Zipline Data Scientist Project

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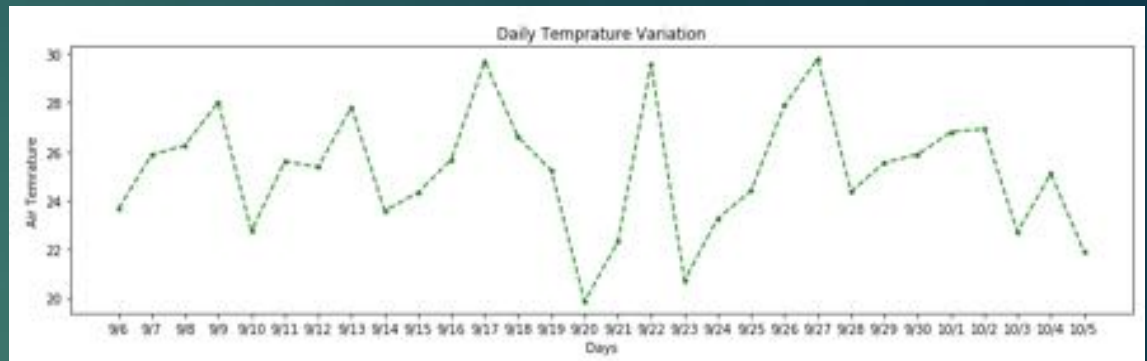
Project Definition

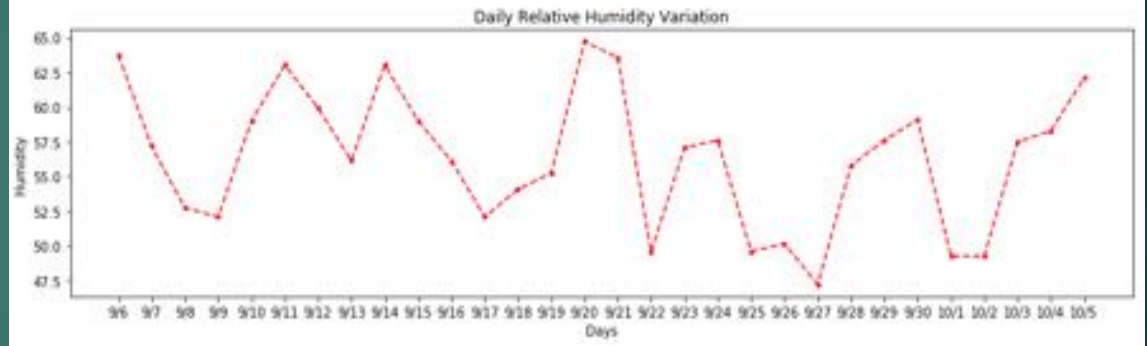
- WHAT?
  - Independent exploratory data analysis & visualization assignment to find patterns in the data

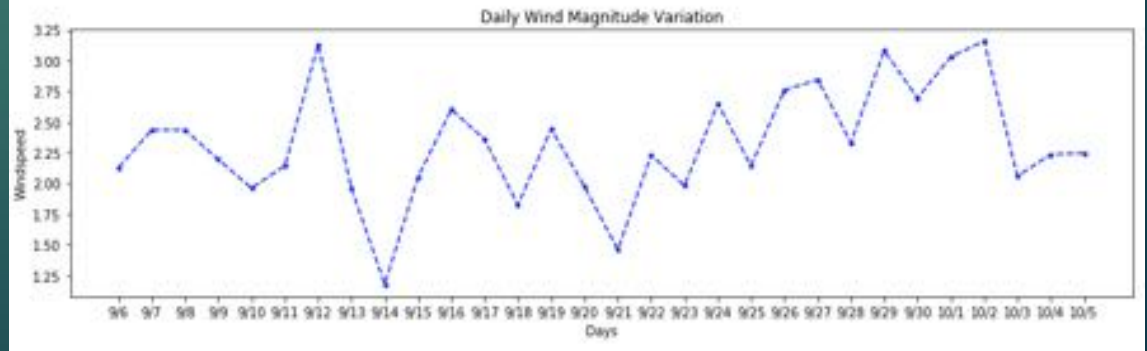
- Why?
  - Communicate actionable insights to the engineering & operations team:
    - diurnal weather patterns
    - missing data points
    - individual outlier launches
    - unexplained behaviors
    - poorly performing parts

