

Faculty of natural sciences

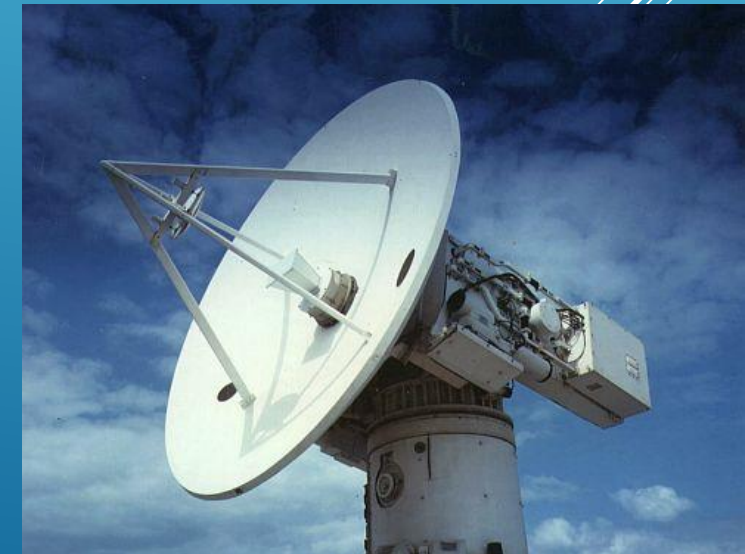


the department of computer science

Geo-Sensorial Data Fusion Visualization

Mali Yakobov, Maayan Kaduri, Stas Rodov, Alex Shimanovich

Advisors: Prof. Aryeh Kontorovich, Mr. Guy Yafe



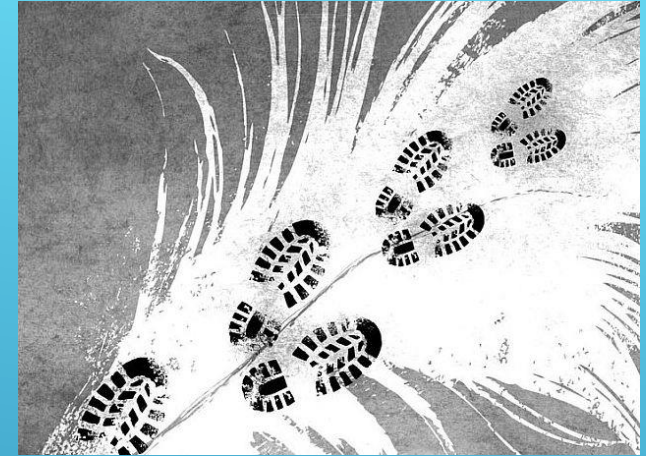
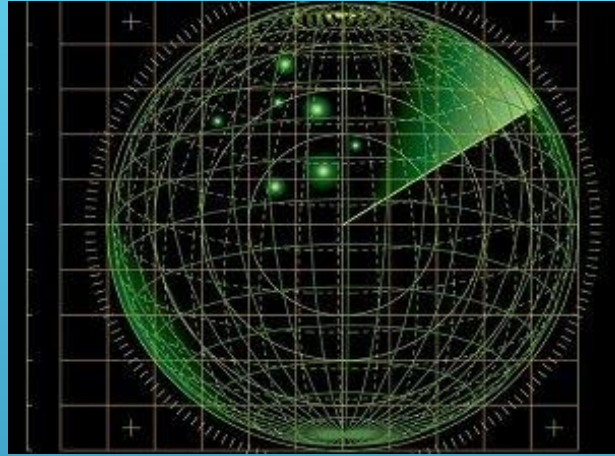
Introduction

- ❖ During the project we designed and developed an interactive visualization system, and implemented some machine learning algorithms
- ❖ The algorithms deal with geo-sensorial data fusion and tracking of spatial entities over time (using Kalman filter).
- ❖ The visualization system plays a temporal scenario resulted from above algorithms and shows information about the scenario and the learning process.



