



USA Aviation Accidents

Visual Analytics class of 2020/21



SAPIENZA
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1

Introduction

Why Visualize Aircraft Accidents?



Aviators

Helping deciding which is the best manufacturer and their information about different conditions of weather and death rate.



Security Agency

Supporting authorities in monitoring the situation and, if necessary, conceiving plan of actions

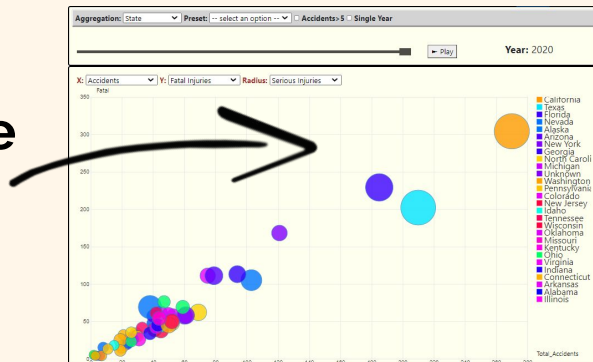


Manufacturer

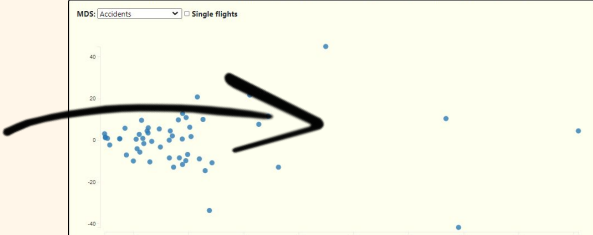
Understands in what their airplane can be improved

Components of our VA tool

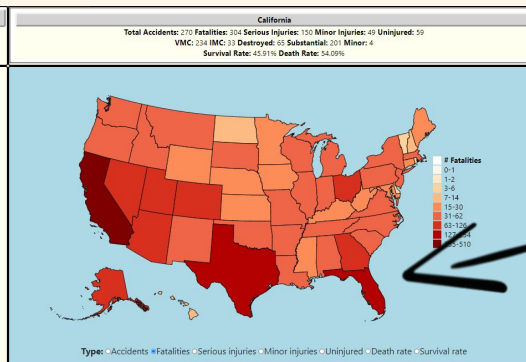
Bubble
Plot



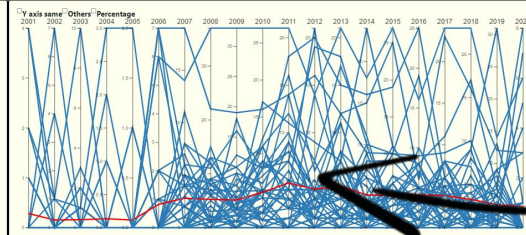
MDS



USA Map



Parallel
Coordinates





2

Related Work

Related Work

Visualizing the FAA Aviation Accident Database

Similar solutions, objective and views

- Animation of the accidents over time on the map chart using a play button and a slider
- Examine relationships between the levels of damage (destroyed, substantial, minor, etc.) and the weather conditions

Fatal weather-related general aviation accidents in the United States

Similar solution and objective

- Correlated the incidents and the weather conditions using line charts

Related Work

Analysis of trends in aviation maintenance risk: An empirical approach

Similar solutions

- The visualization of data over time

Data and Information Visualization Methods, and Interactive Mechanisms: A Survey

Similar solutions and views

- The correspondent mouseon function of the parallel coordinates

Related Work

Data analysis on aviation accidents, Data Science Bowl:

Similar solutions, objective

- Focus analysis on the phase of flight and the aircraft damage

Accidents App:

Similar objective

- Retrieve additional information about some particular flights

3 Dataset



Dataset



The **aviation accident database** contains information from 1962 and later about NTSB civil aviation accidents and selected incidents within the United States, its territories and possessions, and in international waters.

The **National Transportation Safety Board (NTSB)** is an independent U.S. government investigative agency responsible for civil transportation accident investigation

Preprocessing

- We decided to drop some columns which contained sparse data;
- We removed the incidents and focused only on the accidents;
- We took only the rows with the airplane damage;
- We removed the crashes not related to airplanes (helicopters, balloon, amateur built airplanes, etc.);
- We removed the crashes without the weather conditions and the phase of flight;
- We created the Month column, deriving it from the accident date.

