IO-AVSTATS - User Manual

Release 23.05.01

IO Aeronautical Autonomy Labs, LLC

1. Introduction

The National Transportation Safety Board (NTSB) investigates all aviation accidents in the U.S. and makes the investigation results available on their website (data.ntsb.gov, n.d.) in Microsoft Access database files for public use. The NTSB provides aviation event data from 1982 through 2007 in the file **`Pre2008.zip`** (version 9/30/2020 12:51:56 PM). Data since 2008 are available first in the overall **`avall.zip`** file, which is updated monthly, and second with a quasi-weekly amendment file each month on the 1st, 8th, 15th, and 22nd, e.g., **`up22JUN.zip`**.

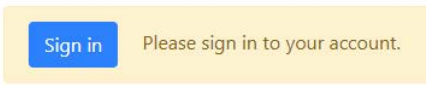
`IO-AVSTATS-DB` is IO-Aero's database version of NTSB's aviation event data. **`IO-AVSTATS-DB`** is based on a PostgreSQL database (The PostgreSQL Global Development Group, 2019) and contains, in addition to the data from NTSB IO-Aero specific extensions and data from the following sources:

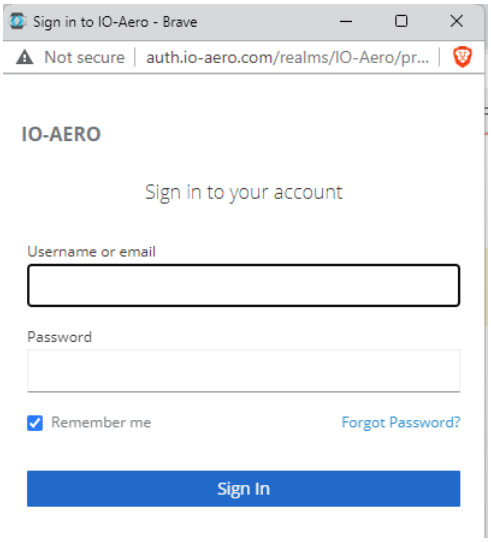
- Aviation Occurrence Categories (AVIATION OCCURRENCE CATEGORIES DEFINITIONS AND USAGE NOTES, 2013)
- GeoDatos (Geodatos.net, 2019)
- opendatasoft (Opendatasoft, n.d.)
- simplemaps (simplemaps.com, n.d.)
- United States Zip Codes.org (UnitedStatesZipCodes, n.d.)

The **`IO-AVSTATS-DB`** is updated on the 8th, 15th, and 22nd of each month with the update file provided by NTSB. Every first of the month a new database version is created from the two files **`Pre2008.zip`** and **`avall.zip`**. This ensures that the deletions made by NTSB, which are not included in the update file, are reflected in the **`IO-AVSTATS-DB`** database.

2. Getting Started

2.1. Application Access





2.2. General Usability

3. Application Association Rule Analysis

4. Application Aviation Event Analysis

5. Application Database Profiling

6. Application US Aviation Fatal Accident Analysis

6.1. Introduction

This is a data and functionally limited version of the 'Aviation Event Analysis' application.

The database view **`io_app_ae1982`** is used for the data. The data limitations concern:

- only events of type accident,
- only operations of type charter services (parts 135), regular scheduled air carriers (parts 121), or general aviation (parts 091x),
- only U.S. related fatal accidents from 2008 to present, i.e., accidents on U.S. soil, departure or planned arrival in the U.S., U.S. owner, U.S. operator, or U.S. registration.

Functionality is limited to:

- total and annual views on fatalities by selected FAR operations parts,
- total and annual views on preventable accidents by safety system, and
- the fatal accident map.

The application is divided into two parts: On the left side there is the so-called sidebar and on the right side the results are displayed. The sidebar has the functional controls in the upper part and the controls for filtering the data in the lower part. Each time the functional or filtering controls are changed, all the results on the right side are recalculated.

6.2. Filter Options

A range of years between 2008 and today can be selected here via this slider widget:

Figure 1: Filter control - interval of event years

6.3. Functional Control: Accident-based Charts

These analyses are based on fatal accidents in U.S. aviation.