Diurnal Weather Patterns

- Mean daily weather patterns were analyzed
- Smooth horizontal patterns indicate diurnal repetitions
  - **Air Temperature:** Diurnal temperature patterns on
    - ***1st and 2nd October.***
    - Additional approximate patterns:
      - 11th and 12th of September, 29th and 30th September
  - **Relative Humidity:** Diurnal Humidity patterns on
    - ***1st and 2nd October.***
    - Additional approximate patterns:
      - 23rd and 24th of September, 25th and 26th September
  - **Wind magnitude:** Diurnal wind magnitude observed
    - ***7th and 8th of September***
    - ***4th and 5th of October***







Missing Data

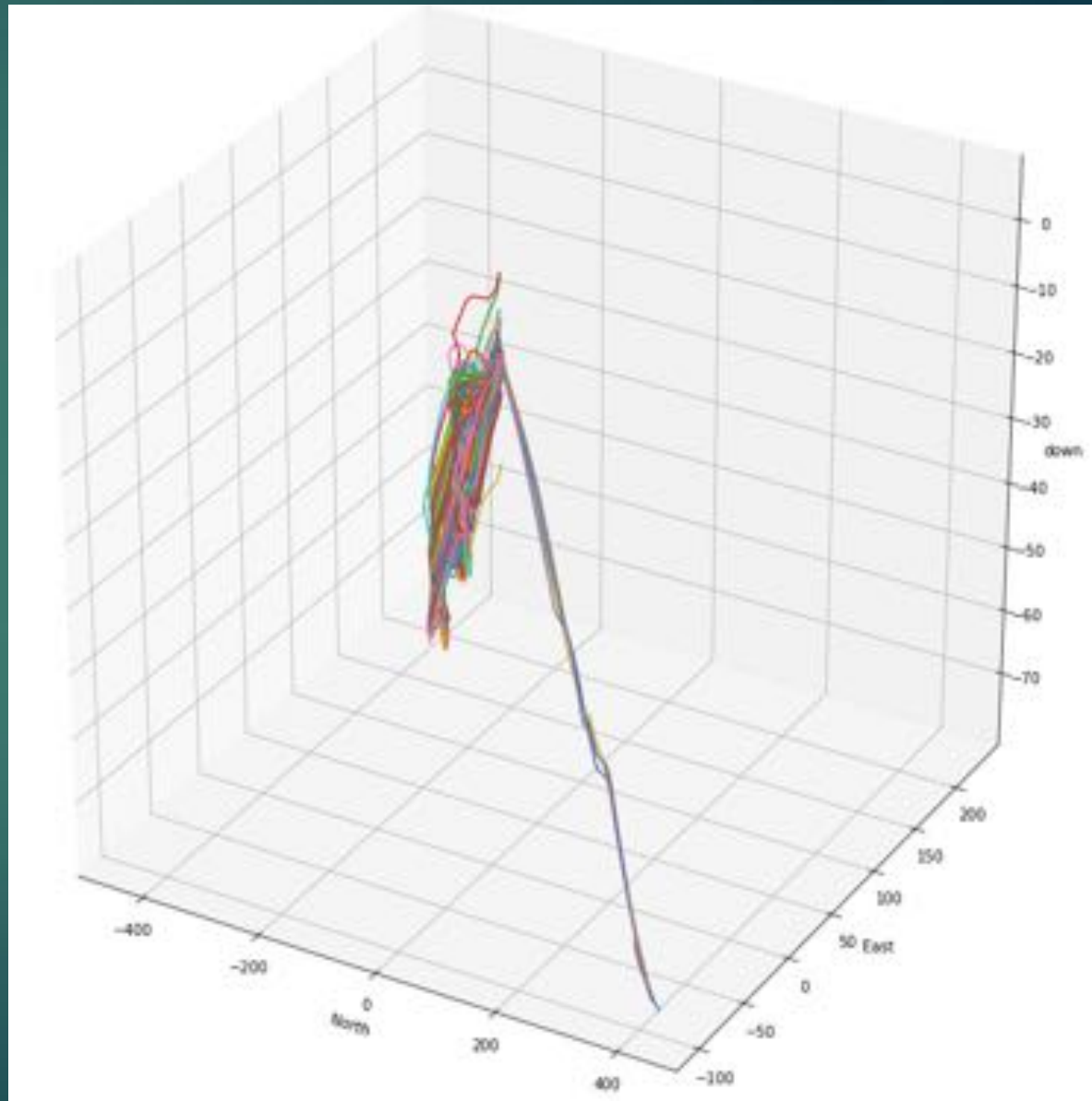
- Pre-flight voltage data missing for the following flights launched on 6th September