Result

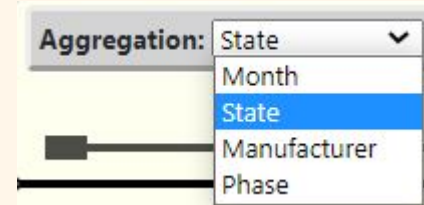
Event.Id	Event.Date	Location	Aircraft.Damage	Make	Total.Fatal.I	Total.Serious.I	Total.Minor	Total.Uninjured	Weather	Broad.Phase.	Crash.Location	Crash.Country	Event.Month
20200502X81549	02/05/2020	PALMYRA, IL	Destroyed	Yakovlev	1.0	0.0	0.0	0.0	VMC	MANEUVER	39.408889,-89.95	Illinois	May
20200413X13054	11/04/2020	Eagle River, AK	Substantial	CESSNA	0.0	2.0	2.0	0.0	VMC	MANEUVER	61.351943999999	Alaska	April
20200326X82317	25/03/2020	Waxahachie, TX	Substantial	CESSNA	0.0	1.0	0.0	0.0	VMC	STANDING	32.448055,-96.91	Texas	March
20200324X34735	23/03/2020	Swansboro, NC	Destroyed	Maule	2.0	0.0	0.0	0.0	IMC	UNKNOWN	34.416945,-77.03	Unknown	March
20200318X22054	18/03/2020	Eagle Creek, OR	Destroyed	PIPER	0.0	1.0	0.0	0.0	VMC	TAKEOFF	45.352778,-122.3	Oregon	March
20200317X10410	16/03/2020	Pinedale, WY	Substantial	PIPER	0.0	1.0	1.0	0.0	VMC	APPROACH	42.796944,-109.8	Wyoming	March

AngeliniSantucci index = $2632 * 14 = 36848$

Aggregations

Dataset entries can be grouped by:

- Month of accident
- State where the accident happened
- Manufacturer of the aircraft involved in the accident
- Phase of flight in which the accident occurred