The selected data can be displayed in up to three different chart types:

- The vertical bar chart shows the annual values,
- Pie chart and horizontal bar chart show the total values.

6.3.1. Preventable Accidents by Safety Systems

The percentage threshold limits the individual display of the affected safety systems. The safety systems whose percentage is below the threshold are grouped in the **`below threshold`** category.

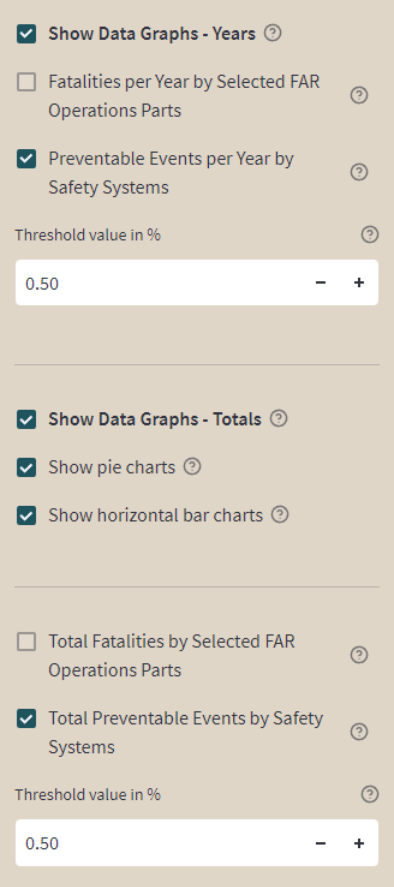


Figure 2: Functional controls

The high-level security system requirements defined in [Hook, Loyd & Sizoo, David & Fuller, Justin. (2022)] are mapped to the data in **`IO-AVSTATS-DB`** as follows:

- Airbone collision **`is_midair_collision`**
- Forced landing **`is_rss_forced_landing`** i.e., **`is_attitude controllable`** and **`is_emergency_landing`**
- Spin / stall **`is_rss_spin_stall_prevention_and_recovery`** i.e., **`is_attitude_controllable`** and **`is_spin_stall`**

- Terrain collision **`is_rss_terrain_collision_avoidance`** i.e., **`is_attitude_controllable`** and **`is_altitude_low`** and **`is_altitude_controllable`**

This data is mainly based on the database tables **`event_sequence`** and **`findings`**. However, since these data are not unique per event and moreover, several aircraft can be involved in an event, combinations of safety systems can occur, e.g.: **`Forced landing, Spin / stall`**.