flight_id	launch_timestamp	battery_serial_number
16984	2018-09-06 17:56:06	15SPJJJ09013015
16960	2018-09-06 12:55:23	15SPJJJ09017016
16959	2018-09-06 11:31:07	15SPJJJ09018015
16961	2018-09-06 07:43:59	15SPJJJ09036021
16967	2018-09-06 15:02:27	15SPJJJ09036021
16986	2018-09-06 18:25:40	15SPJJJ09036021
16988	2018-09-06 18:59:13	15SPJJJ10008029
16964	2018-09-06 09:56:37	15SPJJJ10012034
16961	2018-09-06 13:09:51	15SPJJJ10023027
16952	2018-09-06 07:51:49	15SPJJJ10029029
16965	2018-09-06 14:56:25	15SPJJJ10029029
16957	2018-09-06 11:09:39	15SPJJJ10050049
16983	2018-09-06 18:04:04	15SPJJJ10050049
16962	2018-09-06 13:43:05	15SPJJJ10052026
16980	2018-09-06 17:46:38	15SPJJJ10052026
16955	2018-09-06 10:27:04	15SPJJJ10054027

Outlier Launches

- Flight launches tracked for all 447 flights based on the NED co-ordinates
- Four flights found to follow an entirely different trajectory
- These are definite outliers

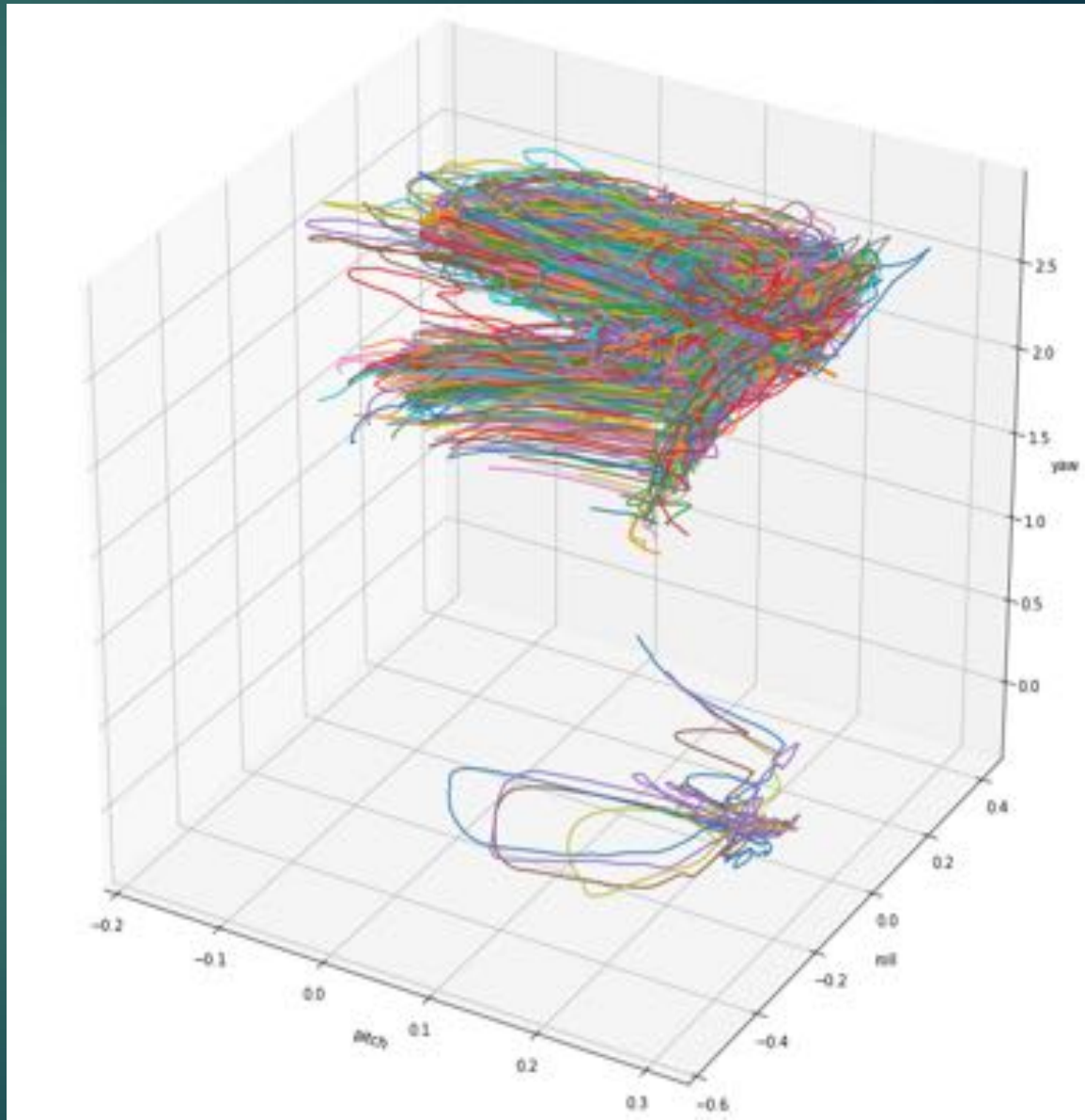
flight_id	launch_timestamp
17438	2018-09-24 19:30:15
17136	2018-09-11 18:54:21
17439	2018-09-24 19:34:41
17437	2018-09-24 19:25:52