Details about the implemented algorithms






*The raw geographic data obtained from sensors.
This data is probabilistic and assumed to have a
Gaussian distribution*

*The data processed by the following pipeline of algorithms,
and becomes a scenario of tracked spatial entities in time*

The output of the pipeline in more detail:

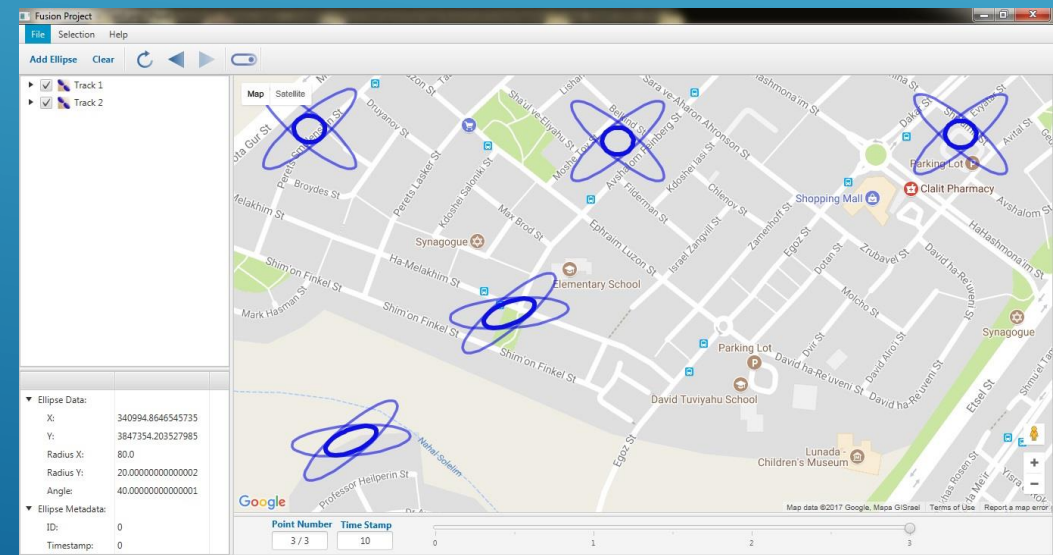
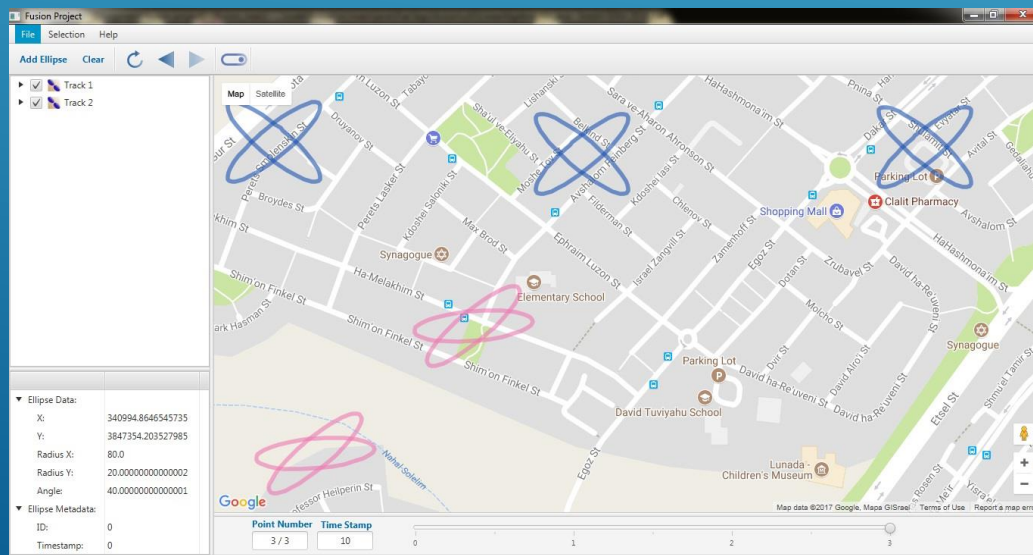
- ❖ *A scenario that consists of points in time.*
 - ❖ *Each point contains tracks – a single track for each tracked entity*
 - ❖ *Each track contains probabilistic positions of the entity over time and the raw data those positions fused from.*
- 
- A series of white diagonal lines of varying lengths and thicknesses are positioned on the right side of the slide, extending from the middle to the bottom right corner.