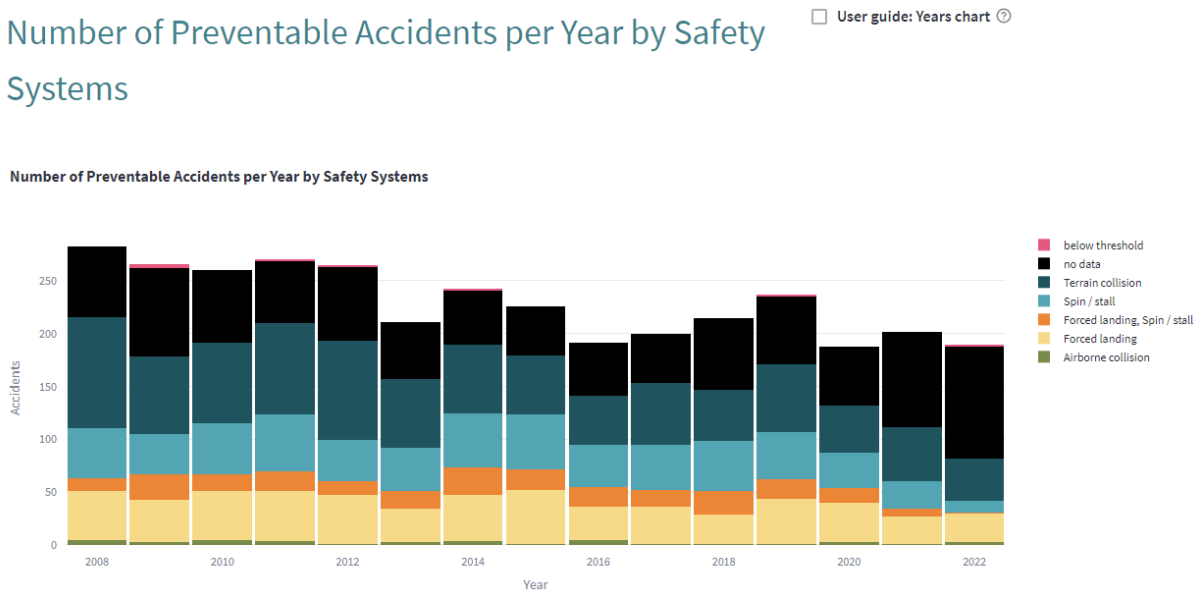


Figure 3: Bar chart representation of annual values

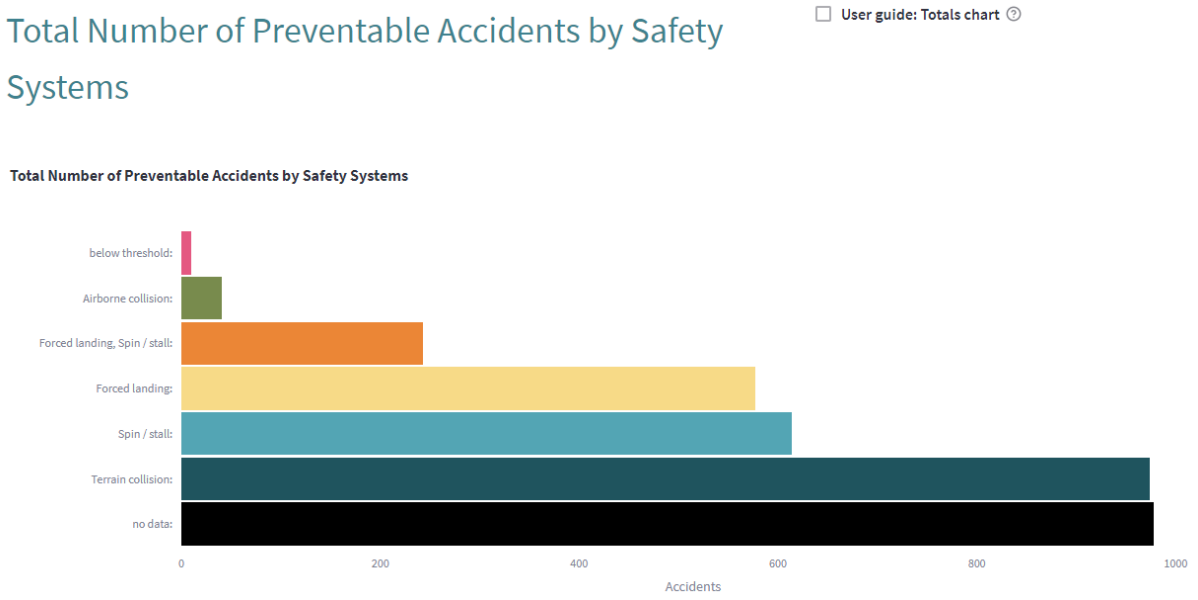


Figure 4: Horizontal bar chart representation of totals

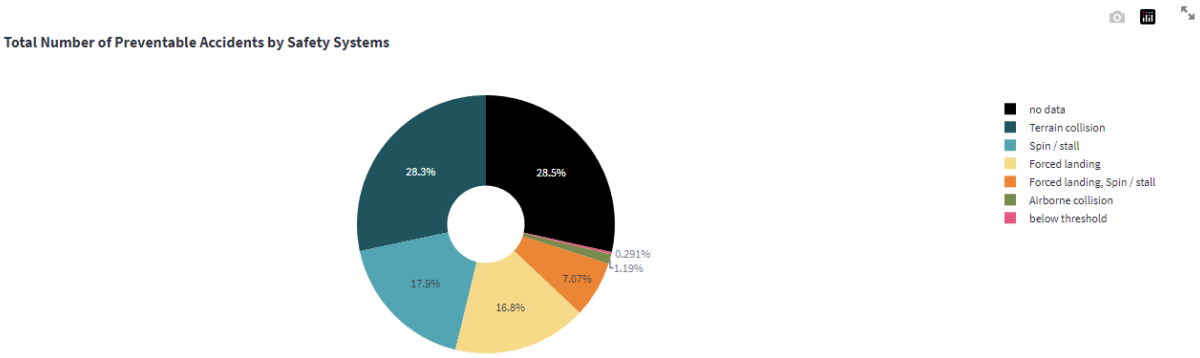


Figure 5: Pie chart representation of totals

6.4. Functional Control: Fatality-based Charts

These analyses are based on U.S. aviation fatalities.

The selected data can be displayed in up to three different chart types:

- The vertical bar chart shows the annual values,
- Pie chart and horizontal bar chart show the total values.

