by default. Pressing the "n" key advances to the next flow file, whereas pressing the "p" key rolls back to the previous one. The name of the flow file that is being visualized is displayed as a title on the top border.

4.4 Project Management
When *STEAM* launches, all parameters fields are blank. After parameters are set, they can be saved in a project file with an extension of "stm" on the disk (File -> Save or File -> Save As). Parameters of a saved project can be loaded by opening the project file (File -> Open).

5. Sample Data

STEAM comes with a "sample_data" folder, which contains two sample datasets. For each sample dataset, a project file is provided.

5.1 Urban mobile phone location data
Open the project file (File -> Open -> locate sample_data/urban_cellphone/urban_cellphone.stm). Select the shapefile directory (sample_data/urban_cellphone/shapefiles) and the flow data directory (sample_data/urban_cellphone/flows). Save the project file (File -> Save) so these settings can be loaded automatically next time.

This datasets includes three OD flow files derived from a mobile phone location dataset a city in China. These files do not reflect real population flows in this city as each flow volume value is overwritten with a random number. Also, the latitude and longitude values of each cell tower are randomly shifted.

5.2 USA migration data

Open the project file (File -> Open -> locate sample_data/usa_migration/usa_migration.stm). Select the shapefile directory (sample_data/usa_migration/shapefiles) and the flow data directory (sample_data/usa_migration/flows). Save the project file (File -> Save) so these settings can be loaded automatically next time.

This dataset includes one OD flow file derived from Census 2000 migration data (https://www.census.gov/population/www/cen2000/migration/). Population flows are aggregated to state-to-state level. Flows whose population sizes are less than 50,000 are removed to avoid cluttering and overlapping.

6. Credit

STEAM is developed based on *Processing* (https://processing.org), a Java-based programming language for art and visual design.

STEAM relies on a Processing library, *MapThing* (http://www.reades.com/2013/04/01/the-mapthing-processing-library/#more-), for *geo*visualization capabilities, such as support for Esri Shapefile. It is developed by Dr. Jon Reades, who kindly agrees to redistribute *MapThing* with *STEAM*.

7. Acknowledgement

Please cite our work if you use this tool in your research.

8. License