The Pipeline:

1. Initial clustering algorithm

The raw data obtained from different sensors, then fused into clusters, each cluster represents a position of single entity in time

Example of initial clustering from the GUI:



2.Distance matrix

Calculating the statistical distances of new clusters from all existing tracks, with respect to two movement models (static and linear)

3.M2M (Many to Many)

Classifying the clusters to the most suitable tracks and movement models

4.Update

*Updating the tracks,
or creating new tracks if there is no suitability.*

Details about the visualization system



The visualization tool plays a scenario of tracked entities over time

- ❖ The scenario is loaded in JSON format*
- ❖ The results are displayed with GoogleMaps API, but can be wired to any map service*



The visualization tool plays a scenario of tracked entities over time

The screenshot displays the Fusion Project interface, which includes a map view and several control panels. The map shows a satellite view of a coastal area with two tracked entities represented by red and blue ellipses. A tooltip for one of the entities displays the following information:

lat: 28.511972174060155
long: 0.037657508312463506
ID: 6368656826135816907
Time Stamp: 7000

The interface also features a hierarchical tree view on the left, a table of ellipse data and metadata at the bottom left, and a timeline slider at the bottom right.

Hierarchical tree view of current point in time.
Controls selection, displaying and displaying informations of all entities

Example of raw data (can be turned on/off)

Two tracked entities

Slider, controls the scenario, synchronized with player above

Ellipse Data:

X:	Y:	Radius X:	Radius Y:	Angle:
1266.1523248334292	-51.14681261908826	266.74217793426965	144.0180101909934	-125.40461692525629