6.4.1. Selected FAR Operations Parts

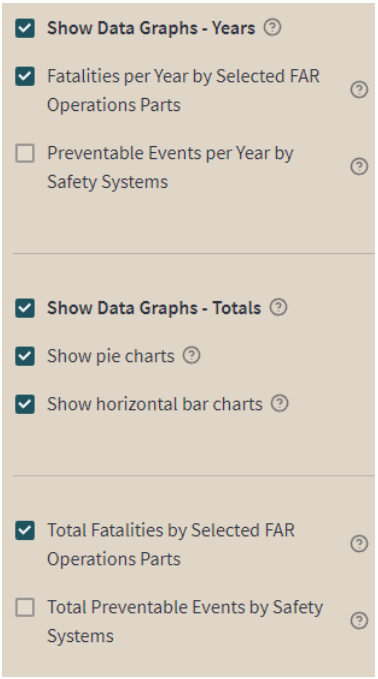


Figure 6: Functional controls

The fatalities processed here result exclusively from accidents that can be assigned to one of the following FAR operations parts:

- Parts 091x General operations
- Parts 121 Regular scheduled air carriers
- Parts 135 Charter type services

Since the assignment is made at the aircraft, accidents with multiple aircraft involved and different FAR Operations Parts may result in multiple fatality counts for the accidents involved. However, this only affects a negligible number of accidents.