Unexplained Behaviors

- The same 4 flights had negligible yaw
- Can be clearly visualized in the 3-D plot
- This usually indicates trouble with the flight rudder. But a deeper technical analysis is required

flight_id	launch_timestamp
17438	2018-09-24 19:30:15
17136	2018-09-11 18:54:21
17439	2018-09-24 19:34:41
17437	2018-09-24 19:25:52

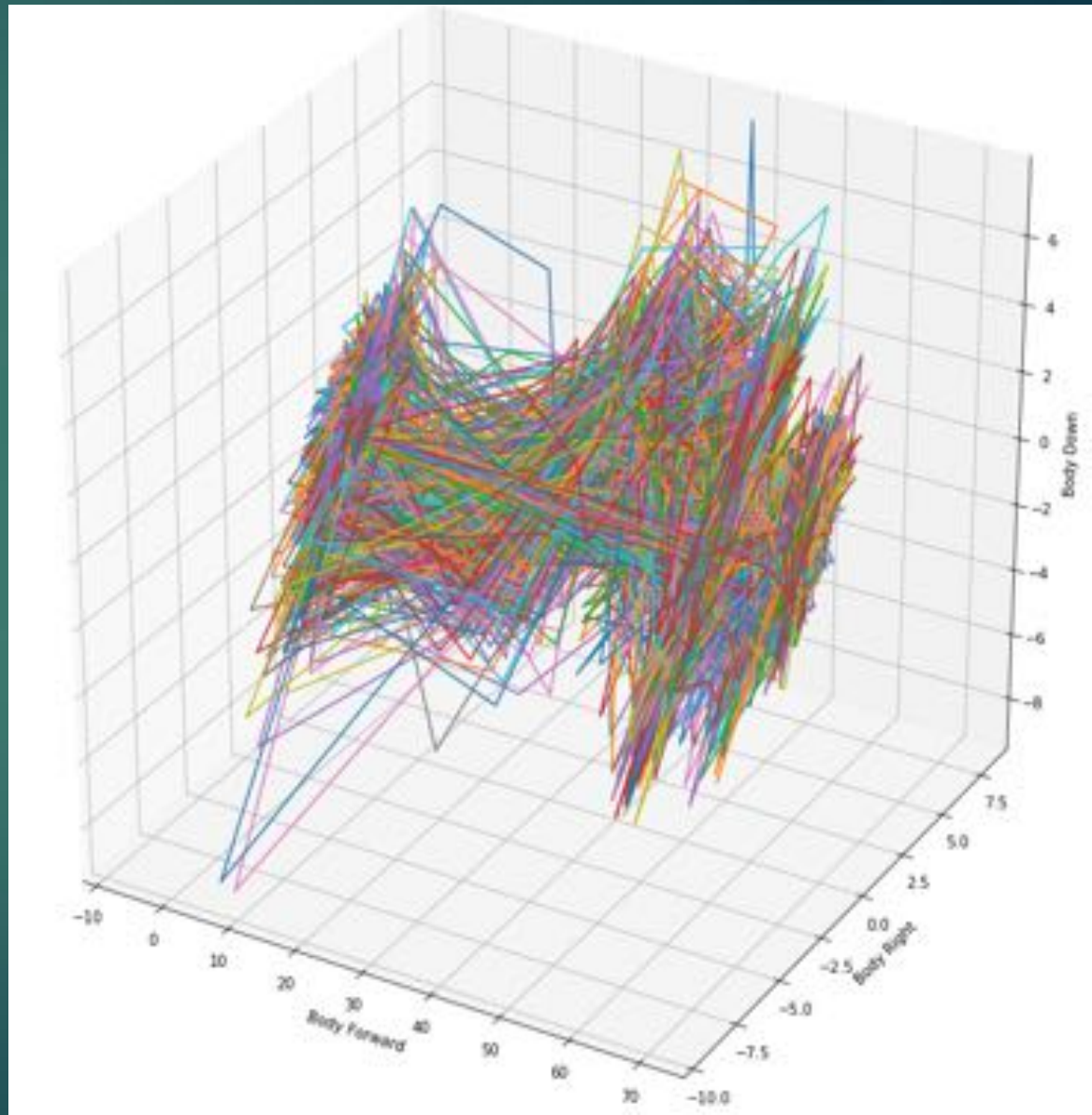


Unexplained Behaviors (contd…)

- Two flights have highly negative acceleration in the Body Right direction.
- May Indicate a faulty body part.

flight_id	launch_timestamp
16988	2018-09-06 18:59:13
17160	2018-09-12 16:07:26

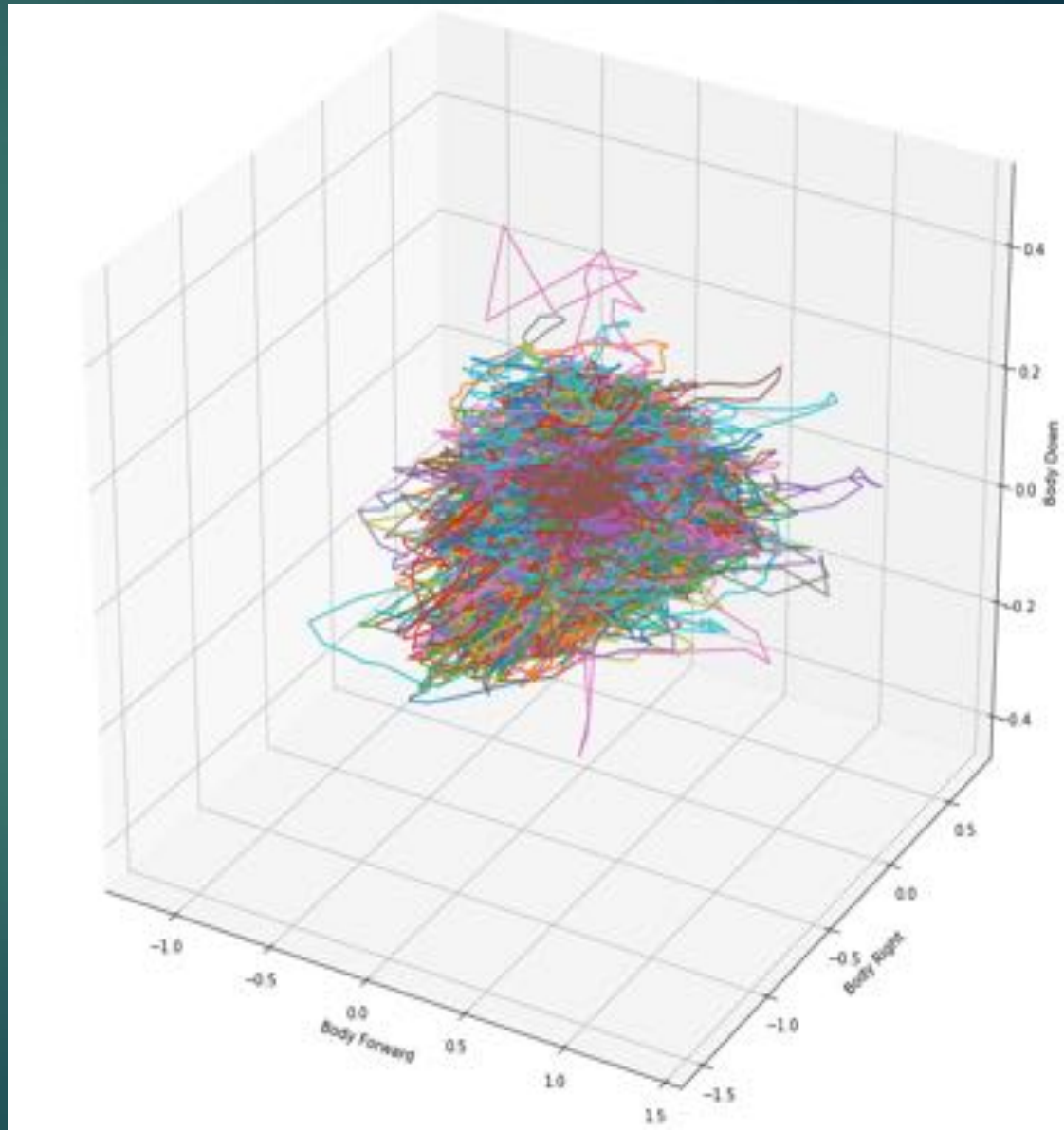
- Further analysis in the faulty body parts section.