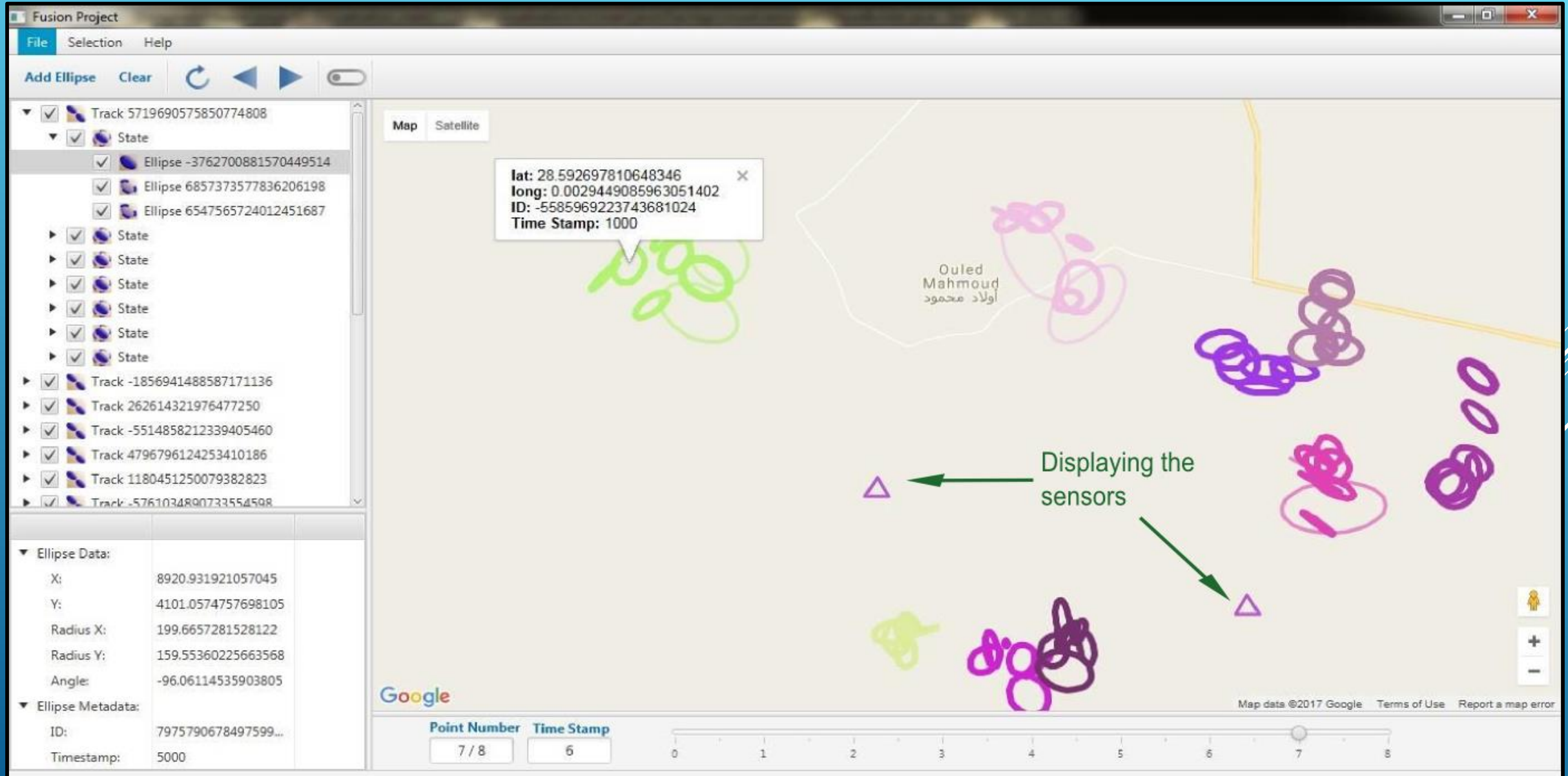
Ellipse Metadata:

ID:	Timestamp:
-5029041432439457...	7000

Point Number 8 / 8 **Time Stamp** 7

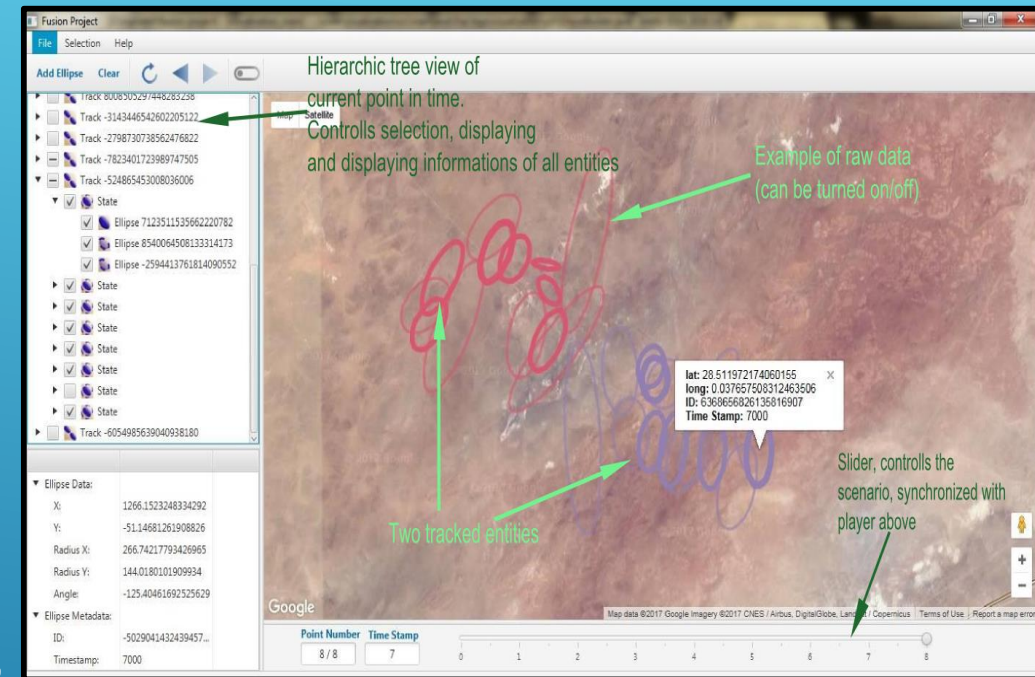
Map data ©2017 Google Imagery ©2017 CNES / Airbus, DigitalGlobe, LandSat / Copernicus Terms of Use Report a map error