Number of Fatalities per Year by Selected FAR Operations Parts

User guide: Years chart

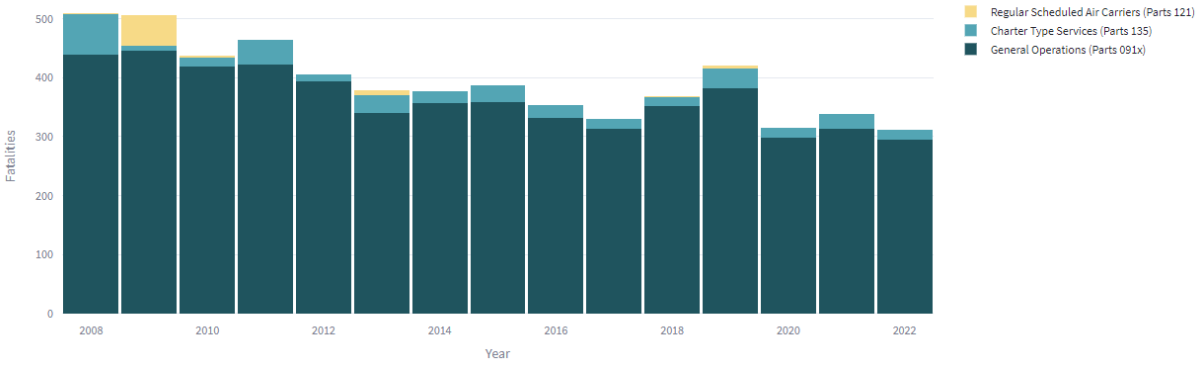


Figure 7: Bar chart representation of annual values

Total Number of Fatalities by Selected FAR Operations Parts

User guide: Totals chart

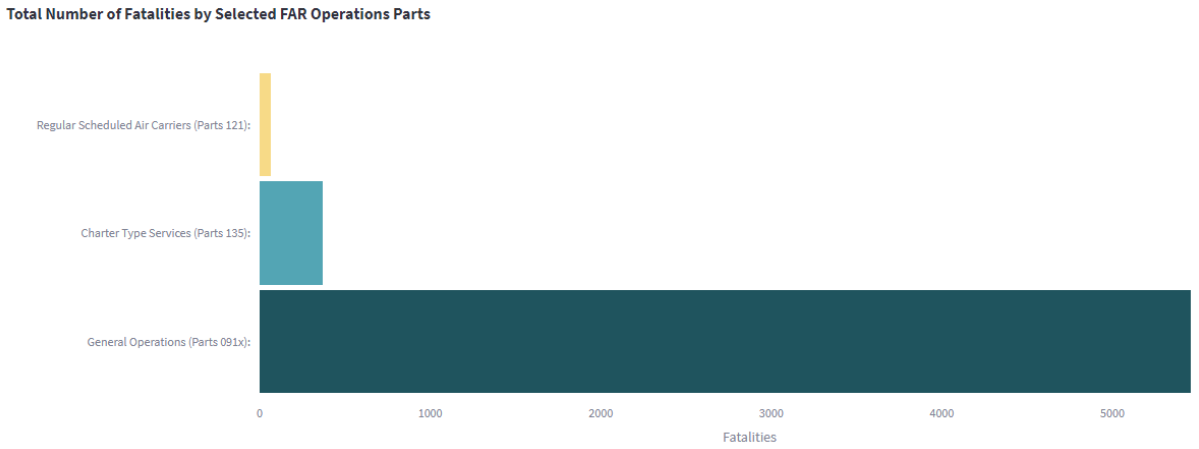


Figure 8: Horizontal bar chart representation of totals

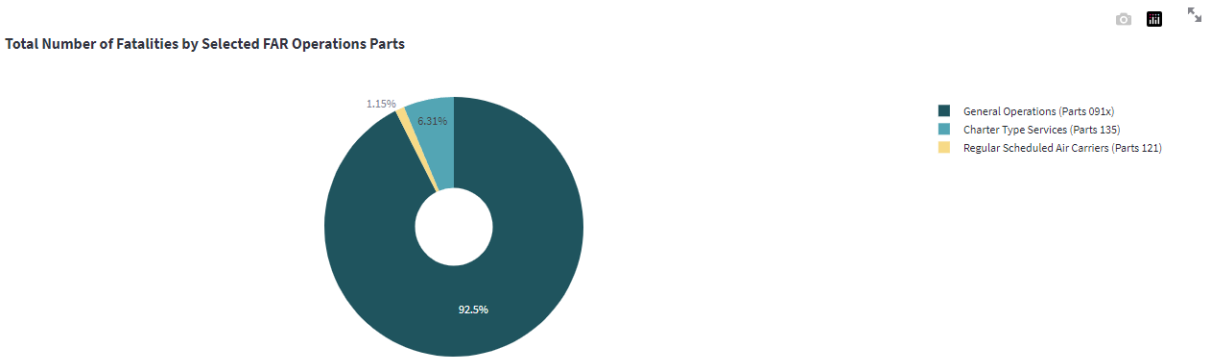


Figure 9: Pie chart representation of totals

6.5. Functional Control: Map

Figure 10: Functional control

The map shows the places where fatal aviation accidents occurred in the selected period. Each point represents at least one accident with fatalities. If you hover the mouse over such a point, you will get detailed information about the accident behind it. However, only those accidents can be shown here for which a decimal longitude and latitude have been entered. The map can be zooming in and out as needed. Furthermore, the map can also be printed out.