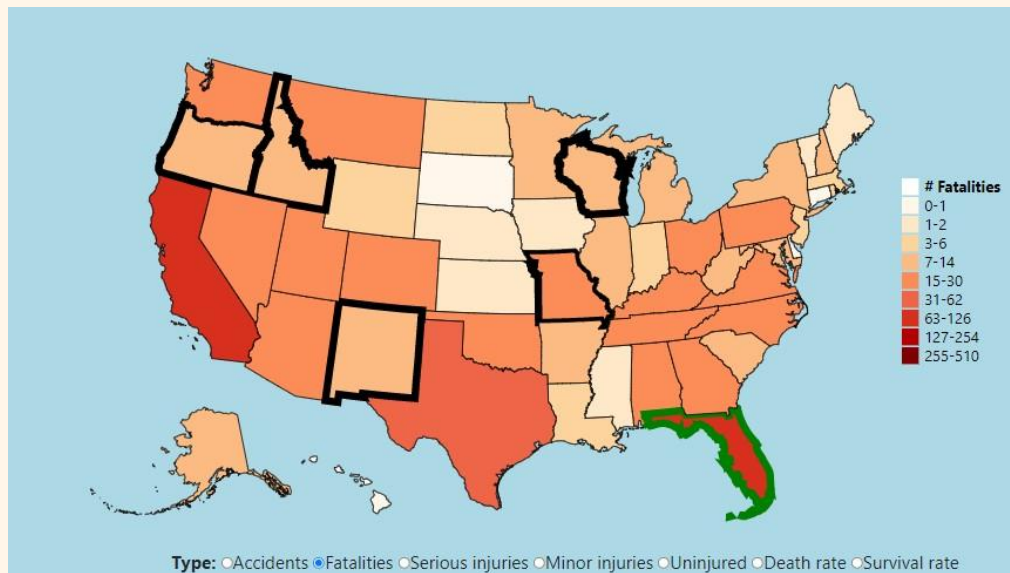
4

Views



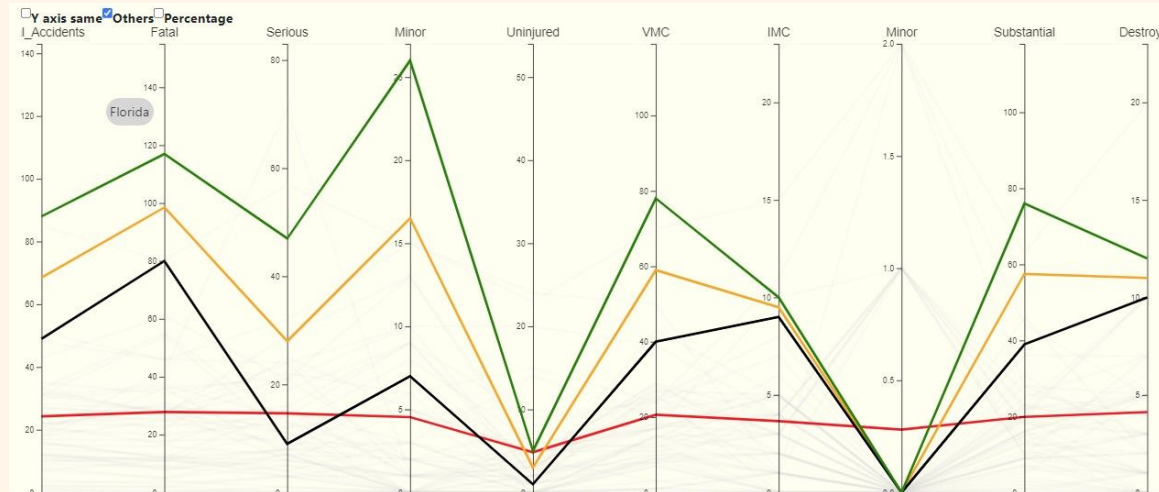
USA MAP

- The USA map allows to visualize data through a color scale, we used colorBrewer2;
- Each color represents the variation of these data on the single state of the USA;
- Supports mouseon
- The entire map is interactive with all others visualizations (when brushing/mouseon on them)



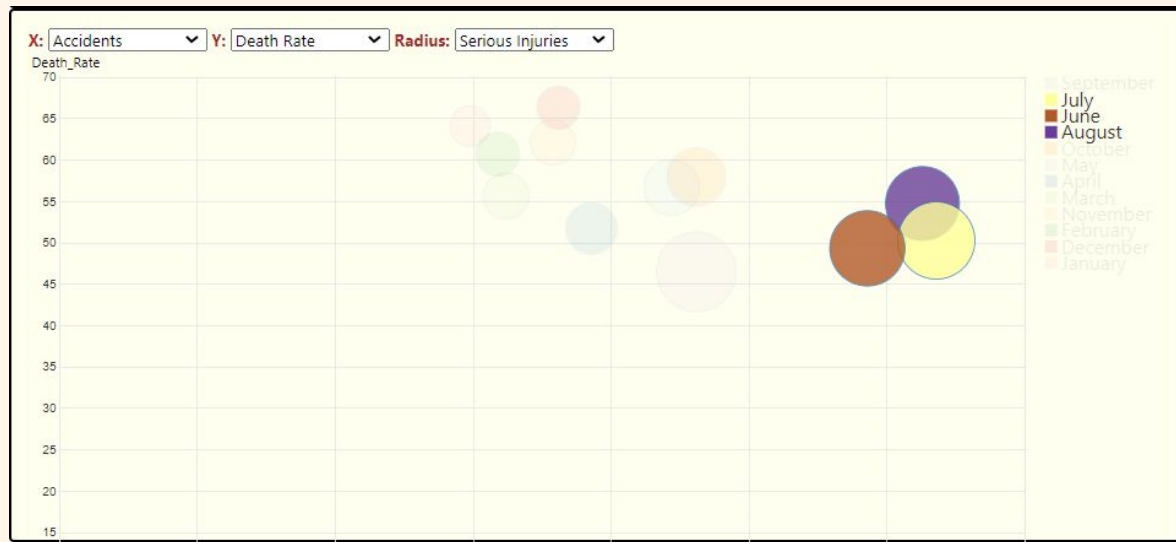
PARALLEL COORDINATES

- Each axis represents a year or an attribute of a crash;
- The lines correspond to the aggregation type (i.e. Manufacturer, State, etc.);
- Supports brushing on the axis to filter only certain lines;
- Supports normalizing the Y axis;
- The red line is the average of all the elements in the dataset
- Supports real time mean line computation for brushed points