The visualization tool plays a scenario of tracked entities over time



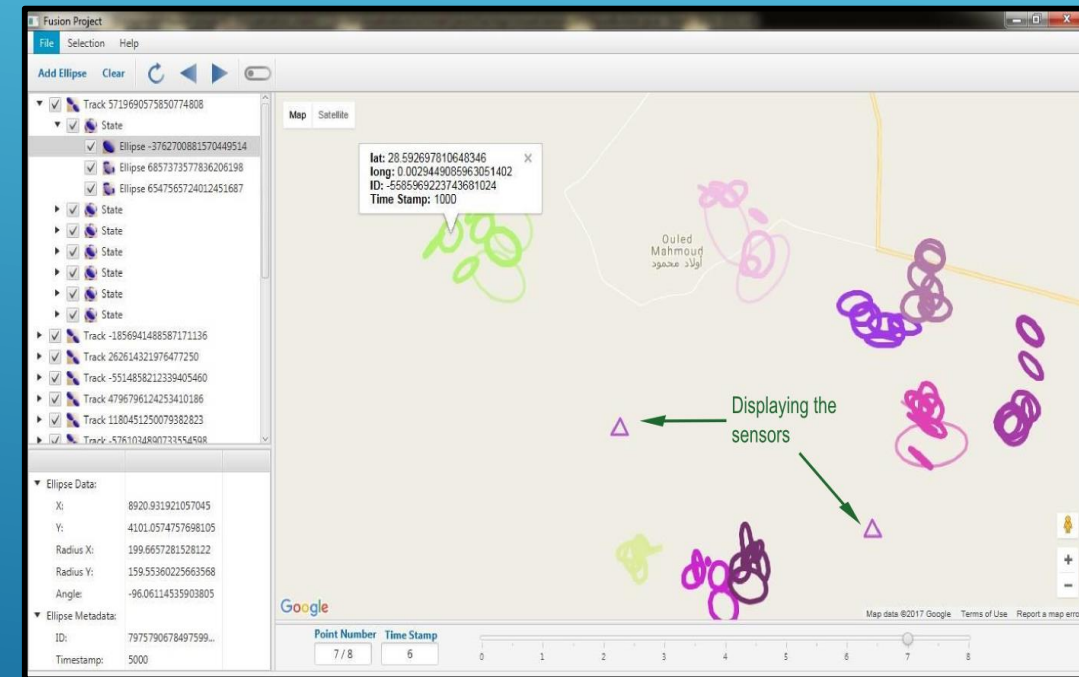
Features:

- ❖ *Player – advances backward and forward in time*
- ❖ *Slider – controls the scenario, synchronized with the player*
- ❖ *Toggle show/hide raw data*
- ❖ *Show information about every entity, in table and in hover balloon*
- ❖ *Each tracked entity have unique random color*



Features:

- ❖ Hierarchic tree view of current point in time - allows to display information about all entities, select entities, show/hide entities and tracks
- ❖ Ability to apply initial clustering algorithm on selected entities (as shown in example above)
- ❖ Ability to add entities to the scenario with mouse click



Technologies we used during the project