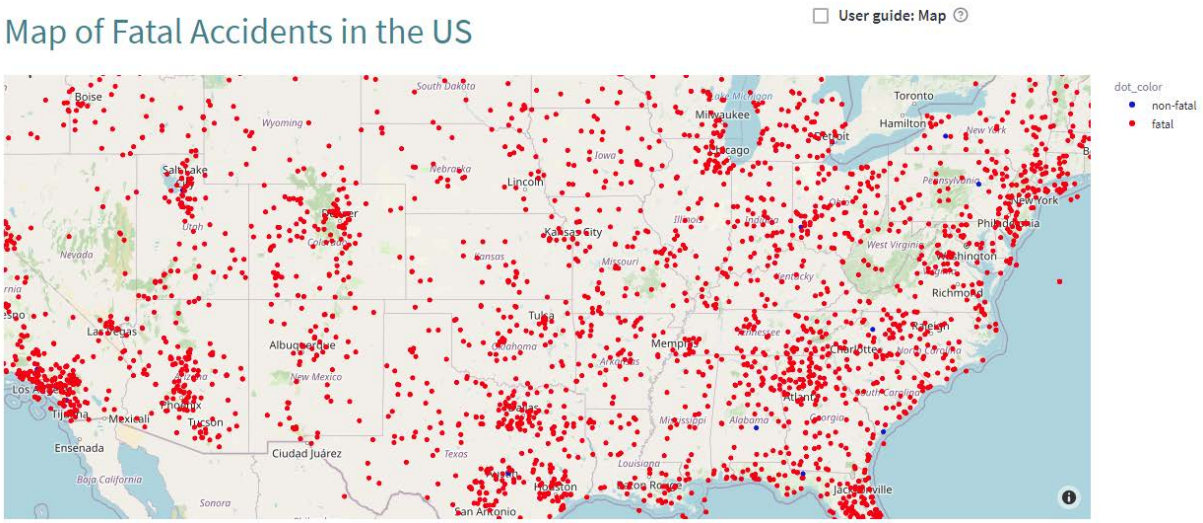


Figure 11: US map

7. Change Log

7.1. Release 23.05.01

- **NTSB files included:**
  - Pre2008.zip - 9/30/2020 12:51:56 PM
  - avall.zip - 5/ 1/2023 6:01:23 AM
  - up01MAY.zip - 5/ 1/2023 3:00:31 AM

7.2. Release 23.04.22

- **National Plan of Integrated Airport Systems (NPIAS) included:**
  - NPIAS-2023-2027-Appendix-A.xlsx
- **NTSB file included:**
  - Up22APR.zip - 4/22/2023 3:30 AM

7.3. Release 23.04.15

- **FAA Airports file included:**
  - 2023.02.23_Airports.csv (23. February 2023)
- **NTSB file included:**
  - Up15APR.zip - 4/15/2023 3:00:12 AM
- **simplemaps files included:**
  - simplemaps_uscities_basicv1.76
  - simplemaps_uszips_basicv1.82
- **United States Zip Codes.org file included:**
  - zip_code_database.xls (42735 entries)

7.4. Release 23.04.08

- **NTSB files included:**
  - Pre2008.zip - 9/30/2020 12:51:56 PM
  - avall.zip - 4/ 3/2023 8:13:22 AM
  - up08APR.zip - 4/ 8/2023 3:01:20 AM

7.5. Release 23.04.01

- **NTSB files included:**
  - Pre2008.zip - 9/30/2020 12:51:56 PM
  - avall.zip - 3/ 1/2023 6:01:23 AM
  - up08MAR.zip - 3/ 8/2023 3:00:22 AM
  - up15MAR.zip - 3/15/2023 3:00:11 AM
  - up22MAR.zip - 3/22/2023 3:00:14 AM
  - up01APR.zip - 4/ 1/2023 3:00:31 AM

8. References

Hook, Loyd & Sizoo, David & Fuller, Justin. (2022). How Digital Safety Systems Could Revolutionize Aviation Safety. pp. 1-9. 10.1109/DASC55683.2022.9925863. Available at: https://www.researchgate.net/publication/365100080_How_Digital_Safety_Systems_Could_Revolutionize_Aviation_Safety