Unexplained Behaviors (contd…)

- One flight has highly unstable angular Velocity.
- It had both more than +0.2 rad/sec and less than -0.4 radians per second angular velocity in the ‘Body Down’ direction.
- Further Technical Analysis required

flight_id	launch_airspeed	launch_groundspeed	launch_timestamp
17286	31.865664	29.875325	2018-09-18 16:09:23



Faulty Parts

- Body part details of flights with outlier launches & Yaw

flight_id	launch_timestamp	body_serial_number	battery_serial_number	wing_serial_number
17438	2018-09-24 19:30:15	577350132807348254	15SPJJJ10022048	15SPJJJ09040032
17136	2018-09-11 18:54:21	577350132840894487	15SPJJJ10027028	15SPJJJ09043062
17439	2018-09-24 19:34:41	577348835962105883	15SPJJJ10023027	15SPJJJ09019061
17437	2018-09-24 19:25:52	577350132840857611	15SPJJJ10048030	15SPJJJ09024061

- Flights with Acceleration issues

flight_id	launch_timestamp	body_serial_number	battery_serial_number	wing_serial_number
16988	2018-09-06 18:59:13	577209618523082792	15SPJJJ10008029	15SPJJJ11049056
17160	2018-09-12 16:07:26	577350132790558758	15SPJJJ10012034	15SPJJJ11049056

- Flight with outlier Angular Velocity

flight_id	launch_timestamp	body_serial_number	battery_serial_number	wing_serial_number
17286	2018-09-18 16:09:23	577350132807348254	15SPJJJ10050016	15SPJJJ09024061

- Wings **15SPJJJ09024061**, **15SPJJJ11049056** appeared multiple times in outlier flights.
- If resources are available batteries and body can also be investigated

Machine Learning Models(Additional)

- The application of a machine learning model to predict flight location
- NED Location 15s post a launch in the distribution center at Muhanga.
- Multiple Linear regression model did not give satisfactory results
- Decision tree however provides extremely promising accuracy scores with much lower RMSE and R-Squared values of 5.96 and 54% accuracy on the validation set.

	MAE	MSE	RMSE	R-Squared
Multiple Linear Regression	9.371903	322.795916	17.966522	-1.569598
Decision Tree Regression	4.248765	35.601001	5.966657	0.544312

- If more data was available , the model can be trained better to make further improved predictions

THANK YOU

- Please reach out to me in case of any questions and concerns regarding my project at antonypaulson@outlook.com