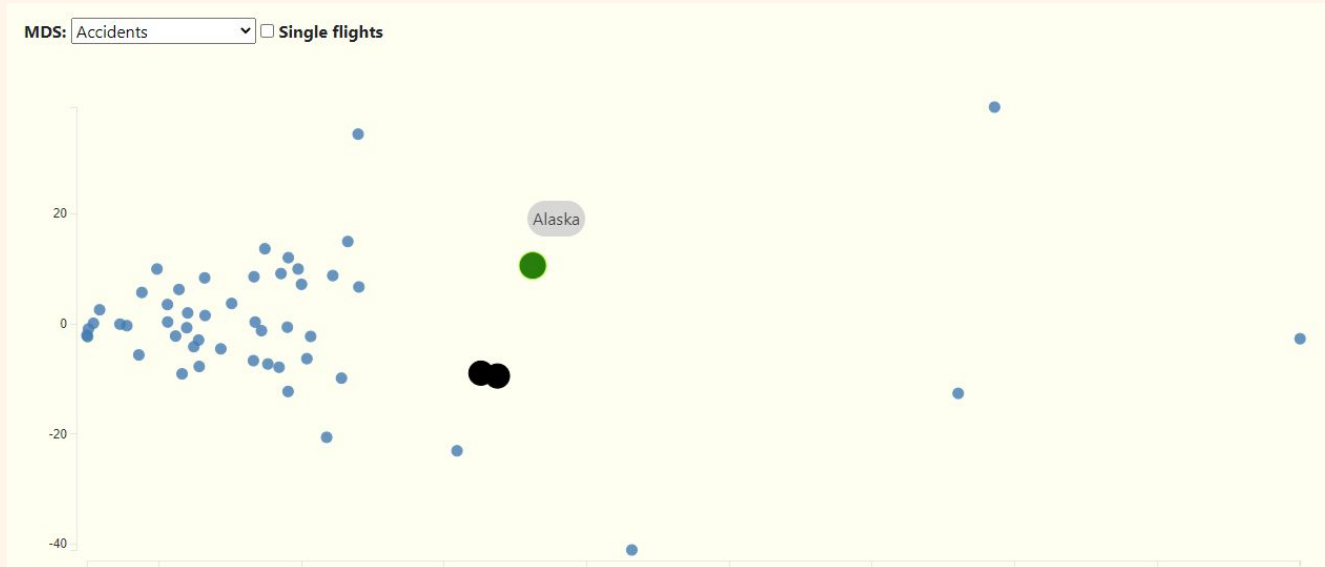
BUBBLE PLOT

- User can change axes and radius
- Bubbles represent single aggregations
- Supports brush and mouseon
- Legend supports mouseon
- Fixed color schema for aggregations with few elements
- Variable color schema for bigger aggregations



MULTIDIMENSIONAL SCALING

- Used for dimensionality reduction
- Represents and visualizes dissimilarity among data points
- Supports brush and mouseon
- Three types of plot (Accident, Percentage and Typology)
- Single flights mode can be enabled





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Future Work

Future Work

- Include USA cities
- Include aircraft model
- Include engine information
- Include accident description
- Include more recent accidents
- Include purpose of flight



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Conclusions

Conclusions

- We introduced this visual analytics tool to support the analysis of airplane crashes in the USA;
- This tool offers to a user a global view of all crashes in the USA from 2001 to 2020;
- A user can investigate what is happening in a particular state, and see the dissimilarities with respect to other data points;
- A user can compare the trends of an attribute (such as Fatalities or Death Rate) for different aggregations over time.

Thanks for the attention



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Project repo available [here](#)
GitHub Pages for live demo available [here](#)